NATURE

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

VOLUME I

NOVEMBER 1869 to APRIL 1870

" To the solid ground
Of Nature trusts the mind that builds for aye."—WORDSWORTH

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No. 1.] THURSDAY, NOVEMBER 4, 1869. [PRICE FOURPENCE.

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*"To the solid ground
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THURSDAY, NOVEMBER 4, 1869

NATURE: APHORISMS BY GOETHE

NATURE! We are surrounded and embraced by her: powerless to separate ourselves from her, and powerless to penetrate beyond her.

Without asking, or warning, she snatches us up into her circling dance, and whirls us on until we are tired, and drop from her arms.

She is ever shaping new forms: what is, has never yet been; what has been, comes not again. Everything is new, and yet nought but the old.

We live in her midst and know her not. She is incessantly speaking to us, but betrays not her secret. We constantly act upon her, and yet have no power over her.

The one thing she seems to aim at is Individuality; yet she cares nothing for individuals. She is always building up and destroying; but her workshop is inaccessible.

Her life is in her children; but where is the mother? She is the only artist; working-up the most uniform material into utter opposites; arriving, without a trace of effort, at perfection, at the most exact precision, though always veiled under a certain softness.

Each of her works has an essence of its own; each of her phenomena a special characterisation: and yet their diversity is in unity.

She performs a play; we know not whether she sees it herself, and yet she acts for us, the lookers-on.

Incessant life, development, and movement are in her, but she advances not. She changes for ever and ever, and rests not a moment. Quietude is inconceivable to her, and she has laid her curse upon rest. She is firm. Her steps are measured, her exceptions rare, her laws unchangeable.

She has always thought and always thinks; though not as a man, but as Nature. She broods over an all-comprehending idea, which no searching can find out.

Mankind dwell in her and she in them. With all men she plays a game for love, and rejoices the more they win. With many, her moves are so hidden, that the game is over before they know it.

That which is most unnatural is still Nature; the stupidest philistinism has a touch of her genius. Whoso cannot see her everywhere, sees her nowhere rightly.

She loves herself, and her innumerable eyes and affections are fixed upon herself. She has divided herself that she may be her own delight. She causes an endless succession of new capacities for enjoyment to spring up, that her insatiable sympathy may be assuaged.

She rejoices in illusion. Whoso destroys it in himself and others, him she punishes with the sternest tyranny. Whoso follows her in faith, him she takes as a child to her bosom.

Her children are numberless. To none is she altogether miserly; but she has her favourites, on whom she squanders much, and for whom she makes great sacrifices. Over greatness she spreads her shield.

She tosses her creatures out of nothingness, and tells them not whence they came, nor whither they go. It is their business to run, she knows the road.

Her mechanism has few springs—but they never wear out, are always active and manifold.

The spectacle of Nature is always new, for she is always renewing the spectators. Life is her most exquisite invention; and death is her expert contrivance to get plenty of life.

She wraps man in darkness, and makes him for ever long for light. She creates him dependent upon the earth, dull and heavy; and yet is always shaking him until he attempts to soar above it.

She creates needs because she loves action. Wondrous! that she produces all this action so easily. Every need is a benefit, swiftly satisfied, swiftly renewed.—Every fresh want is a new source of pleasure, but she soon reaches an equilibrium.

Every instant she commences an immense journey, and every instant she has reached her goal.

She is vanity of vanities; but not to us, to whom she has made herself of the greatest importance. She allows every child to play tricks with her; every fool to have judgment upon her; thousands to walk stupidly over her and see nothing; and takes her pleasure and finds her account in them all.

We obey her laws even when we rebel against them; we work with her even when we desire to work against her.

She makes every gift a benefit by causing us to want it. She delays, that we may desire her; she hastens, that we may not weary of her.

She has neither language nor discourse; but she creates tongues and hearts, by which she feels and speaks.

Her crown is love. Through love alone dare we come near her. She separates all existences, and all tend to intermingle. She has isolated all things in order that all may approach one another. She holds a couple of draughts from the cup of love to be fair payment for the pains of a lifetime.

She is all things. She rewards herself and punishes herself; is her own joy and her own misery. She is rough and tender, lovely and hateful, powerless and omnipotent. She is an eternal present. Past and future are unknown to her. The present is her eternity. She is beneficent. I praise her and all her works. She is silent and wise.

No explanation is wrung from her; no present won from her, which she does not give freely. She is cunning, but for good ends; and it is best not to notice her tricks.

She is complete, but never finished. As she works now, so can she always work. Everyone sees her in his own fashion. She hides under a thousand names and phrases, and is always the same. She has brought me here and will also lead me away. I trust her. She may scold me, but she will not hate her work. It was not I who spoke of her. No! What is false and what is true, she has spoken it all. The fault, the merit, is all hers.

So far Goethe.

When my friend, the Editor of NATURE, asked me to write an opening article for his first number, there came into my mind this wonderful rhapsody on "Nature," which has been a delight to me from my youth up. It seemed to me that no more fitting preface could be put before a Journal, which aims to mirror the progress of that fashioning by Nature of a picture of herself, in the mind of man, which we call the progress of Science.

A translation, to be worth anything, should reproduce the words, the sense, and the form of the original. But when that original is Goethe's, it is hard indeed to obtain this ideal; harder still, perhaps, to know whether one has reached it, or only added another to the long list of those who have tried to put the great German poet into English, and failed.

Supposing, however, that critical judges are satisfied with the translation as such, there lies beyond them the chance of another reckoning with the British public, who dislike what they call "Pantheism" almost as much as I do, and who will certainly find this essay of the poet's terribly Pantheistic. In fact, Goethe himself almost admits that it is so. In a curious explanatory letter, addressed to Chancellor von Müller, under date May 26th, 1828, he writes:—

"This essay was sent to me a short time ago from amongst the papers of the ever-honoured Duchess Anna Amelia; it is written by a well-known hand, of which I was accustomed to avail myself in my affairs, in the year 1780, or thereabouts.

"I do not exactly remember having written these reflections, but they very well agree with the ideas which had at that time become developed in my mind. I might term the degree of insight which I had then attained, a comparative one, which was trying to express its tendency towards a not yet attained superlative.

"There is an obvious inclination to a sort of Pantheism, to the conception of an unfathomable, unconditional, humorously self-contradictory Being, underlying the phenomena of Nature; and it may pass as a jest, with a bitter truth in it."

Goethe says, that about the date of this composition of "Nature" he was chiefly occupied with comparative anatomy; and, in 1786, gave himself incredible trouble to get other people to take an interest in his discovery, that man has a intermaxillary bone. After that he went on to the metamorphosis of plants, and to the theory of the skull; and, at length, had the pleasure of seeing his work taken up by German naturalists. The letter ends thus:—

"If we consider the high achievements by which all the phenomena of Nature have been gradually linked together in the human mind; and then, once more, thoughtfully peruse the above essay, from which we started, we shall, not without a smile, compare that comparative, as I called it, with the superlative which we have now reached, and rejoice in the progress of fifty years."

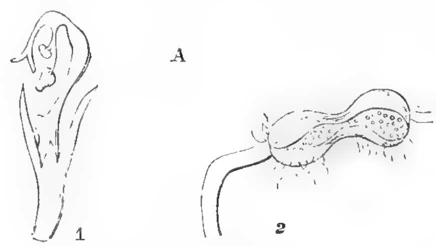
Forty years have passed since these words were written, and we look again, "not without a smile," on Goethe's superlative. But the road which led from his comparative to his superlative, has been diligently followed, until the notions which represented Goethe's superlative are now the commonplaces of science—and we have a super-superlative of our own.

When another half-century has passed, curious readers of the back numbers of NATURE will probably look on *our* best, "not without a smile;" and, it may be, that long after the theories of the philosophers whose achievements are recorded in these pages, are obsolete, the vision of the poet will remain as a truthful and efficient symbol of the wonder and the mystery of Nature. T. H. HUXLEY

ON THE FERTILISATION OF WINTER-FLOWERING PLANTS

THAT the stamens are the male organ of the flower, forming unitedly what the older writers called the "andrœcium," is a fact familiar not only to the scientific man, but to the ordinary observer. The earlier botanists formed the natural conclusion that the stamens and pistil in a flower are intended mutually to play the part of male and female organs to one another. Sprengel was the first to point out, about the year 1790, that in many plants the arrangement of the organs is such, that this mutual interchange of offices in the same flower is impossible; and more recently, Hildebrand in Germany, and Darwin in England, have investigated the very important part played by insects in the fertilisation of the pistil of one individual by the stamens of another individual of the same species. It is now generally admitted by botanists that cross-fertilisation is the rule rather than the exception. The various contrivances for ensuring it, to which Mr. Darwin has especially called the attention of botanists, are most beautiful and interesting; and the field thus opened out is one which, from its extent, importance, and interest, will amply repay the investigation of future observers. For this cross-fertilisation to take place, however, some foreign agency like that of insects is evidently necessary, for conveying the pollen from one flower to another. The question naturally occurs, How then is fertilisation accomplished in those plants which flower habitually in the winter, when the number of insects that can assist in it is at all events very small? I venture to offer the following notes as a sequel to Mr. Darwin's observations, and as illustrating a point which has not been elucidated by any investigations that have yet been recorded. I do not here refer to those flowers of which, in mild seasons, stray half-starved specimens may be found in December or January, and of which we are favoured with lists every year in the corners of newspapers, as evidence of "the extraordinary mildness of the season." I wish to call attention exclusively to those plants, of which we have a few in this country, whose normal time of flowering is almost the depth of winter, like the hazel-nut *Corylus avellana*, the butcher's broom *Ruscus aculeatus*, and the gorse *Ulex europæus;* and to that more numerous class which flower and fructify all through the year, almost regardless of season or temperature; among which may be mentioned the white and red dead-nettles *Lamium album* and *purpureum*, the *Veronica Buxbaumii*, the daisy, dandelion, and groundsel, the common spurge *Euphorbia peplus*, the shepherd's purse, and some others.

During the winter of 1868-69, I had the opportunity of making some observations on this class of plants; the result being that I found that, as a general rule, fertilisation, or at all events the discharge of the pollen by the anthers, takes place in the bud before the flower is opened, thus ensuring *self-fertilisation* under the most favourable circumstances, with complete protection from the weather, assisted, no doubt, by that rise of temperature which is known to take place in certain plants at the time of flowering. The dissection of a flower of *Lamium album* (Fig. A) gathered the last week in December, showed the stamens completely curved down and brought almost into contact with the bifid stigma, the pollen being at that time freely discharged from the anthers. A more complete contrivance for self-fertilisation than is here presented would be impossible. The same phenomena were observed in *Veronica Buxbaumii*, where the anthers are



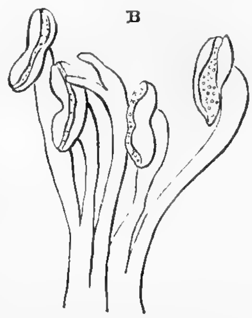
A. LAMIUM ALBUM.
1. Section of bud, calyx and corolla removed.
2. Stamen from bud, enlarged, discharging pollen.

almost in contact with the stigma before the opening of the flower, which occurs but seldom, *V. agrestis* and *polita*, the larger periwinkle *Vinca major*, the gorse, dandelion, groundsel, daisy, shepherd's purse, in which the four longer stamens appear to discharge their pollen in the bud, the two shorter ones not till a later period, *Lamium purpureum*, *Cardamine hirsuta*, and the chickweed *Stellaria media*, in which the flowers open only under the influence of bright sunshine. In nearly all these cases, abundance of fully-formed, seed-bearing capsules were observed in the specimens examined, all the observations being made between the 28th of December and the 20th of January.

In contrast with these was also examined a number of wild plants which had been tempted by the mild January to put forth a few wretched flowers at a very abnormal season, including the charlock *Sinapis arvensis*, wild thyme *Thymus serpyllum*, and fumitory *Fumaria officinalis;* in all of which instances was there not only no pollen discharged before the opening of the flower, but no seed was observed to be formed. An untimely specimen of the common garden bean *Faba vulgaris*, presented altogether different phenomena from its relative the gorse, the anthers not discharging their pollen till after the opening of the flower; and the same was observed in the case of the *Lamium Galeobdolon* or yellow archangel (Fig. B) gathered in April, notwithstanding its consanguinity to the dead-nettle.

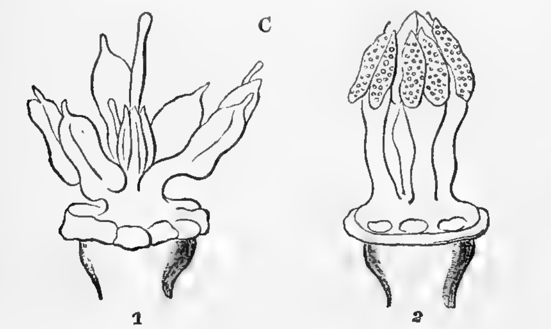
Another beautiful contrast to this arrangement is afforded by those plants which, though natives of warmer climates, continue to flower in our gardens in the depth of winter. An example of this class is furnished by the common yellow jasmine, *Jasminium nudiflorum*, from

China, which does not discharge its pollen till considerably after the opening of the flower, and which never fructifies in this country. But a more striking instance is found in the "allspice tree," the *Chimonanthus fragrans*, or *Calycanthus præcox* of gardeners, a native of Japan, which,



B. Lamium Galeobdolon.—Pistil and stamens from open flower; the latter discharging pollen.

flowering soon after Christmas, has yet the most perfect contrivance to prevent self-fertilisation (Fig. C). In a manner very similar to that which has been described in the case of *Parnassia palustris*,* the stamens, at first nearly horizontal, afterwards lengthen out, and rising up perpendicularly, completely cover up the pistil, and then discharge their pollen outwardly, so that none can possibly fall on the stigma. As a necessary consequence, fruit is never produced in this country; but may we not conjecture that in its native climate the *Chimonanthus* is



C. Chimonanthus fragrans

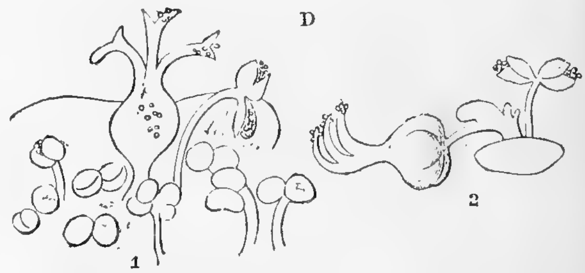
1. Early stage of flower, calyx and corolla removed.
2. Later stage, stamens surrounding the pistil, and discharging their pollen outwardly.

abundantly cross-fertilised by the agency of insects, attracted by its delicious scent, in a similar manner to our Grass of Parnassus?

The description detailed above cannot of course apply to those winter-flowering plants in which the male and female organs are produced on different flowers; but here we find commonly another provision for ensuring fertilisation. In the case of the hazel-nut the female flowers number from two to eight or ten in a bunch, each flower containing only a single ovule destined to ripen. To each bunch of female flowers belongs at least one catkin (often two or three) of male flowers, consisting of from 90 to 120 flowers, and each flower containing from three to eight anthers. The pollen is not discharged till the stigmas are fully developed, and the number of pollen-grains must be many thousand times in excess of what would be required were each grain to take effect. The arrangement in catkins also favours the scattering of the pollen by the least breath of wind, the reason probably why so many of the timber-trees in temperate climates, many of them flowering very early in the season, have their male inflorescence in this form.

* Journal of the Linnæan Society for 1868-69, Botany, p. 24.

The *Euphorbias* or spurges have flowers structurally unisexual, but which, for physiological purposes, may be regarded as bisexual, a single female being enclosed along with a large number of male flowers in a common envelope of involucral glands. Two species are commonly found flowering in the winter, and producing abundance of capsules, *E. peplus* and *helioscopia*. In both these species the pistil makes its appearance above the involucral glands considerably earlier than the bulk of the stamens (Fig. D).



D. Euphorbia helioscopia

1. Head of flowers opened, pistil and single stamen appearing above the involucral glands.
2. The same somewhat later, with the stigmas turned upwards.

A single one, however, of these latter organs was observed to protrude beyond the glands simultaneously, or nearly so, with the pistil, and to discharge its pollen freely on the stigmas, thus illustrating a kind of quasi-self-fertilisation. The remaining stamens do not discharge their pollen till a considerably later period, after the capsule belonging to the same set has attained a considerable size. In *E. helioscopia* the capsules are always entirely included within the cup-shaped bracts, and the stigmas are turned up at the extremity so as to receive the pollen freely from their own stamens. Now contrast with this the structure of *E. amygdaloides*, which does not flower before April (Fig. E). The heads of flowers which first open are entirely male, containing no female flower; in the hermaphrodite heads, which open subsequently, the stigmas are completely

E. Euphorbia amygdaloides.—Head of flower, pistil appearing above the involucral glands, all the stamens still undischarged.

exposed beyond the involucral glands long before any stamens protrude from the same glands. Here, therefore, complete cross-fertilisation takes place, the pollen from the first-opened male heads no doubt fertilising the stigma from the next-opened hermaphrodite heads, and so on. In this species the bracts are not cup-shaped, but nearly flat; the stigmas hang out very much farther than in *E. helioscopia;* and the styles are perfectly straight.

The above observations are very imperfect as a series, and I can only offer them as a contribution towards an investigation of the laws which govern the cross-fertilisation or self-fertilisation of winter-flowering plants. On communicating some of them to Mr. Darwin, he suggested that the self-fertilised flowers of *Lamium album,* and other similar plants, may possibly correspond to the well-known imperfect self-fertilised flowers of *Oxalis* and *Viola;* and that the flowers produced in the summer are cross-fertilised; a suggestion which I believe will be found correct.

In conclusion, I may make two observations. The time of flowering of our common plants given in our text-books is lamentably inexact; for the hazel, March and April for instance! and for the white dead-nettle, May and June! according to Babington. Great care also should be taken to examine the flowers the moment they are brought in-doors; as the heat of the room will often cause the anthers to discharge their pollen in an incredibly short space of time. This is especially the case with the grasses.

ALFRED W. BENNETT

PROTOPLASM AT THE ANTIPODES

THE Protoplasm excitement seems to have died away in a great measure in this country; and it is probably no loss to science that the matter has ceased to be a prevailing topic of conversation at dinner tables. We learn, however, from the Melbourne papers, that the arrival of the February number of the *Fortnightly Review* in the Australian colonies gave rise to an epidemic there of controversial science in a very alarming form. The description they give of the intellectual condition of Melbourne in June and July last, in fact, reminds us of that famous time at Constantinople, when a cobbler would not mend a pair of shoes until he had converted his customer from a Homousian to a Homoiousian, or *vice versâ.* The *Melbourne Daily Telegraph* is proud to think that a city which a few years back could only be stirred by a "Jumping Frog," is now agitated by proteinaceous theories; and this, too, in spite of the fact that they had previously been warned by the scientific correspondent of the *Melbourne Leader* of Mr. Huxley's gross ignorance and sensational superficiality. It is perfectly well known that at home here Mr. Huxley has been refuted many more times than there are copies of his article; but in Melbourne he was refuted over again afresh. We learn that the Rev. H. Higginson, "in a singularly able discourse at the Unitarian Church, tore the theory to shreds in a way"—reports the *Argus* with felicitous dubiety—"which showed the preacher to be as keen a humorist as he is a subtle logician." So able was the discourse, and so humorous, that it was repeated shortly afterwards as a lecture at the Mechanics' Institute. Here, however, the lecturer stated that it was a mistake to suppose that he had in the sermon either torn the theory to shreds or treated it in a humorous way; and the report of the lecture lends great support to the statement.

It may be perhaps gratifying to Mr. Huxley, to think that he has stirred men's minds in a place which was almost a *terra incognita* when the unknown young assistant-surgeon of the *Rattlesnake* looked upon it; but the papers tell us that a reprint of the *Fortnightly* article has been the first instance of infringement of copyright in that colony; and when the learned anatomist was speaking at Edinburgh he probably little thought that materialism would take its revenge on him by producing the following exercise in applied Biology :—

THE PHYSICAL BASIS OF LIFE.

Huxley's celebrated Essay on this subject is lectured on daily, by

WILLIAM BARTON,

who has made the matter a life study. It is also illustrated daily at his tables, where the "physical basis" can be laid in from 11 to 3, in the best cooked and most varied

HOT LUNCHEON

in the city.

The first feeling which comes to the mind after such things as these is an unbounded belief in the wisdom of those old teachers who kept esoteric and exoteric doctrines wide apart, and who laid bare the workings of their minds to trusted scholars only, and never to the vulgar gaze. We begin fervently to wish that our illustrious biologist had not, by the dress and mode of his lecture, so laid great biological truths before the public as to excite those especially ignorant of the science of life to try and trample them under foot, and then leave them for a vulgar tavern-keeper to hang up for a sign.

Second—better—thoughts, however, remind us that men of science work not for themselves, or for their scientific fellows, but for mankind; and that only mischief can come of it if they whose business it is to ask Nature her secrets are hindered from telling the world all that they think they hear. It is impossible to separate science from other knowledge and from daily life: all new discoveries especially must have ties with every part of our nature. It is not the business of the biologist to enforce on others what he believes to be the consequences of his biological discoveries; but it is certainly not his duty to withhold his facts from the common people because of the results which he thinks will follow.

And in regard to Australia in particular, we have this reflection, that the plough is needful for the seed; heavy land wants well turning up. There are not wanting signs that a national character is beginning to form among the inhabitants of that country; and we trust that scientific zeal will be one of its chief features. We hope that science even in a controversial form will never again give way in Melbourne to the vain delights of the "Jumping Frog;" and that the protoplasm which Mr. William Barton so admirably cooks will reappear in the nerve cells of Australian brains, and give rise to that love of truth, apart from gold or gain, which is the "moral" basis of "national" life. We may add that we hope not without confidence; for a bright example of conscientious truthfulness appeared in the midst of this small biological tempest. Many of our readers may remember the abundant fervour with which Prof. Halford, some years since, attacked Mr. Huxley's "Man's Place in Nature." At the end of Mr. Higginson's lecture the talented Melbourne anatomist courageously told the meeting, that he had seen reason to change his opinions. Every one here will rejoice to receive from the Antipodes a lesson of self-denial and moral daring, not too common amongst ourselves.

THE RECENT TOTAL ECLIPSE OF THE SUN

IF our American cousins in general hesitate to visit our little island, lest, as some of them have put it, they should fall over the edge; those more astronomically inclined may very fairly decline, on the ground that it is a spot where the sun steadily refuses to be eclipsed. This is the more tantalising, because the Americans have just observed their third eclipse this century, and already I have been invited to another, which will be visible in Colorado, four days' journey from Boston (I suppose I am right in reckoning from Boston?) on July 29, 1878.

Thanks to the accounts in *Silliman's Journal* and the *Philosophical Magazine*, and to the kindness of Professors Winlock and Morton, who have sent me some exquisite photographs, I have a sufficient idea of the observations of this third eclipse, which happened on the 7th of August last, to make me anxious to know very much more about them—an idea sufficient also, I think, to justify some remarks here on what we already know.

A few words are necessary to show the work that had to be done.

An eclipse of the sun, so beautiful and yet so terrible to the mass of mankind, is of especial value to the astronomer, because at such times the dark body of the moon, far outside our atmosphere, cuts off the sun's light from it, and round the place occupied by the moon and moon-eclipsed sun there is therefore none of the glare which we usually see—a glare caused by the reflection of the sun's light by our atmosphere. If, then, there were anything surrounding the sun ordinarily hidden from us by this glare, we ought to see it during eclipses.

In point of fact, strange things are seen. There is a strange halo of pearly light visible, called the corona, and there are strange red things, which have been called red flames or red prominences, visible nearer the edge of the moon—or of the sun which lies behind it.

Now, although we might, as I have pointed out, have these things revealed to us during eclipses if they belonged to the sun, it does not follow that they belong to the sun because we see them. Halley, a century and a half ago, was, I believe, the first person to insist that they were appearances due to the moon's atmosphere, and it is only within the last decade that modern science has shown to everybody's satisfaction—by photographing them, and showing that they were eclipsed as the sun was eclipsed, and did not travel with the moon—that the red prominences really do belong to the sun.

The evidence, with regard to the corona, was not quite so clear; but I do not think I shall be contradicted when I say, that prior to the Indian eclipse last year the general notion was that the corona was nothing more nor less than the atmosphere of the sun, and that the prominences were things floating in that atmosphere.

While astronomers had thus been slowly feeling their way, the labours of Wollaston, Herschel, Fox Talbot, Wheatstone, Kirchhoff, and Bunsen, were providing them with an instrument of tremendous power, which was to expand their knowledge with a suddenness almost startling, and give them previously undreamt-of powers of research. I allude to the spectroscope, which was first successfully used to examine the red flames during the eclipse of last year. That the red flames were composed of hydrogen, and that the spectroscope enabled us to study them day by day, were facts acquired to science independently by two observers many thousand miles apart.

The red flames were "settled," then, to a certain extent; but what about the corona?

After I had been at work for some time on the new method of observing the red flames, and after Dr. Frankland and myself had very carefully studied the hydrogen spectrum under previously untried conditions, we came to the conclusion that the spectroscopic evidence brought forward, both in the observatory and in the laboratory, was against any such extensive atmosphere as the corona had been imagined to indicate; and we communicated our conclusion to the Royal Society. Since that time, I confess, the conviction that the corona is nothing else than an effect due to the passage of sunlight through our own atmosphere near the moon's place has been growing stronger and stronger; but there was always this consideration to be borne in mind, namely, that as the spectroscopic evidence depends mainly upon the brilliancy of the lines, that evidence was in a certain sense negative only, as the glare might defeat the spectroscope with an uneclipsed sun in the coronal regions, where the temperature and pressure are lower than in the red-flame region.

The great point to be settled then, in America, was, What is the corona? and there were many less ones. For instance, by sweeping round the sun with the spectroscope, both before and after the eclipse, and observing the prominences with the telescope merely during the eclipse, we

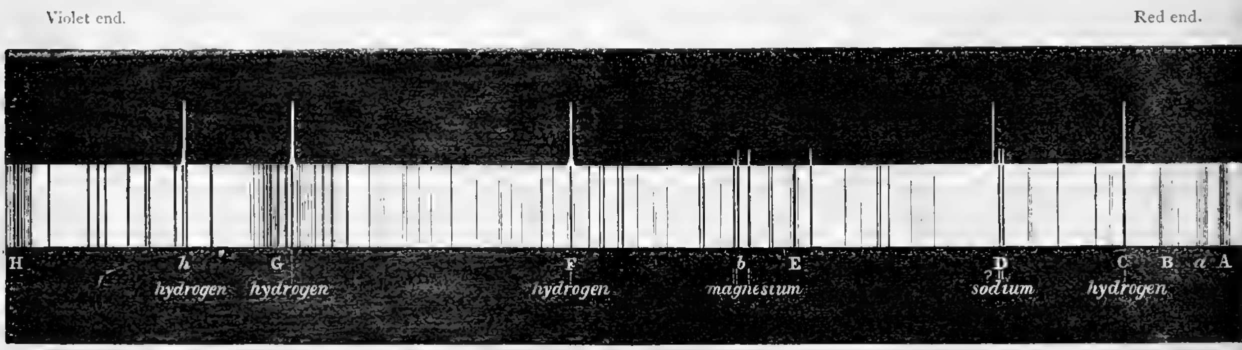


Fig. 1.—Showing the solar spectrum, with the principal Fraunhofer lines, and above it the bright-line spectrum of a prominence containing magnesium, sodium, and iron vapour at its base.

should get a sort of key to the strange cypher band called the spectrum, which might prove of inestimable value, not only in the future, but in a proper understanding of all the telescopic observations of the past. We should, in fact, be thus able to translate the language of the spectroscope. Again, by observing the spectrum of the same prominence both before and during, or during and after the eclipse, the effect of the glare on the visibility of the lines could be determined—but I confess I should not like to be the observer charged with such a task.

What, then, is the evidence furnished by the American observers on the nature of the corona? It is *bizarre* and puzzling to the last degree! The most definite statement on the subject is, that it is nothing more nor less than a *permanent solar aurora!* the announcement being founded on the fact, that three bright lines remained visible after the image of a prominence had been moved away from the slit, and that one (if not all) of these lines is coincident with a line (or lines) noticed in the spectrum of the aurora borealis by Professor Winloch.

Now it so happens that among the lines which I have observed up to the present time—some forty in number—this line is among those which I have most frequently recorded: it is, in fact, the first iron line which makes its appearance in the part of the spectrum I generally study when the iron vapour is thrown into the chromosphere. Hence I think that I should always see it if the corona were a permanent solar aurora, and gave out this as its brightest line; and on this ground alone I should hesitate to regard the question as settled, were the new hypothesis less startling than it is. The position of the line is approximately shown in the woodcut (Fig. 1) near E, together with the other lines more frequently seen.

It is only fair, however, to Professor Young, to whom is due this important observation, to add that Professor Harkness also declares for one bright line in the spectrum of the corona, but at the same time he, Professor Pickering, and indeed others, state its spectrum to be also continuous, a remark hard to understand unless we suppose the slit to have been wide, and the light faint, in either of which cases final conclusions can hardly be drawn either way.

So much, then, for the spectroscopic evidence with which we are at present acquainted on the most important point. The results of the other attacks on the same point are equally curious and perplexing. Formerly, a favourite argument has been that because the light of the corona is polarised; therefore it is solar. The American observers state that the light is *not* polarised—a conclusion, as M. Faye has well put it, "very embarrassing for Science." Further,—stranger still if possible,—it is stated that another line of inquiry goes to show that, after all, Halley may be right, and that the corona may really be due to a lunar atmosphere.

I think I have said enough to show that the question of the corona is by no means settled, and that the new method has by no means superseded the necessity of carefully studying eclipses; in fact, their observation has become of much greater importance than before; and I earnestly hope that all future eclipses in the civilised area in the old world will be observed with as great earnestness as the last one was in the new. Certainly, never before was an eclipsed sun so thoroughly tortured with all the instruments of Science. Several hundred photographs were taken, with a perfection of finish which may be gathered from the accompanying reproduction of one of them.

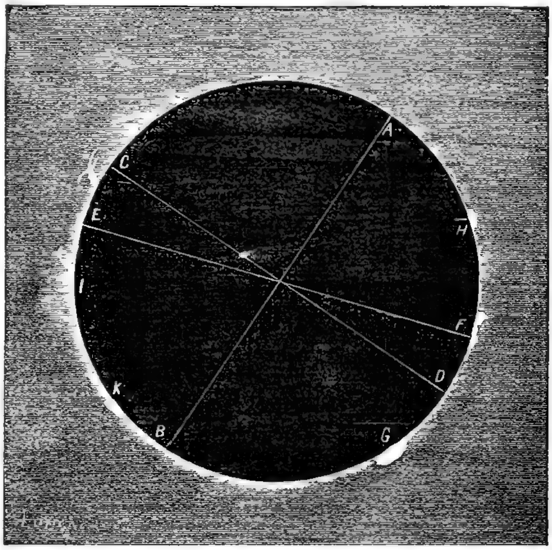


FIG. 2.—Copy of a photograph of the Eclipse of August 7, obtained by Professor Morton's party

The Government, the Railway and other companies, and private persons threw themselves into the work with marvellous earnestness and skill; and the result was that the line of totality was almost one continuous observatory, from the Pacific to the Atlantic. We read in *Silliman's Journal*, "There seems to have been scarcely a town of any considerable magnitude along the entire line, which was not garrisoned by observers, having some special astronomical problem in view." This was as it should have been, and the American Government and men of science must be congratulated on the noble example they have shown to us, and the food for future thought and work they have accumulated.

J. NORMAN LOCKYER

Since writing the above, I find the following independent testimony in favour of Dr. Frankland's and my own notion of the corona in the *Astronomische Nachrichten*, from the pen of Dr. Gould. He says:—"Its form varied continually, and I obtained drawings for three epochs at intervals of one minute. It was very irregular in form, and in no apparent relation with the protuberances on the sun, or the position of the moon. Indeed, there were many phenomena which would almost lead to the belief that it was an atmospheric rather than a cosmical phenomenon. One of the beams was at least 30′ long."

MADSEN'S DANISH ANTIQUITIES

Antiquités préhistoriques du Danemarck. By M. Madsen. Folio, pp. 19, with 45 engraved plates, some coloured. Price 36*s*. (London: Williams and Norgate.)

THIS work contains forty-five carefully executed plates of Danish Antiquities belonging to the Stone age. The first represents the Shellmound of Fannerup; a difficult subject, very faithfully rendered, as the present writer can testify. The three following plates give the common and characteristic objects of the Shellmounds. Then follow ten plates devoted to tumuli and dolmens. These are admirably executed, those of the great chambered tumulus at Uby being particularly successful. Plates xv. to xx. give certain remarkable "finds." These are very interesting, 50 objects discovered together being more instructive than 500 found separately. On the remaining plates are represented the most characteristic Danish forms, as well as many unique specimens. The work is devoted to the Stone age (the Bronze age portion, though commenced, not being yet completed), but it must not be supposed that all the specimens of stone implements here figured necessarily belong to the Stone age, although the great majority no doubt do so. It cannot, however, be too often repeated that many stone implements were in use during the Bronze age.

Everyone looking even cursorily at these plates must be struck by the excellence of the Danish flint, and the wonderful mastery which had been acquired over it. The daggers, for instance, represented in Pl. xxxv. are extraordinary instances of skill in flint chipping, and it must be confessed that such masterpieces could hardly be found in any country but Denmark.

It will be observed also that all the specimens figured belong, or may have belonged, to the Neolithic or second Stone period; there is not in the whole series, nor I believe is there in any of the great Danish museums, a single specimen of the characteristic Paleolithic forms. The rarity of the reindeer and of the mammoth renders this still more significant. We suppose that no one could look through these plates and yet retain any doubts as to the important part played by stone, and especially flint implements, in ancient times; though we must confess that we once showed our collection to a lady, who remained incredulous almost to the last, until we came to a drawer containing a roedeer's horn, which she at once said was evidently of human workmanship, and showed much skill.

The letterpress attached to the plates is confined to twenty pages, of which nine contain an introduction, the rest giving descriptions of the plates. It would, we admit, have been scarcely worth while to describe each specimen figured, but we regret that, excepting as regards the first few plates, no information is given as to the localities in, and the circumstances under, which they were discovered.

The introduction represents very fairly the general opinion of Danish archæologists, and with it we in the main concur. M. Madsen points out that the large, chambered, tumuli never contain metal, and, like Steenstrup, he doubts whether during that period the inhabitants of Denmark had any other domestic animal than the dog. No doubt some modern races, for instance the Polynesians, present this condition; but then their islands contained no cattle or sheep. It is, we think, very improbable that a people capable of such considerable constructions as the chambered tumuli, would not have tamed the wild cattle of the country.

Neither can we agree with M. Madsen and the Danish antiquaries in fixing the commencement of the Danish Iron age so late as the third century. We know that in southern Europe the use of iron commenced several hundred years earlier, and the great similarity of the bronze weapons all over Europe indicates clearly, we think, that they belonged to one and the same period. We cannot but think that the use of iron, when once discovered, would have spread rapidly over Europe, though it would, no doubt, have remained scarce in a comparatively poor country, as Denmark then was.

Lest our readers should suppose that a book containing more than forty beautifully executed plates must necessarily be very expensive, we may mention that the price is only *1l. 16s.* We heartily thank M. Madsen for this valuable addition to our Archæological Libraries.—JOHN LUBBOCK

NEWMAN'S BRITISH MOTHS

An Illustrated Natural History of British Moths. By Edward Newman, F.L.S. F.Z.S. &c. Large 8vo. pp. 486. (London: W. Tweedie.)

A HUNDRED years ago, or perhaps even less, a man who displayed a fondness for collecting insects was commonly regarded as a weak-minded individual, whose power of managing his own affairs, although it might in charity be conceded by his neighbours, was at least somewhat doubtful. To use the old Scotch phrase, he was supposed to have "a Bee in his bonnet," because he liked to have a Butterfly under his eyes.

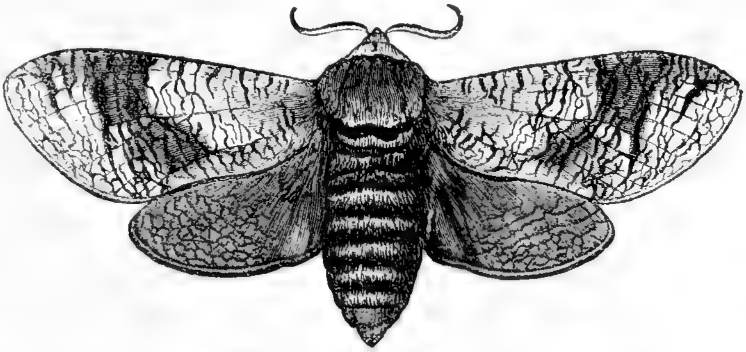
In the present day, although many people may be found who cannot see the use of such pursuits, one runs no risk of a commission *de lunatico*, on account of a predilection for moths or beetles; and if we may judge from the articles provided for the delectation of the multitude in our popular journals, natural history subjects, including entomology, form a not unattractive portion of their bill of fare.

The fact is, that the *cacoëthes colligendi* is one of the commonest affections of humanity, and there are few forms of the disease more harmless than the entomological one. Pictures and statues, books, prints and old china, call for a very considerable expenditure of hard cash, if it is desired to form ever so small a collection of any of them; but the insect-collector generally brings his treasures together by the labour of his own hands, and his boxes and pins do not cost much. Moreover, the collector of insects can hardly avoid learning something of the structure and habits of the objects of his pursuit—a knowledge which must have a favourable effect upon his own mind, and may frequently enable him to be serviceable to his neighbours.

Mr. Newman's "History of British Moths," which is now completed so far as the larger forms are concerned, is admirably adapted to favour these desirable objects; it not only furnishes good descriptions of the British species of moths, but gives an account of their habits in all stages of their existence. This book, which forms a handsome octavo volume, will be welcomed with enthusiasm by numbers of young entomologists in all parts of the country, as it gives them, in a convenient and intelligible form, pretty nearly all that can be told about the great group of insects of which it treats. It has another claim upon their attention also in the admirably executed woodcuts with which it is illustrated. Mr. Newman has given figures of every species, in many cases of both sexes of the species, and sometimes of their most prominent varieties, and these figures, although from their nature they are only in black and white, have been so carefully drawn, and so admirably cut, that the want of colour is hardly felt.

We reproduce here two of the cuts, which will show how effective the illustrations are. To the country entomologist working at a distance from any library, whence he can obtain the expensive illustrated works in which these insects are represented on coloured plates, these figures, accompanied as they are by good descriptions, will prove an invaluable boon; and we can only hope that Mr. Newman's book, the result of years of study, may meet with the success which it so well deserves.

W. S. DALLAS



THE GOAT MOTH (*Cossus ligniperda*)

THE MERVEILLE DU JOUR (*Agriopis aprilina*)

OUR BOOK SHELF

Text Book of Botany.—*Lehrbuch der Botanik für Gymnasien, Realschulen, &c.* By Dr. Otto W. Thomé. 1 vol. 8vo. 358 pp., with 621 woodcuts. Price 3*s.* (Brunswick, 1869.)

DR. THOMÉ'S name is new to us. He is a teacher in what we may call the Upper Grammar School at Cologne. Because he has not published original observations it does not follow that he should be a bad teacher. Rather, indeed, this is a point in his favour; for original observers, unless they be men of wide grasp of mind, or of great experience, are apt to ride special hobbies too far, and to be very unfair and crotchety.

A cursory inspection of this book leaves a favourable impression. It is German, of course, and the first chapter is entitled *Die Zelle als Individuum*, but so far as we can judge it is a handy book for a beginner, and if not all pure milk, it does not seem very badly diluted: much cream now-a-days it is hardly fair to look for. It is very copiously illustrated; the cuts by no means all original, and not a few borrowed from this side the Channel, but none the less well adapted to their purpose. D. O.

The Retardation of the Beat of the Heart.—*Das Hemmungsnervensystem des Herzens.* By Adolf Bernhard Meyer. (Berlin, 1869. London: Williams and Norgate.)

A CRITICAL and experimental inquiry into the inhibitory action of the pneumogastric nerve on the beat of the heart. The chief features of the experimental investigation are—first, the extension of the facts of inhibition to many animals (chiefly reptiles) not hitherto specially examined in reference to this point. Curiously enough, in *Emys lutaria* the left pneumogastric is inert; unfortunately Dr. Meyer has not worked out the cause of this singularity. Second, the author brings experiments to show that the effect of stimulation on the pneumogastric may be kept up for a very long time—more than an hour. In frogs the effect may be carried as far as complete stoppage for this time; in mammals as far as retardation only of the beat. M. F.

Exotic Lepidoptera.—*Lepidoptera Exotica; or, Descriptions and Illustrations of Exotic Lepidoptera.* By A. G. Butler, F.L.S., &c. (London: E. W. Janson.)

MR. BUTLER, who is well known as an ardent and careful student of the diurnal Lepidoptera, has undertaken, in conjunction with Mr. Janson as publisher, what will no doubt prove a very valuable and beautiful work. Many new species of Lepidoptera have been described—by Mr. Butler himself amongst others—without any figure: this practice is exceedingly inconvenient to those who attempt to identify species; and though, as Mr. Butler observes, it enables those who adopt it to "call the beautiful their own" to a larger extent than if they had to wait for figures, it is nevertheless a reprehensible proceeding, and has afflicted the conscience of one at least who has been guilty of it. Mr. Butler is a very skilful artist, and evidently an intense admirer of the lovely colours and forms of the insects he deals with. Consequently it is a matter for congratulation that he has undertaken to make up for the shortcomings of past times, and intends to bring out once a quarter a part of his "Lepidoptera Exotica," with three coloured plates of new or unfigured species. In the two parts already issued, which are before us, the figures are admirably done, and very handsome; whilst the descriptive text is concise, and in Latin in part. Some of Mr. Wallace's Bornean butterflies are figured in the second part. E. R. L.

Physiology of the Human Voice.—*Physiologie und Pathologie der Menschlichen Stimme.* By Dr. M. J. Rossbach. (Würzburg. London: Williams & Norgate.)

A TREATISE on the physiology of the voice, intended by the author to be useful not only to physiologists and pathologists, but also to those engaged in singing or in teaching singing. A chapter on the nature and qualities of sounds, based on Helmholtz' well-known work, and a short one on musical instruments, introduce the main topic, the physiology of the human organ of voice. There are also separate chapters on the vocal register, the different kinds of voice, and the relations of voice, speech, and song.

The Convolutions of the Brain.—*Die Hirnwindungen des Menschen.* By Alex. Ecker, Professor of Anatomy in the University of Freiburg. (Brunswick, 1869. London: Williams and Norgate.)

A SUCCINCT but detailed description of the various Convolutions of the Brain, intended chiefly for the use of physicians. It is illustrated by half-a-dozen outline sketches. The references to the development of the convolutions are not very full, but the author promises a more complete account elsewhere.

The Absolute Value of Knowledge.—*Der Sebstandige Werth des Wissens.* By Prof. K. Rokitansky. (London: Williams and Norgate.)

THE Materialist school of philosophy are just now getting very badly treated by men of science, much to the astonishment, it appears, of the general public. Mr. Huxley has startled the world by proclaiming himself in a way a disciple of Berkeley and Kant, and here is Rokitansky, the great master of modern pathological anatomy, walking in a similar path. To many minds pathological anatomy would seem to be intensely materialistic. It is not so, however, to the Viennese professor. This little lecture is chiefly devoted to a development of idealism: of that kind of idealism, moreover, which "makes the objective wholly and in every way dependent on the subjective, for the former is but the projection of the latter."

Tables of Pomona.—*Tafeln der Pomona, mit Berucksichtigung der Storungen durch Jupiter, Saturn, und Mars.* By Dr. Otto Lesser. Publication der Astronomischen Gesellschaft. (Leipzig: Engelmann.)

THESE tables of Pomona are founded on the disturbance of the planets Jupiter, Saturn, and Mars, calculated according to Hansen's method, and published by the author in Nos. 1596-7 of the *Astronomische Nachrichten.* The preface gives a full account of the character of the tables, illustrated in the usual manner by the calculation of the place of the planet Pomona for a given time.

Although it might seem that the construction of a series of tables as full and as elaborate as Bouvard's Tables of Jupiter and Saturn, would be a waste of labour in the case of a minute planet like Pomona, not merely invisible to the naked eye, but not appreciably affecting by its influence any of the great planets of our scheme, yet this is not in reality the case. Though Pomona cannot affect the other planets, yet these affect Pomona. Her sister orb, Themis, has lately been made the means of affording a useful estimate of Jupiter's mass, through the careful consideration of the perturbations which that planet exerts upon the tiny asteroid. Long since Nicolai applied the perturbations of Juno, Encke those of Vesta, Gauss those of Pallas, and Brünnon those of Iris, to the same end. The more such researches are multiplied, the more exact will be our estimate of the mass of the principal planets of the solar system. Therefore, the present tables, by means of which it will be rendered an easy matter to estimate the disturbing action of Jupiter, will have a high value. In a less exact but not unsatisfactory manner, the mass of Mars may be estimated from the same tables, since in certain positions the disturbances of Pomona caused by Mars' attraction can be readily separated from those of Jupiter. R. A. P.

SCIENCE-TEACHING IN SCHOOLS*

THE claims of Physical Science, on *à priori* grounds, to a fair place in the course of school work, have been abundantly vindicated, and are, I suppose, established. But the method and details of its teaching, the books and apparatus which it requires, and the amount of time which must be given to it, are points which can be decided only by experiment, and have not yet been decided at all. I cannot premise too distinctly that the aim of this paper is practical. Of the necessity for teaching science to their boys many good schoolmasters are convinced; as regards the machinery by which it is to be taught, they mostly confess their ignorance, and cry aloud for guidance. In my own school it has been taught systematically for the last five years, and I offer the fruit of this experience, very humbly, to all who are interested in Education.

The subjects to be taught—the time to be spent upon them—the books and apparatus necessary—and the mode of obtaining teachers—are the points on which information seems to be required. I will take them in order.

The subjects which naturally suggest themselves as most essential are Experimental Mechanics, Chemistry, and Physiology. But it has been urged by high authority, familiar to the members of this Association, that between Chemistry and Physiology Systematic Botany should be interposed, as well because of the charm this science lends to daily life, as from its cultivating peculiarly the habit of observation, and illustrating a class of natural objects which are touched indirectly or not at all by the other sciences named. Whether all these four subjects can be taught depends upon the period to which school education is protracted; but at any rate, let these, and none but these, employ the hours assigned especially to Physical Science, in the scheme of actual work in school. Abundant opportunity will remain for less direct instruction in many other branches of science. The Geographical lectures, if properly treated, will include the formation of the earth's crust, with the classification and distribution of its inhabitants, both animal and vegetable, both extinct and recent. The possession of meteorological instruments, whose observations are regularly taken, and their computations worked by the boys, will almost insensibly teach the principles of atmospheric phenomena; while such books as Maury's "Physical Geography of the Sea," Airy's "Popular Astronomy," and Herschel's "Meteorology," may be given as special matter for annual scientific prizes. The laws of light and heat will be taught as prefatory to chemistry. Electricity attracts boys so readily that with very little help they will make great progress in it by themselves. The mathematical master, whose best boys are well advanced, will not be satisfied till he has obtained a transit instrument and a mural circle. And the wise teacher, living in the country, will not disdain to encourage a knowledge of natural history. He will know that it is not only ancillary to severer scientific study, but in itself a priceless and inexhaustible resource. By country walks, by well-chosen holiday tasks, by frequent exhibitions of his microscope, he will not only add to the intellectual stock of his boys, but will build up safeguards to their moral purity. Indeed, even without such encouragement, boys who are trained thoroughly in certain sciences will of their own accord seek to become acquainted with other and collateral ones. Cases multiply in my own experience where pupils of a chemistry class have taken up electricity, pupils of a geography class mineralogy, pupils of a physiology class microscopy, and I need hardly say that boys make nothing their own so thoroughly as that which they select themselves.

The time to be given to science should not be less than three hours a week. At this rate two years may be given to mechanics, two years to chemistry, one year to botany; while the rest, if any remain, will be free for physiology. We need not be afraid of beginning early. A boy of eleven years old, fresh from an intelligent home, where his love of observation has been fostered, and his inquiries have been carefully answered, is far more fit to appreciate natural laws than a much older boy, round whose intellect, at an old-fashioned school, the shades of the prison house have steadily begun to close. Most schools are now divided into lower, middle, and upper. I would commence the study of mechanics with the junior class in the middle

* A Paper read before the British Association at Exeter, by the Rev. W. Tuckwell. Communicated by the Author.

school. For the first year the teaching may be *viva voce*, with easy problems and abundant experiment; care being taken that each week's lectures shall be reproduced on paper, and great attention being paid to correct drawing. In the second year the teaching will be more minute and more extended, and a good book will be mastered. At the end of this time the class is fit to pass creditably the Oxford Local Examination for juniors, and has done with mechanics for the present. The third and fourth years will be given to inorganic chemistry. The third year will include only lectures in the class room; a text-book being used, experiments being shown by the master, but no laboratory work being done by the boys. The fourth year's work will be conducted entirely in the laboratory, each boy manipulating with his own instruments at his own table. At the expiration of these two years the class will be qualified for the chemistry examination in the London University Matriculation. The fifth year is given to botany. If a good book is used, if each boy works for himself with lens and knife, if Henslow's Schedules, or a modification of them, are regularly filled up; above all, if plates are not made to do the work of living plants, the pupils will at the year's end thoroughly understand the principles of classification, will know the characteristics of at least all the British orders, and will be able with the help of Bentham or Babington to make out almost any English flower. The boys who have completed this course will be from 16 to 17 years old. Some of them will now be leaving school; those who remain will give the rest of their time to physiology. They will begin with human and will pass to comparative physiology, using in the first Professor Huxley's valuable little book; dependent for the second, of which no school manual exists, on the skill and method of their teacher. But whether at the earlier or the later age, they will pass out into the world immeasurably superior to their contemporaries who know not science, with doors of knowledge opened which can never again be closed; with a fund of resource established which can never be exhausted; with minds in which are cultivated, as nothing else can cultivate them, the priceless habits of observation, of reasoning on external phenomena, of classification, arrangement, method, judgment.

The subject of books and apparatus, involving as it does the question of expense, is of the highest practical importance. Apparatus need not cost much; but it may, and if possible it should, cost a great deal. While poor and struggling schools may begin cheaply and proceed gradually, institutions which can spend money on racket courts and gymnasiums ought not to grudge it on museums and botanic gardens. We have taught mechanics efficiently, that is to say, we have passed our classes for the last three years in the Oxford Local, with a good air-pump, a set of pulleys, models of the force-pump and the common pump, with Keith Johnston's scientific maps, and with the diligent use during the second year of Newth's "Natural Philosophy." But we have lost no opportunity of making the boys acquainted with machinery; from the crane and the water-mill of our daily walks, to the steam engine and the spinning jenny of the manufactory; for he who has not examined engines at work will never understand them clearly, or describe them correctly. For teaching chemistry, a laboratory is absolutely essential. No matter how rough or shabby a room, so that it be well ventilated, have gas and water laid on, and will hold from sixteen to twenty boys. I hold in my hand the model of a cheap laboratory table, on the scale of two inches to a foot. It is about nine feet by three, and contains eight compartments, each two feet by sixteen inches, with two slight shelves, and a special recess for the teacher. It costs about 4*l.* If made for twice the number of boys, it may be made at about nine shillings per boy. The general laboratory stock, including a still, a stove or furnace, gas jars, a pneumatic trough, a proper stock of retorts, crucibles, tubing, &c., and the necessary chemicals will cost under 12*l.* Each pair of pupils must have also between them a set of test tubes, a washbottle, a spirit lamp, a waste basin beneath their table, and twenty-four bottles of test solutions, while each boy has his own blowpipe, tripod and stand, pestle and mortar, and three beakers. These will cost each boy about eight shillings. He will replace everything that he breaks, and will receive the value of his stock from his successor when he quits the class. The text-book used should be Roscoe's, or Williamson's, and a large black board is quite indispensable. In botany the book for the boys' use is Professor Oliver's Lessons; but the teacher will find great advantage from Le Maout's "Leçons de Botanie." An excellent modification of Henslow's Schedule is published by Professor Babington for the use of his Cambridge classes, and Lindley's "Descriptive Botany," price one shilling, is a most useful help. Every boy should be furnished with a small deal board, a lens, and a sharp knife. The botanical microscope which I exhibit, including a lens fixed or movable, a black glass stage, two dissecting needles and a forceps, is made by Mr. Highley, of Green-street, Leicester-square. If they are ordered by the dozen he will furnish them at six shillings each. Flower trays, such as I hold in my hand, should be kept constantly in use; the boys being encouraged to bring in wild flowers, and to place them in their appropriate niches. Their cost per tray, holding eighteen bottles, is under two shillings. Fitch's diagrams designed for the Committee of Council on Education, which cost 2*l.* 9*s.* the set, are a valuable help to the lectures; and for schools which have large purses or liberal friends, Dr. Auzoux's Models of Plants and Plant Organs, ranging in price from 20 to 100 francs, and ten times the size of life, form a luxuriant assistance to beginners, which only those can appreciate who have worn out their eyesight and their temper over a composite floret or the glume of a small grass. The same excellent modellist, whose catalogue is on the table, provides every organ necessary for the study of comparative and human physiology; and his prices ought not to be beyond the reach of any prosperous school. In any case a skeleton will be necessary, and will cost about £5; and if the Committee of Council were to authorise the reproduction of such typical physiological cases as, from the skilful hands of Mr. Charles Robertson of the Oxford Museum, drew so many admirers in the Exhibition of 1862, these would find immediate purchasers in many of our schools. At present teachers want the skill or the leisure to make their own preparations, and they cannot buy them. A good set of meteorological instruments costs from £16 to £20, but these, with astronomical apparatus, are a costly luxury, and may be left out of the list of indispensable necessities. I cannot think that any school, professing to teach science systematically, will be long satisfied without a typical museum. As scientific work proceeds, specimens of all kinds, some purchased for lecture work, others given by friends or collected by the boys, will gather and increase, till the class-room cupboards and shelves are choked, and a special room must be devoted to them. Here will be arranged, in one place rocks and fossils, in another trays of minerals, in a third zoological specimens, in a fourth physiological preparations. The driest corner in the room will be assigned to the Herbarium, a small library of scientific reference will give promise of the future. Everything not typical will be rigorously excluded; every case will be so carefully arranged and so plainly labelled as to tell the history of its contents to the eye of the least instructed observer. And it will be hard if some corner of the playground cannot be laid out as a botanic garden. In the crowded school premises which we are happily leaving I have found room for nearly four hundred plants, and at the new school to which we are about to migrate, I shall riot in two acres of garden ground, with a pond for water plants and a sheltered rockery for ferns.

It remains only to examine the mode of obtaining teaching power; a point which presses heavily on many head-masters who have themselves no knowledge of science. That all head-masters should have such knowledge is a fact which, if science is to be taught at all, trustees and governing bodies must come to recognise before long: meanwhile every school which teaches science thoroughly is training skilled teachers for a not distant generation. Institutions which can give so high a salary as to command a London bachelor of science or a first class Oxford or Cambridge man, will find no more difficulty than attends the choice of all masters: where this is not the case it is sometimes possible by combining mathematics with physical science to tempt a superior man with a sufficient income; and, if only a small salary can be given, the ordinary pass B.A. of the London University will sometimes make a fairly good teacher. But one point has struck me forcibly in my own experience; namely, the unexpected value of general culture in teaching special subjects. The man who knows science admirably, but knows nothing else, prepares boys well for an examination; but his teaching does not stick. The man of wide culture and refinement brings fewer pupils up to a given mark within a given time: but what he has taught remains with them; they never forget or fall back. I am not sure that I understand the phenomenon, but I have noted it repeatedly.

I cannot end this paper without a word as to the educational results which our five years' experience has revealed. The system has brought about this result first of all, that there are no dunces in the school. In a purely classical school, for every promising scholar there are probably two who make indifferent progress, and one who makes no progress at all; and a certain proportion of the school, habitually disheartened, loses the greatest boon which school can give, namely, the habit and the desire of intellectual improvement. By giving importance to abstract and physical science, we at once redress the balance. Every boy progresses in his own subject; some progress in all; no one is depressed, no one thinks learning hateful. Secondly, the teaching of science makes school-work pleasant. The boy's evident enjoyment of the scientific lesson rouses the emulation of other masters. They discover that the teaching of languages may become as interesting as the teaching of science. They realise—a point not often realised—the maxim of Socrates, that no real instruction can be bestowed on learners "*παρὰ τοῦ μὴ ἀρέσκοντος*, by a teacher who does not give them pleasure." Lastly, the effect on the boy's character is beyond all dispute. It kindles some minds which nothing else could reach at all. It awakes in all minds faculties which would otherwise have continued dormant. It changes, to an extent which we cannot over-estimate, the whole force and character of school-life both to the learner and the teacher. It establishes, as matter of experience, what has long been urged in theory, that the widest culture is the noblest culture; that universality and thoroughness may go together; that the system which confines itself to a single branch of knowledge, does not gain, but loses incomparably, by its exclusiveness: that observation, imagination, and reasoning may all be trained alike; that we may, and so we must, teach many things, and teach them well.

W. TUCKWELL

THE LATE PROFESSOR GRAHAM

AT 9 o'clock in the evening of Thursday, the 16th September, 1869, died at his house, No. 4, Gordon Square, a man whose name will be honoured as long as true greatness is appreciated.

Thomas Graham spent his life in reading the book of Nature, and giving to mankind a knowledge of the truths which he found there. His greatness is to be measured not merely by the amount and importance of the knowledge which he thus gave, but even more by the singleness and strength of purpose with which he devoted his whole life to labours of experimental philosophy.

Some men have made important discoveries by occasionally applying to experimental investigation, powers of mind which they exerted usually in the pursuit of their own worldly advancement.

But from an early age Graham's one great object of life was the discovery of new truths, and he appreciated so fully the value of such work that he resolved to make any personal sacrifices which might be needed for its sake. And nobly he kept his resolution; for at an early stage of his career he endured, for the sake of pursuing chemistry, privations and sufferings so severe, that they are believed to have permanently injured his constitution; and at its very end, long after he had attained a world-wide reputation, when his delicate frame sorely needed the repose which was at his command, he continued to labour even more effectively than before, and to enrich science with new discoveries.

It might be difficult to find in history a character so perfect in its noble simplicity and elevation.

Graham was born at Glasgow, on the 21st December, 1805, the eldest of a family of seven, of whom only one survives.

He went to the English preparatory school at Glasgow, in 1811, and was there under the care of Dr. Angus. In the year 1814 he was removed to the High School, where for four years his studies (which included the Latin language) were directed by Dr. Dymock, and subsequently for one year by the Rector, Dr. Chrystal, under whom he studied Greek. It is said that during these five years he was not once absent at school-time. In 1819 he commenced attendance in the University classes in Glasgow.

Thomas Thomson then occupied the Chair of Chemistry, and young Graham benefited by his instruction, as also by that of Dr. Meikleham, the Professor of Natural Philosophy.

By this time he had already acquired a strong taste for experimental science, and formed a wish to devote himself to chemistry. His father, an able and successful manufacturer, had formed different views for his future career, and wished him to become a minister of the Scotch Church. It is hardly to be wondered at that the father should not have seen in the prosecution of science much scope for an honourable or advantageous career; but young Graham had already seen something of the means afforded by experimental science of getting knowledge from the fountain head—from Nature herself. He felt the need of more such knowledge to mankind, and his scheme of life was formed accordingly.

After taking the degree of M.A. at Glasgow, he continued his studies for two years at Edinburgh, and there studied under Dr. Hope, and enjoyed the friendship of Prof. Leslie. On his return to Glasgow, he taught mathematics for some time at the suggestion and under the patronage of Dr. Meikleham, and subsequently opened a laboratory in Portland Street, Glasgow, where he taught chemistry. It is probable that some of the severest trials of his life occurred at about this period.

While absent from Glasgow he was in the habit of writing regularly and at great length to his mother, and from the tenor of these letters it is easy to see what that mother must have been to him. A writer on the social position of women has described the feelings of boys towards their mothers as scarcely amounting to respect! Young Graham's mother seems to have been his guardian angel, sympathising with his hopes and his sorrows; and certainly his feelings towards her would have been very inadequately described by that frigid word. While studying at Edinburgh he earned, for the first time in his life, some money by literary work, and the whole sum (6*l.*) was expended in presents to his mother and sisters.

In 1829 he was appointed lecturer on Chemistry at the Mechanics' Institution, Glasgow, in place of Dr. Clark; but the decisive step of his life was in the subsequent year. It was in 1830 that he was appointed Professor of Chemistry at the Andersonian University, Glasgow; and it is said that his mother, who was on her deathbed, lived to hear the glad tidings of his appointment. He was now more favourably circumstanced for experimental labours, and we find that the seven years spent at the Andersonian University were years of great activity.

In 1837 he was appointed Professor of Chemistry in the London University, now called University College, London, and he occupied that chair with great distinction till the year 1855, when he succeeded Sir John Herschel as Master of the Mint, which appointment may be considered an acknowledgment on the part of the Government of his scientific services and of his high character.

His numerous discoveries have been much quoted. Some of their theoretical bearings claim a brief notice here.

His investigation of the phosphates is remarkable in many ways. It was known that solutions of phosphoric acid in water vary in their properties; and chemists were satisfied with giving a name to the changes without investigating their nature. These solutions contained phosphoric acid and water, and were assumed to have like composition. They were accordingly called isomeric. Graham observed that they differ from one another in the proportion of water combined with the acid, and constitute in reality different compounds.

He knew that water combines with acids as other bases do, and he showed that the various compounds of phosphoric acid and water constitute distinct salts, each of which admits of its hydrogen being replaced by other metals without disturbance of what we should now call the type. Thus, to use our present notation, the three hydrates PO_4H_3, $P_2O_7H_4$, PO_3H, correspond to the following proportions of acid and water:—

$$P_2O_5 + 3H_2O = 2PO_4H_3$$
$$P_2O_5 + 2H_2O = P_2O_7H_4$$
$$P_2O_5 + H_2O = 2PO_3H$$

THOMAS GRAHAM (from a recent Photograph)

Graham observed that the hydrate PO_4H_3 is constituted like a salt, inasmuch as its hydrogen can be replaced atom for atom by other metals, like sodium, potassium, &c., forming such compounds as PO_4NaH_2, PO_4Na_2H, &c.

In order to appreciate duly the powers of mind of the author of this admirable research, we ought to compare his methods of reasoning with those generally prevalent among contemporary chemists, and on the other hand with the methods of to-day. One would fancy that Graham had been acquainted with the modern doctrines of types and of polybasic acids, so clearly does he describe the chemical changes in matter-of-fact language, and so consistently does he classify the compounds by their analogies. At that early period we find Graham considering hydrogen, in various salts, as a basylous metal; an idea which (in spite of its undeniable truth) some chemists of the present day have not fully realised.

Amongst minor chemical researches may be mentioned a series of experiments on the slow oxidation of phosphorus by atmospheric air. He discovered that this process (and the faint light which accompanies it) is arrested by the presence in the air of a trace of olefiant gas, $\frac{1}{150}$ of the volume of the air being sufficient for the purpose. Still smaller proportions of some other vapours were found capable of producing this same effect; spirits of turpentine being particularly remarkable, as less than a quarter of a thousandth of its vapour with air was found sufficient to prevent the slow oxidation of phosphorus.

On another occasion Graham investigated phosphuretted hydrogen, and made some remarkable observations concerning the conditions of the formation of the spontaneously inflammable gas. One of these deserves especial notice in connection with the action of olefiant gas, and in preventing the oxidation of phosphorus. He found that phosphuretted hydrogen is rendered spontaneously inflammable by the admixture of a very small proportion of an oxide of nitrogen, probably nitrous acid.

One of the most obscure classes of combinations are those which water forms with various salts. These bodies are characterised by the chief peculiarities which belong to definite chemical compounds; but chemists are as yet unable to explain them.

Water so combined is called water of crystallisation, and is said to be physically, not chemically, combined. A very convenient way of getting rid of a difficulty, by passing it on to our neighbours.

Graham examined the proportion of such water of crystallisation in a considerable number of salts, and he moreover examined the properties which it has when so combined. He found that some of the water in an important class of sulphates is held far more firmly than the remainder, and with force equal to that with which water is held in various chemical compounds. He showed that such firmly combined water can be replaced by salts in a definite chemical proportion. In fact, he got fairly hold of the subject by chemical methods, and laid the foundation for an explanation of it.

He discovered and examined compounds of alcohol with salts, and derived from them valuable evidence of the analogy between alcohol and water.

On a later occasion he made a series of important experiments upon the transformation of alcohol into ether and water, by the action of hydric sulphate. Liebig had endeavoured to explain the formation of ether in this process, by representing it as due to the decomposition at a high temperature of a compound of ether previously formed at a lower temperature; such decomposition being due to the increased tension of the vapour of ether at the higher temperature.

Graham justly argued that if the decomposition were due to the tension of ether vapour, it would not take place, and ether would not be formed, if the tension were not allowed to exert itself. He heated the materials in a closed tube, and proved that ether was formed, although the tension of its vapour was counteracted by the pressure thus obtained.

The line of research which occupied most of his attention, and in which his results were perhaps the most important, was that of diffusion; and it would be difficult to over-estimate the importance to molecular chemistry of his measurements, of the relative velocities of these spontaneous motions of particles of matter, whether in the state of gas or in the liquid state.

It was known that 1 part by weight of hydrogen occupies the same volume as 16 parts by weight of oxygen when measured at like temperature, and under like pressure. Chemical investigations prove that these equal volumes of the two gases contain the same number of atoms. We also know that the atoms in such a gas are in rapid motion, and resist the pressure to which the gas is at any particular time exposed, by striking against the surface which presses them together with force equal to that which presses them together.

Thus a given volume of hydrogen is maintained against the atmospheric pressure by an energy of atomic motion, equal to that of the same volume of oxygen. Each atom of hydrogen accordingly exerts a mechanical energy equal to that of each atom of oxygen; but we have seen that the hydrogen atom is much lighter than the oxygen atom, and accordingly it must move with much greater velocity than the oxygen atom.

Now Graham allowed hydrogen to escape through a very small hole in a plate of platinum; and allowed oxygen to escape under similar circumstances. He found that each hydrogen atom moves out four times as fast as each oxygen atom. His experiments were so arranged as to enable him to measure the relative velocities of certain motions of the atoms—motions not imparted to them by any peculiar or unnatural conditions, but belonging to them of necessity in their natural state. He found, moreover, that heat increases the velocity of these atomic motions, whilst increasing the force with which a given weight of the gas resists the atmospheric pressure.

The study of the condensation of gases by solids, and the combination of soluble compounds with membranes led him to discoveries which are likely to be of great value to physiologists in explaining processes of absorption and secretion.

Thus he found that oxygen is absorbed to a greater extent than nitrogen by caoutchouc, and that when a bag made of a thin membrane of this substance is exhausted by means of a good air-pump, the oxygen and nitrogen diffuse through it (probably as condensed liquids), and evaporate inside the bag in different proportions from those in which they are present in air; the oxygen rising to over 40 per cent. of the diffused air. Again, a mixture of hydrogen and oxygen was separated almost completely by the action of palladium, which condensed the hydrogen in very large quantity, and the oxygen very slightly.

Perhaps the most remarkable substances discovered in the course of his experiments on diffusion, were the soluble modifications of tungstic and molybdic acids, ferric oxide, &c., and the process by which these bodies were obtained was, perhaps, the most instructive part of the result; proving, as it does, that in their salts, these bodies have properties different from those which they normally possess in the free state; and retain them when the other constituent is removed by a sufficiently gentle process.

Another remarkable fact which bears on a most important theory, is the separation effected by Graham of potassic hydrate and hydric sulphate, by diffusion of potassic sulphate in aqueous solution—a fact which requires us to admit that the solution of the salt in water contains those products mixed with one another; just as much as the experiment of diffusing air through a porous clay pipe, and getting its constituent in a different proportion from that of the original air, proved that air is a mixture and not a compound of the two gases.

In his later researches, Graham was assisted by Mr. W. C. Roberts, and cordially acknowledged the zeal and efficiency displayed by that able young chemist. Graham's scientific influence extended beyond his researches; for, on the one hand, his lectures for 18 years at University College were remarkable for logical accuracy and clearness of exposition, and were highly valued by those who had the privilege of hearing them. On the other hand, his "Elements of Chemistry" is a masterly exposition of the best known facts of the science and of chemical physics. It was translated into German, and afforded at that time the most philosophical account of the working and theory of the galvanic battery.

In many of his ideas Graham was in advance of his contemporaries, and it might be difficult to find a chemist who has dealt more cautiously with general questions and delicate experimental operations,—or one whose results, in each direction in which he has worked, may more safely be expected to stand the test of future investigations.

A. W. WILLIAMSON

THE MEETING OF GERMAN NATURALISTS AND PHYSICIANS AT INNSBRUCK, TYROL

FROM the 18th to the 24th of September last the little town of Innsbruck wore an air of unwonted bustle and excitement. Its population, already augmented by the usual throng of summer tourists, was swelled by the advent of somewhere about 800 additional visitors—professors, doctors, directors, men of all sciences, often with their wives and daughters, who had come from all parts of Germany to attend the forty-third Meeting of the German Naturalists and Physicians. These meetings resemble those of our own British Association, though they differ in several very characteristic respects. One of the first contrasts to strike an Englishman is the entire absence of private hospitality. Everybody, so far as we can learn, is in private lodgings or in a hotel; and there are no such things as dinner-parties. Although our own customs in these respects are certainly very pleasant, there can be no doubt that the German fashion leaves the visitors more freedom, and allows them much more opportunity of seeing and talking with the friends they most wish to meet. With us it is no easy matter to get together a party of chemists, or geologists, or physiologists, to hold a social gathering after the labours of the sections are over. We are all either staying with friends, or invited to dinner, or engaged in some way. But at the German meetings such social reunions are one of the distinguishing features. One o'clock in the day brings with it the necessity for dining, and numerous dinner parties are improvised there and then; friends of like tastes, who have not met perhaps for a year before, adjourn to a *restauration* or *kaffee-haus*, and while eating the meal have a pleasant opportunity of comparing notes, and discussing questions which have in the interval arisen.

Another feature of contrast is in the length of time devoted to the sitting of the sections. At the British Association the sections open their sittings at eleven in the forenoon; and the work goes on steadily all day without intermission till four or five o'clock in the afternoon. But, in Germany, the sittings commence sometimes as early as 8 A.M., and are frequently over by ten or eleven o'clock, leaving the rest of the day for some short after-dinner excursion, or for general miscellaneous intercourse among the members. In fact, the German meetings are designed less for the purpose of bringing forward new scientific work, than with the view of affording to men of science opportunities of becoming personally acquainted with each other, and of discussing the value and bearing of recent contributions to knowledge. Hence, the papers which are brought before the sections, contain, to a large extent, outlines, summaries or notices of recent researches, and exhibitions of books, maps, memoirs, specimens, experiments, &c., which have recently attracted notice.

In our British Association gatherings, there is probably more hard work than in those of our German brethren, and I daresay there is as much opportunity for sociality as suits our national temperament. For our Association is meant, not merely to promote a friendly intercourse among scientific men, but to be a kind of propagandist for the advancement of science through the general community. So we make a compromise between sober, serious, hard work for science on the one hand, and unrestrained festivities on the other. The German meetings keep less prominently before them the scientific culture of the world outside, and aim rather at the strengthening of the hands of the individual worker.

From the papers read at the different sections; from the discussion which they elicited; and still more perhaps from the public addresses on subjects of general interest given to the whole assembled meeting; one could gather some suggestive traits of the present current of thought in at least one great section of the cultivated society of Germany. What specially struck me was the universal sway which the writings of Darwin now exercise over the German mind. You see it on every side, in private conversation, in printed papers, in all the many sections into which such a meeting as that at Innsbruck divides. Darwin's name is often mentioned, and always with the profoundest veneration. But even where no allusion is specially made to him, nay, even more markedly, where such allusion is absent, we see how thoroughly his doctrines have permeated the scientific mind even in those departments of knowledge, which might seem at first sight to be furthest from natural history. "You are still discussing in England," said a German friend to me, "whether or not the theory of Darwin can be true. We have got a long way beyond that here. His theory is now our common starting point." And so, as far as my experience went, I found it.

But it is not merely in scientific circles that the influence of Darwin is felt and acknowledged. I do not think it is generally known in England, that three years ago, when, after the disastrous war with Prussia, the Austrian Parliament had assembled to deliberate on the reconsolidation of the empire, a distinguished member of the Upper Chamber, Professor Rokitansky, began a great speech, with this sentence:—"The question we have first to consider is, Is Charles Darwin right or no?" Such a query would no doubt raise a smile in our eminently unspeculative houses of legislature. But surely never was higher compliment paid to a naturalist. A great empire lay in its direst hour of distress, and the form and method of its reconstruction was proposed to be decided by the truth or error of the theory of Darwin. "The two men," said one able physician of Vienna to me (himself, by the way, a North-German), "who have most materially influenced German thought in this country are two Englishmen—George Combe and Charles Darwin."

There was another aspect of the tone of thought at Innsbruck, which could not but powerfully impress a Briton. Although we were assembled in the most ultra-Catholic province of Catholic Austria, there was the most unbridled freedom of expression on every subject.

In an address on recent scientific progress, Helmholtz thus expressed himself—"After centuries of stagnation physiology and medicine have entered upon a blooming development, and we may be proud that Germany has been especially the theatre of this progress—a distinction for which she is indebted to the fact that among us, more than elsewhere, there has prevailed a fearlessness as to the consequences of the wholly known Truth. There are also distinguished investigators in England and in France, who share in the full energy of the development of the sciences, but they must bow before the prejudices of society, and of the Church, and if they speak out openly, can do so only to the injury of their social influence. Germany has advanced more boldly. She has held the belief, which has never yet been belied, that the full Truth carried with it the cure for any injury or loss which may here and there result from partial knowledge. For this superiority she stands indebted to the stern and disinterested enthusiasm which, regardless alike of external advantages and of the opinions of society, has guided and animated her scientific men."

This liberty of expression, however, seemed sometimes apt to wear not a little the aspect of a mere wanton defiance of the popular creed. Yet it was always received with applause.

In an address on the recent progress of anthropology, Karl Vogt gave utterance to what in our country would be deemed profanity, such as no man, not even the most free-thinking, would venture publicly to express. Yet it was received, first with a burst of astonishment at its novelty and audacity, and then with cries of approval and much cheering. I listened for some voice of dissent, but could hear none. When the address, which was certainly very eloquent, came to an end, there arose such a prolonged thunder of applause as one never hears save after some favourite singer has just sung some well-known air. It was a true and hearty *encore*. Again and again the bravos were renewed, and not until some little time had elapsed could the next business of the meeting be taken up. Not far from where I was standing, sat a Franciscan monk, his tonsured head and pendent cowl being conspicuous among the black garments of the *savans*. He had come, I daresay, out of curiosity to hear what the naturalists had to say on a question that interested him. The language he heard could not but shock him, and the vociferation with which it was received must have furnished material for talk and reflection in the monastery.

ARCH. GEIKIE

TRIASSIC DINOSAURIA

It will probably interest geologists and palæontologists to know that a recent examination of the numerous remains of *Thecodontosauria* in the Bristol Museum, enables me to demonstrate that these Triassic reptiles belong to the order *Dinosauria*, and are closely allied to *Megalosaurus*. The vertebræ, humerus, and ilium, found in the Warwickshire Trias, which have been ascribed to *Labyrinthodon*, also belong to *Dinosauria*. The two skeletons obtained in the German Trias near Stuttgart, and described by Prof. Plieninger, some years ago, are also unquestionable *Dinosauria;* and, as Von Meyer is of opinion, probably belong to the genus *Teratosaurus*, from the same beds. Von Meyer's *Platæosaurus*, from the German Trias, is, plainly, as he has indicated it to be, a Dinosaurian.

As Prof. Cope has suggested, it is very probable that *Bathygnathus*, from the Triassic beds of Prince Edward's Island, is a Dinosaurian; and I have no hesitation in expressing the belief, that the *Deuterosaurus*, from the Ural, which occurs in beds which are called Permian, but which appear to be Triassic, is also a Dinosaurian. It is also very probable that *Rhopalodon*, which occurs in these rocks, belongs to the same order. If so, the close resemblance of the South African *Galesaurus* to *Rhopalodon*, would lead me to expect the former to prove a Dinosaur.

I have found an indubitable fragment of a Dinosaurian among some fossils, not long ago sent to me, from the reptiliferous beds of Central India, by Dr. Oldham, the Director of the Indian Geological Survey. Further, the determination of the Thecodonts as *Dinosauria*, leaves hardly any doubt that the little *Ankistrodon* from these Indian rocks, long since described by me, belongs to the same group.

But another discovery in the same batch of fossils from India, leaves no question on my mind that the Fauna of the beds which yield Labyrinthodonts and Dicynodonts in that country, represents the terrestrial Fauna of the Trias of Europe. I find, in fact, numerous fragments of a crocodilian reptile, so closely allied to the *Belodon* of the German Trias, that the determination of the points of difference requires close attention, associated with a *Hyperodapedon*, larger than those discovered in the Elgin Sandstones, but otherwise very similar to it.

Thus, during the Triassic epoch, extensive dry land seems to have existed in North America, Western and Central Europe, Eastern Europe, Central India, and South Africa, as it does now; and, throughout this vast area, the *Dinosauria*—the links between reptiles and birds—seem to have been represented by not fewer, probably by many more, than nine or ten distinct genera.

I hope, shortly, to have the honour of placing the details of the researches into the structure and distribution of the *Dinosauria*, in which I have been engaged for the last two years, and of which the above notice is one of the results, before the Geological Society.

T. H. HUXLEY

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents.*]

The Suez Canal

THE all-engrossing topic of the day is the Suez Canal, about which some diversities of opinion still exist. As for many years back I have had my attention particularly drawn to some of the chief matters in dispute, having been engaged on the largest irrigation works in India, I venture to trouble you with the following remarks.

Engineering science and indomitable energy have, in the case of the Suez Canal, overcome difficulties which at one time were considered insurmountable; but even up to the present moment doubts still exist, and some fear that the whole scheme may yet prove a failure, owing to the débris of the Nile travelling eastward transported by the currents of air and water. That we can overcome the former is, in my opinion, beyond all doubt; for it is found that whenever an irrigation channel is run out from the Jumna Canal into the great desert of Northern India, rich vegetation takes the place of arid sand. And so in Egypt will irrigation force back the desert; so the only question is, Can irrigation be carried out on an extensive scale? And of this also I have no doubt, for the enormous volume of water which now flows into the sea and is lost, is quite sufficient to reclaim the whole of the desert.

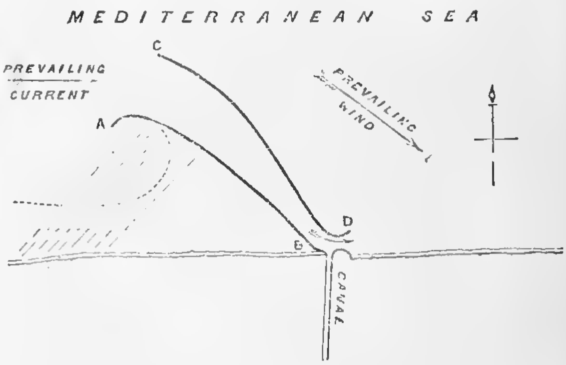
It may be asked, Can the water be made to flow over the desert? And of this I hold that there can also be no doubt. The very name of the Timsa Lake proves, I think, that the Nile, or at least a branch of it, flowed eastward, for the word *Timsa* signifies crocodile, showing that the water must at one time have been brackish or fresh, for these creatures could not have existed in this lake had it been salt as at present. If, therefore, a portion of the Nile water at one time flowed eastward, there can be no great engineering difficulty to make it do so again; and I am almost inclined to think that it would have been better to have made the canal a fresh-water one, for it is only by vegetation, the produce of irrigation, that the desert can be kept under control. Other advantages may be cited, such as cleaning the bottom of ships by bringing them into fresh water, and the prevention of any of the disturbed and very muddy waters along the Mediterranean coast getting admission into the canal; for by keeping the water in the canal at a higher level than that of the sea at both ends there could only be an outflow. So all the water wasted would be expended on lockage.

It may be objected that the fresh-water canal would get silted up by the muddy waters of the Nile; but could not this Timsa Lake be used as a silt-trap? I do not mean to say, that the present canal will be a failure because it has not been made a fresh-water one; but what I do think is, that possibly in the end a fresh-water canal would have been best and perhaps cheapest, as the dredging of the canal might have been much reduced,* as the water could have been kept at a higher level in the canal.

The great difficulty, however, to contend against, appears to me to be to keep a deep-water channel at the Mediterranean end of the Canal; and what drew my attention to this more than a dozen years ago, was the fact that the harbour of Alexandria does not get silted up. Some have supposed that the subsidence of the delta accounts for this, and that the small advance of the land on the sea in this direction is owing to a constant sinking of the land. In my opinion a very different cause can be assigned: Nature here is working by a very different agency, namely, the current in the Mediterranean which flows eastward all along the African coast, and transports the débris of the Nile, depositing it all along the western portion of the Mediterranean. The fact of the Timsa Lake being at one time fresh or brackish, goes to support this view; so the only question is, Will the cost of continuous dredging be so excessive that the Canal will become a financial failure? On this point I cannot venture to give an opinion, as I have no data, but I think this difficulty may be met by forcing this easterly current to aid in keeping the mouth of the Canal clear of silt deposits.

What aids this current to transport the earthy matter is the beat of the sea always stirring the mud and sand up on the coast, and enabling the water to hold a large proportion of matter in suspension, and even to transport heavy matter.*

The proportion of earthy matter a short distance out to sea is comparatively little, so the great object appears to me to prevent the agitated water travelling as it does at present, and this can be done by arranging the breakwaters somewhat as shown in this diagram.



The breakwater AB is intended to prevent the very muddy water travelling along the coast, and the point A should extend well out into deep water. The breakwater CD is to direct the comparatively pure water where the sea is deep to pass across the mouth of the canal; and by the funnel-mouthed shape thus given, the velocity at D will be increased, and thus keep deep water at the head of the canal. Some may say that the expense will be enormous, and that it will have to be year after year extended. But, in reply to this, I say that deltas do not extend out into the sea at so rapid a rate as some suppose; and that the formation of a delta takes several thousands of years to accomplish, so that in this very delta, the advance is hardly perceptible; and that a sinking of the land has been brought forward, to account for the very slow progress made; while, in fact, Nature has at present a power at work which is quite sufficient to explain the reason why so little advance is made on the sea during the historic period (see my paper on the Delta of the Irrawaddy, read before the Royal Society of Edinburgh in 1857).

In conclusion, I have no doubt this Suez Canal will have many ready to abuse it and say it is a total failure, as has been said of the Ganges Canal; but like the latter work, which last year saved some three million human beings from starvation, so will this canal, I have little doubt, outlive the abuse, and become one of the greatest blessings to the civilised world.

T. LOGIN, C.E., late of the Ganges Canal.

London, Oct. 29, 1869.

* I observe that, in a discussion at the Civil Engineers Institution, the total excavation of the Suez Canal is stated to be 70,000,000 cubic metres. The excavation of the Ganges Canal was 2,547,000,000 cubic feet, or a little over 70,000,000 metres; but this latter does not include some 3,000 miles of distribution channels.

* At Felixstowe, last March, during a gale of wind, I watched a mass of brickwork, some eighteen inches square and about six inches thick, moved along the coast by the action of the waves, which were in an oblique direction to the coast, and no doubt the same takes place along the mouths of the Nile. By a sample I took of this agitated water, I found it contained 0·7375 per cent. of its weight of small pebbles, sand, and mud. This sample was taken at a height of nearly ten feet above the sea, and was got by catching the spray of the sea as it was falling.

NOTES.

BY offering Dr. Temple the Bishopric of Exeter, Mr. Gladstone has removed from his post the most eminent schoolmaster in England. Dr. Temple has done much for the education, present and future, of all classes; and although this is not the place to comment on all he has done in this direction, we may note here what he has done for education in Science. He may fairly claim to be the first head-master who has recognised its importance, and effectively introduced it into his school. And its introduction at Rugby is of special importance, because it is the acknowledged leader in educational progress, and because so many head-masters have been trained there. Now Harrow and Eton, and several other schools are doing something, though none yet with quite the same liberality as Rugby: but it will be instructive to look back ten years, and thus to estimate the advance. Rugby was then the only public school where science was taught at all. But even there it was under great disadvantages. No school was assigned to it; it was an extra, and heavily weighted by extra payment. There was no laboratory, scarcely any apparatus, and scarcely any funds for procuring it. About forty to fifty boys attended lectures on it, but there was no possibility of making those lectures consecutive, and of dealing with advanced pupils. Now there is a suite of rooms devoted to science. A large and excellent laboratory, where thirty boys are working at the same time at practical chemistry with the assistance of a laboratory superintendent, opens into a smaller private laboratory, which is for the use of the master and a few advanced students. This again opens into a chemical lecture room, in which from forty to fifty can conveniently sit. The seats are raised, and the lecture table fitted with all that is required. Adjoining is the physical science lecture room, in which sixty can sit, and of which a part is assigned to work tables. And out of this the master's private room is reached, in which apparatus is kept, and experiments and work prepared. There is a considerable geological museum, and an incipient botanical collection. A Natural History Society meets frequently, and publishes reports and papers contributed by the boys. Five masters take part in teaching natural science. It is introduced into the regular school work (about 360 out of 500 appear to be in the Natural Science classes); being compulsory on all the middle school; an alternative in the upper school; and optional in the Sixth Form. And the result of the teaching has been satisfactory. It has not damaged classics. It has been the means of educating many boys, and has been a visible gain to the great majority; and it has steadily contributed to the lists of honours gained at the University. If Dr. Temple had done nothing else, his name would deserve honour at our hand for having brought about this change. Let us hope that his successor will be equally liberal to science, and maintain its efficiency.

THE public anxiety about the fate of our great explorer, Dr. Livingstone, has been anything but allayed by the recent telegrams from Bombay and Zanzibar, wanting, as they seem to do at present, the stamp of the approval of Sir R. Murchison. The Bombay mail is now hourly expected; and, by the opening meeting of the Royal Geographical Society, Sir Roderick will be in possession of all the data on which to form a complete estimate of the recent intelligence, and will then communicate the results. In the meantime, we wait and hope; Livingstone is not the man to do his work hastily or incompletely, or to return leaving anything unexplored.

THE President of the Royal Society, Sir Edward Sabine, being unable, through pressure of official duty, to accept the Khédive's invitation to be present at the opening of the Suez Canal, was allowed to nominate a gentleman to represent the Royal Society on the memorable occasion. The President's choice, which has been approved by the Council, fell on Mr. J. F. Bateman, C.E. This selection will perhaps gratify the civil engineers as well as the Royal Society, for Mr. Bateman, who is now on his way to Egypt, has made himself known on the Mediterranean, by his land-reclamations in Majorca and at the mouth of the Ebro.

DRS. CARPENTER and WYVILLE THOMSON have just concluded a remarkably successful dredging expedition in the surveying ship *Porcupine*, the scientific results of which will shortly be laid before the Royal Society. They succeeded in bringing up large quantities of ooze from a depth of more than 2,400 fathoms, and have established the wonderful facts, that at such enormous depths, in total darkness, and with a temperature below the freezing-point, there is not merely life but life in abundance; not merely the lowest organisms, but highly developed Mollusca, Echinoderms, and Star-fishes. Many practical points of great importance for future investigation have been established during this cruise, more especially the proper mechanical arrangements by which dredging can be carried on in almost all weathers, thus enormously increasing the amount of work that can be performed in a given time; and, what is perhaps of equal value, the discovery by Captain Culver of a far more effectual method than the dredge for obtaining in large numbers many of the characteristic inhabitants of these profound ocean depths. Copious series of thermometric observations have also been taken, which point to results of great theoretical interest.

THE "Female Physicians" question, thanks to Professor Masson, has made a great stride during the past week. Ladies are to be admitted to study Medicine at Edinburgh University. Imagine the feelings of the non-contents when Professor Masson, in a final outburst, described their argumentation as "rampageous mysticism, dashed with drivel from Anacreon!"

WE are glad to learn that, through the generosity of a friend of science who forbids the mention of his name, the publication of the *Astronomical Journal* is about to be resumed. Dr. Gould will edit it, as before.

THE Fellows of the Chemical Society reassemble this evening (Thursday), and begin the work of the session by discussing the President's elaborate paper on the Atomic Theory, which has been printed at length in the Journal of the Society. Any contribution to chemical philosophy from the pen of Professor Williamson must command the attention of those who have studied the history of chemistry, and the discussion he has invoked will doubtless be sustained by able supporters and opponents. Prof. Williamson holds that the atomic theory is the consistent general expression of all the best known and best arranged facts of chemistry, and he challenges detractors to bring forward an alternative theory. He asserts that all chemists use the atomic theory, though many refer to it as something which they would be glad to dispense with; and that all the facts which point so distinctly to the existence of molecules derive their significance from the atomic theory. Even those who cannot accept Dr. Williamson's conclusion that the atomic theory is the very life of chemistry, will doubtless feel duly grateful for his masterly summary of the evidence by which the theory is upheld.

WE learn with regret from *Trübner's Literary Record* that the Imperial College of Pekin, which was established to disseminate the knowledge of the West amongst the Celestials, appears to have ended in a failure. Prince Kung favoured it, but other powerful Mandarins, and amongst them Wo-Jen, a leader of the anti-foreign party, have succeeded in extinguishing it. We are afraid that we have here the result of Occidental diplomacy. Has Wo-Jen been tampered with by Lowe-king?

IT should make Englishman sad to think that while Mr. Peabody, who we trust is now better, finds the most pressing call here on his far more than princely munificence, to be the cry of the poor to heaven for bread and fresh air, in his own country, he finds the progress of Science alone needing his fostering aid. We have before us the first annual report of the Trustees of the *Peabody Academy of Science*, giving a full account of the manner in which the gift of 140,000 dollars is to be expended or invested, and of the progress already made in the buildings, natural history collections, musuems, and published proceedings, which we trust will worthily carry down the name of Peabody to posterity.

M. LOUIS LACAZE has bequeathed to the French Academy of Sciences the funds necessary for the foundation of three prizes of 10,000 francs each, to be awarded every second year. The sciences for which these prizes are to be given are Physiology, Physics, and Chemistry.

WE understand that Mr. James Young intends founding in Glasgow an institution for the study of Technology, to be opened in the course of the ensuing year.

A FRENCH translation of Professor Huxley's Elementary Physiology is announced.

WE understand that the appointment of Master of the Mint has not yet been filled up.

EARTHQUAKES seem approaching inconveniently near us. On Sunday night and Monday morning severe shocks were felt at Frankfort, Darmstadt, Wiesbaden, and Mayence; while a succession of shocks on the night of October 2, seems to have been unpleasantly violent, as the following extract from a letter from Coblentz, with which we have been favoured, will show:—"The greatest event we have had lately was an *earthquake!* It was on the night of Saturday, October 2, a little before 12, when most people were in bed, and were startled out of their sleep. I was wide awake, luckily, so came in for the whole; the noise was most alarming, and when my bed shook under me I guessed what it was. People in the town ran into the streets, and there was general alarm, as the shocks were so severe. The worst was about ten miles off, where chimneys fell and some walls cracked, but everywhere the accompanying noise seems to have been very great, like a train running under the house in bumps and jerks. The whole extent of the earthquake was very considerable, and many said they had never felt so bad a one before."

HERE are some notes from Oxford:—

On the 28th ult., the Warden and Fellows of Merton College elected Professor Clifton, F.R.S. (as Professor of Experimental Philosophy) to a Fellowship in the College. This is, we believe, only the second time that a college has availed itself of the power given by its new statutes of electing a professor to a fellowship, the person so elected being unconnected with the college in question, either by past or present membership, or by his professorship. Instances have occurred of the election of Professors to Fellowships in the colleges to which their Professorships were attached, but in this case the authorities of Merton College, without the least pressure or solicitation from without, have acted up to their increased powers given them by the last statutes, although the professorship is attached to Wadham College. We hail this piece of news with the greatest pleasure, as it indicates the desire which is now beginning to show itself, to devote the funds represented by fellowships to the purposes of University work, rather than to treat fellowships as simple prizes. The triennial elections of members of Council of the University is an important event at Oxford, as that body has sole power of initiation in University matters. The following were elected as the result of the poll on Thursday last:—The Dean of Christ Church; the Presidents of Trinity and Magdalen; Professors Price, H. Smith, and Scott; Mr. Ince, of Exeter; Mr. Liddon, of Christ Church, and Mr. Fowler, of Lincoln. The deputy appointed by Sir Benjamin Brodie to deliver lectures for him this term is Mr. A. Vernon Harcourt, of Christ Church. There are nineteen "unattached students" among the Freshmen, unattached students being persons who have availed themselves of the recently granted privilege of becoming members of the University, without becoming members of any College. Mr. Lawson, the Professor of Botany and Rural Economy, will give a course of Lectures during the ensuing term on the minute anatomy of plants. They are to be delivered in the Herbarium at the Botanic Gardens every Tuesday and Friday at 8 P.M. Is this hour fixed as the one at which it is most likely that members of the University, interested in Botany, will attend? We well remember when Prof. Lindley lectured at University College, London, to audiences of from eighty to a hundred students at 8 A.M. An election to the Lee's Readership in Anatomy will be holden at Christ Church on Saturday, December 18. Candidates for the office are requested to apply for information to the Dean on or before Saturday, the 13th of November.

AND here is a note from Cambridge:—The Rev. T. G. Bonney, B.D., Tutor of St. John's, has been appointed Lecturer in Natural Science at Cambridge; and Mr. Trotter, of Trinity, will lecture on Electricity, Magnetism, and Botany. We understand that these arrangements have been made because the staff of university professors is not large enough to do all the teaching in Natural Science that is required. We congratulate the University on the increased desire for instruction in these subjects; but is the number of men in the University competent to teach them so small that it has been found necessary to entrust Electricity and Botany to the same lecturer?

ASTRONOMY

The Astronomical Congress at Vienna

THE German Astronomical Society, although it dates from only one or two years back, is already in earnest work, and this year a Congress, extending over several days, was held at Vienna, at which not only were the president and council elected for the next year, but many papers of astronomical importance were read. Count Marshall has been good enough to send us the following account of the meeting:—The Society numbers actually 209 members, most of them superintendents of German and Extra-German Observatories; about 50 met at Vienna, among whom MM. Struve, of Pulkowa (President), Möller (Sweden), Forster (Berlin), Scheibner (Leipzig), Hersch (Neufchâtel), Lieut.-Gen. Bager (Berlin), Prof. Schaub (Trieste), Prof. Julius Schmidt (Athens), Mr. Schönfeld (Mannheim), were perhaps the most eminent. On Sept. 13, the first day of meeting, M. Struve opened the session with an exposition of the purpose of the Society and the recent progress of astronomy, especially of the knowledge of the physical nature of celestial bodies. Since the last meeting at Bonn, the number of members, the pecuniary resources, and the library have notably increased, and the following publications have been issued: Two years of the Quarterly Periodical, Dr. Auwers's paper on Variable Proper Movements, Dr. Lesser's Tables of Pomona, and Dr. von Asten's new Tables of Reduction for the "Histoire céleste Française." The study of the Asteroids, new Tables of Jupiter and of Comets, especially of the periodical ones, are in active preparation. Prof. Auwers distributed copies of tables for the reduction of positions of fixed stars from 1750 up to 1840, prepared at the Observatory of Pulkowa; and gave an account of his own new reduction of Bradley's observations, undertaken by order of the same Observatory, and of his tour to England for this purpose, during which he found, at Oxford, a number of old and very complete observations of fixed stars. The President referred to his connection with the German North Polar expedition. Prof. Julius Schmidt exhibited and explained a map of the Moon 6 feet in diameter, made at the Observatory of Athens. Prof. Zöllner (of Leipzig) detailed his recent observations of the Sun on the Janssen-Lockyer method.

September 15.—Prof. Bruhns (Leipzig) commemorated the hundredth birthday of A. von Humboldt, and distributed the prospectus of a biography of this illustrious man of science, which he intends to publish. Forty new members were admitted. Prof. Zöllner continued his lecture on his observations of the solar protuberances, and on a method of ascertaining the movements of celestial bodies by means of spectral analysis. His views were discussed by MM. Oppolzer, Scheibner, and Struve. A number of proof-prints of Prof. Heis' (Münster) stellar maps were committed to MM. Julius Schmidt and Prof. Galle, to report upon. M. de Littrow, superintendent of the Vienna University Observatory, communicated and explained the plan of the new Observatory to be built there, and commented upon the recent endeavours of some calculators of the solar parallax to derive useful results from Father Hell's observations, dating from 1769, proving these attempts to be altogether useless, by exhibiting the original diaries of this observer, and distributing fac-similes of the most important passages of them. A communication, concerning the establishment of a Humboldt Foundation at Vienna, was read.

September 16.—The president and council were elected; M. Struve, President; Prof. Bruhns, Vice-President; MM. Auwers and Winnecke, secretaries; Prof. Zöllner, Librarian; M. Auerbach, Treasurer; MM. Argelander and de Littrow, members of the Council. A new member was admitted. Mr. Julius Schmidt read his report on Prof. Heis's stellar maps. Prof. Forster read a paper concerning the solar eclipse of August 18, 1868, with Dr. Tieb's remarks on the photograms of it, taken at Aden, and proposed that the President and Council should ensure their assistance on the occasion of the next transit of Venus to any astronomers who should apply for it. The motion has been adopted. Dr. Kaiser gave an account of his observations concerning the ellipsoidal form of the Moon, and the solar protuberances, which elicited a reply from Prof. Zöllner, M. de Littrow communicated the first report of the permanent Adriatic Commission, and the programme of the prizes for the discovery of comets, lately proposed by the Imperial Academy of Vienna. Prof. Schönfeld exhibited a letter from Fabricius to Tycho Brahe (1596), in which the first notice of Mira Ceti is given, and entered into historical details concerning this variable star. The session of 1869 was closed by thanks voted to the Imperial Academy for having placed suitable localities at the disposal of the Society.

CHEMISTRY

Preparation of Uranium

M. PELIGOT has communicated to the Annales de Chimie et de Physique [xvii. 368] a short note on the preparation of uranium. A mixture of 75 grammes of uranous chloride, 150 grammes of dry potassium chloride, and 50 grammes of sodium in fragments, is introduced into a porcelain crucible, itself surrounded by a plumbago crucible. The reaction is effected in a wind furnace, at the temperature of redness; but the heat must be increased for a short time at the close of the operation. In the black slag may be found, after cooling, globules of fused uranium. Throughout the operation, it is necessary to avoid the presence both of moisture and atmospheric air.

A specimen of the metal prepared in this way by M. Valenciennes had the specific gravity, 18·33. Uranium, is, therefore, one of the densest of metals.

Stannous Chloride and Acids of Arsenic

A. BETTENDORFF has examined the action of stannous chloride on the oxygen acids of arsenic. When a solution of stannous chloride in fuming hydrochloric acid is added to a solution of arsenious or arsenic oxide in the same acid, a brown precipitate is formed, which, after proper washing and drying, consists of metallic arsenic mixed with a small quantity of stannic oxide. In an aqueous solution of arsenious or arsenic acid, stannous chloride produces no precipitate; but on adding strong hydrochloric acid till the liquid fumes slightly, precipitation takes place. Arseniferous hydrochloric acid of sp. gr. 1·182 to 1·135 gives an immediate precipitate; the same diluted to sp. gr. 1·115 gives imperfect precipitation after some time; and in a similar solution of sp. gr. 1·100, no precipitation takes place. From this it may be inferred that the reaction occurs only between stannous chloride and arsenious chloride; further, that in a solution of arsenious acid in hydrochloric acid of sp. gr. 1·115 part of the arsenic is present as chloride, but that hydrochloric acid of sp. gr. 1·100 dissolves arsenious acid as such, without converting it into chloride. The reaction above described is extremely delicate, and capable of detecting 1 pt. of arsenic in a million parts of solution. On antimony compounds stannous chloride exerts no reducing action, even after prolonged heating: hence the above-described reaction may be used to detect the presence of arsenic in antimony compounds, the solution being previously saturated with hydrochloric acid gas. Another useful application of the same reaction is to the preparation of hydrochloric acid free from arsenic: 421 grms. of crude hydrochloric acid of sp. gr. 1·164 were mixed with a fuming solution of stannous chloride, the precipitate separated by filtration after twenty-four hours, and the hydrochloric acid distilled, the receiver being changed after the first tenth had passed over, and the remaining liquid distilled nearly to dryness. The acid thus obtained gave not the slightest indications of arsenic, either by Marsh's test or by precipitation with hydrogen sulphide.—[Zeitschr. f. Chem. (2), v. 492.]

Dichlorinated Aldehyde

PATERNO has obtained dichlorinated aldehyde $C_2H_2Cl_2O$ by the action of sulphuric acid on dichloracetal. It is a liquid boiling at 89°—90°, attracts moisture from the air, and is thereby converted into a hydrate, which crystallises in beautiful laminæ, Left to itself, even in sealed tubes, it becomes dense, and changes into a white amorphous mass, which has the aspect of porcelain; but, when heated to 120°, is reconverted into the original product. Dichlorinated aldehyde dissolves without decomposition in alcohol and ether; when poured into water, it first sinks to the bottom and then dissolves, especially on application of heat; in short, it exhibits the most complete analogy with chloral. It is difficult to oxidise, its vapour not undergoing any sensible alteration when mixed with air or oxygen and passed over red-hot spongy platinum; but when gently heated with several times its own volume of fuming nitric acid, it is energetically attacked and converted into *dichloracetic acid* $C_2H_2Cl_2O_2$. Phosphoric pentachloride attacks it strongly, producing the compound $C_4H_4Cl_6O$ or $C_2H_2Cl_2O \,.\, C_2H_2Cl_4$, the action doubtless consisting in the replacement of O by Cl_2 (as in the action of PCl_5 on aldehydes in general), whereby $C_2H_2Cl_4$ is produced, which, as soon as it is formed, unites with a portion of the undecomposed dichlorinated aldehyde, producing the compound $C_4H_4Cl_6O$. The constitution of this body may be represented by the following formulæ:—

$$CHCl_2—CH_2—O—CCl_2—CHCl_2,$$

or perhaps by

$$CHCl_2—CHCl—O—CHCl—CHCl_2.$$

The compound $C_4H_4Cl_6O$ is a colourless oil, having an irritating odour, heavier than water, soluble in alcohol and ether; it distils at 250° emitting acid vapours. Alcoholic potash attacks it strongly, with evolution of heat, and formation of potassium chloride; and, on adding water to the resulting liquid, a heavy aromatic oil separates, boiling at 196°, and having the composition $C_4H_2Cl_4O$—that is to say, containing 2HCl less than the preceding. This last compound unites directly with four atoms of bromine, forming the crystalline compound $C_4H_2Cl_4Br_4O$. In this respect, the compound $C_4H_2Cl_4O$ is analogous to Malaguti's *chloroxethose* C_4H_6O, which he obtained by abstracting four atoms of chlorine from perchlorinated ethylic oxide $C_4Cl_{10}O$. According to this analogy, the compound $C_4H_4Cl_6O$ may be designated as *hexchlorinated ethylic oxide*, and $C_4H_2Cl_4Br_4O$ as *tetrachloro-tetrabrominated ethylic oxide*. The two compounds C_4Cl_6O and $C_4H_2Cl_4O$ may also be regarded, respectively, as *perchlorinated vinyl oxide* and *tetrachlorinated vinyl oxide*.—[Giornale di Scienze di Palermo, v. 123, 127.]

Colouring Matter of Wine

FR. PONCHIN proposes the use of a solution of potassium permanganate acidulated with sulphuric acid to distinguish between the natural colouring matter of wine and the various substances added to imitate that colour. For this purpose a normal solution of 2 grammes of the permanganate in 100 grammes of distilled water is prepared when wanted for use; 15 grammes of this solution acidulated, and 3 drops of pure sulphuric acid, are added to 15 grammes of normal red wine contained in a test-tube, and the liquid after being shaken is left at rest. The greater part of the colouring matter is then slowly precipitated in red flocks, while the supernatant liquid retains the same colour, without weakening, for 24 hours afterwards. After a few days, however, the precipitate acquires a deeper red colour and the liquid becomes nearly colourless. For very deeply coloured wines a larger proportion of the normal solution must be used, care being, however, taken not to add it in excess, as that would produce complete decolorisation. If, on the other hand, the same solution be added in the same quantities to wine which has been artificially coloured red, the deception will soon become apparent by the speedy decolorisation of the liquid, or by the communication of some different colour to the liquid and to the precipitate. The following table exhibits the various colours assumed by the liquid and precipitate produced under these circumstances in wine coloured by different substances—

Substances added.	*Colour of Liquid.*	*Colour of Precipitate.*
Pernambuco wood	Light orange red	Reddish yellow
Campeachy wood	Golden yellow	Orange yellow
Archil	Very light red	Reddish yellow
Laccamuffa	Very light green	Greenish-grey
Prepared Cochineal	Nearly colourless	Grey
Fitolacca	Nearly colourless	Yellowish
Myrtle	Nearly colourless	Dingy-greenish
Violets	Very light rose	Yellowish
Colouring matter of normal wine	Persistent wine-red.	Blood-red

Dye-woods resist decolorisation more strongly than vegetable juices; and Brazil wood, when treated with the above-mentioned reagent, aided by heat, acquires a crimson-red colour, due to the formation of brazilin.—[Ann. di Chim. app. alla Med., September, 1869, p. 142.]

PHYSICS

Professor Magnus on Heat Spectra.

Professor Magnus has recently contributed to the Berlin Academy a memoir on the radiation and absorption of heat at low temperatures. The results, which are of the highest importance, are essentially as follows:—

1. Different bodies, heated to 150° C., radiate different kinds of heat.

2. Some substances emit only one kind, some many kinds, of heat.

3. Of the first class, perfectly pure rock-salt is an instance. Just as its incandescent vapour, or that of one of its constituents (sodium), is solitary in tint, so the substance itself, even at 150°, emits heat of but a single ray. It is monothermic, just as its vapour is monochromatic.

4. Rock-salt absorbs heat radiated from rock-salt in larger quantity, and more powerfully, than that derived from sylvine and other kinds. It does not, therefore, as maintained by Melloni and Knoblauch, transmit heat from all sources with uniform facility.

5. The amount of absorption effected by rock-salt increases with the thickness of the absorbing plate.

6. The high diathermancy of rock-salt, does not depend on its small absorptive power for the different kinds of heat, but on the fact that it only radiates (and, consequently, only absorbs) heat of one kind; while almost all other bodies at the temperature of 150° emit heat which contains only a small fraction or none of those rays which are given out by rock-salt.

7. Sylvine (potassium chloride) behaves like rock-salt, but is not monothermic to an equal extent. This circumstance is also obviously in analogy with the incandescent vapour of the salt, or of potassium, which is known to furnish an almost continuous spectrum.

8. Heat purely derived from rock-salt is almost completely absorbed by fluor-spar. It might thence have been expected that heat radiated from fluor-spar would also be energetically absorbed by rock-salt; yet 70 per cent. of it traverse a plate of rock-salt 20 mm. in thickness. If we remember that the total heat emitted by fluor-spar is more than thrice as large as that of rock-salt, this phenomenon is readily explicable; nevertheless, it is probably dependent upon some other property of fluor-spar.

9. If a spectrum could be projected of the heat radiated at 150°, and rock-salt were the radiating substance, such a spectrum would contain only *one* band. If sylvine were employed, the spectrum would be more expanded, but still would only include a small portion of the spectrum which would be given by the heat radiated from lamp-black.

In a subsequent communication, Herr Magnus treats of the reflection of heat radiated at the surfaces of fluor-spar and other bodies.

Having succeeded in obtaining the heat from different substances at 150° free from the rays of flames and other thermogenic bodies, and afforded proof that there are some substances which emit waves of one or but few lengths, while others present them in more frequent variety, it next appeared interesting to solve the problem how bodies behave with reference to reflective power; whether, in bodies which act similarly upon light, differences parallel to those which are observed in respect of the absorption and transmission of heat do not also occur in its reflection.

Differences in reflective power are unmistakably apparent only when rays are reflected which have a uniform, or but slightly varying, length. Such rays have already been derived either from a section of the spectrum furnished by a rock-salt prism, or by transmitting the rays from a source of heat of many wave-lengths through substances which absorb a number of them. There are, however, but very few bodies that transmit rays of only one or a few wave-lengths; moreover, such rays, obtained by either method, have a very low intensity.

In spite of this difficulty, MM. de la Provostaye and Desains showed, as early as 1849, that different quantities of the heat from a Locatelli's lamp were reflected from speculum metal, silver and platinum, according as it had been conducted through glass or rock-salt; and, for reflecting surfaces of all kinds, less in the case of glass than in that of rock-salt.

Soon afterwards, by an extended series of experiments, and employing the prismatically dispersed heat of a lamp, it was proved by the same physicists that heat from the different portions of the spectrum is differently reflected. But, doubtless in consequence of the low intensity of the incident heat, their researches had reference solely to reflection by means of metallic surfaces. Now, if in rock-salt we possess a substance that emits waves of only one or but few lengths, and are acquainted with other bodies which, at 150°, also radiate but a few kinds, researches can be instituted on reflection at non-metallic surfaces. It has thus appeared that the different kinds of heat or wave-lengths are reflected from such surfaces in very different proportions. One of the most striking examples may here be adduced: it refers to the reflective power of fluor-spar.

Of the heat radiated by a great variety of substances, unequal (though but slightly differing) amounts were reflected at an angle of 45°; being in the case of—

Silver	between 83 and 90 per cent.	
Glass	,, 6 ,, 14 ,,	
Rock-salt	,, 5 ,, 12 ,,	
Fluor-spar	,, 6 ,, 10 ,,	

But of the heat from rock-salt, fluor-spar reflected 28 to 30 per cent., whereas silver, glass, and rock-salt returned no more of this heat than in the preceding cases.

Here, too, it was evident, as in the experiments on thermic transmission, that sylvine emits, besides a large quantity of the rock-salt kind, species of heat of another nature. Fluor-spar reflects 15 to 17 per cent. of the heat from sylvine; less, consequently, than that from rock-salt, and more than that from the other radiating bodies.

Granted an eye that could distinguish different wave-lengths of heat in the same manner as wave-lengths of light, and when the waves from rock-salt are incident upon different bodies, fluor-spar will appear to it brighter than any. If the rays are derived from sylvine, fluor-spar would seem still brighter than all the above bodies, but not so bright as when submitted to the rock-salt rays.

Melloni has shown that different substances transmit heat in very unequal proportions, and that the source of heat has a marked influence on the facility of transmission. Still, the sources of heat were only distinguished by degree; it was merely recognised that an increased temperature corresponds to increased variability of wave length. It now appears that at one and the same temperature, and *that*—viz., 150°—far below incandescence, different substances emit very different kinds of heat, and that, within such a range, an extraordinarily large number of different heat-rays or wave-lengths continually intermingle. This manifold intermixture is particularly furthered by the selective reflection taking place at the different surfaces.

It follows from what has been said that an eye capable of discerning the different wave-lengths of heat, as it can now discriminate the colours of light, would perceive, with very little warmth to itself, every possible variety of tint in surrounding objects.

PHYSIOLOGY

Pettenkofer on Cholera

Nearly the whole of the second part of the Zeitschrift für Biologie, bd. v. (300 pages), is taken up by a long memoir by Prof. Von Pettenkofer on "Soil and Sock-water in their

Relations to Cholera and Typhus" (Boden und Grundwasser in ihren Beziehungen zu Cholera und Typhus) in which he developes at length his views. To many these are probably now well known, but still, it may be perhaps as well to state that they are somewhat as follows.

The phenomena of Cholera result from the introduction into the animal system of a cholera poison, which is possibly an organic being, and which we may call *z*. Now, *z* is non-reproductive; does not of itself multiply or spread. But there is another distinct thing, the cholera germ (originating in India), which we may call *x*. *x* of itself will not produce cholera symptoms. It may remain, and probably may multiply in the human body, and be carried in or on the body from place to place without *of itself* producing cholera. Cholera symptoms can only be brought about by *z*, and *x* can only give rise to cholera, indirectly, by generating *z*. But *x*, in order that it may generate *z*, must come in contact with and act upon another substance, which we may call *y*. That is, *x* cannot germinate into *z* unless it meets with the substratum *y*; or we may use the idea, thrown out we believe by Dr. Farr, and imagine *x* and *y* to be the male and female parents of the offspring *z*, which is either sterile, or can only reproduce *x*.

Thus, then, *x* originating at certain times in India, and meeting with *y* at once gives rise to *z*, and an outbreak of cholera is the result. The quantity of *z* is probably more than sufficient to account for all the cases that occur; the surplus may even perhaps be carried about, and so spread the epidemic; but there being no reproduction of *z*, the stock would soon be exhausted. With *z*, however, a quantity of *x* is also carried about, more particularly by the excrement; *x*, in fact, clings to its products just as yeast cells cling to a fermented liquid. And whenever *x* meets with fresh *y*, it generates fresh *z*; and so the epidemic travels on, *x* making itself felt by *z* whenever it falls upon a store of *y*. For the existence of *y*, certain things are necessary, to wit:—

1. A soil which, like alluvium, is permeable to air and water for several feet deep.
2. A rise and fall of sock-water. A soil which is permanently dry, or one which is always filled with sock-water, are equally unfavourable for the development of *y*. The change of level of water is absolutely necessary.
3. The presence of organic and mineral matters on which the variations in the amount of sock-water may act, and out of them produce *y*.
4. A temperature suitable for such processes of organic evolution.

All these points and many others are fully discussed in a series of chapters with such headings as "Porous and Compact Soils"; "The Soil and the Immunity of Wirzburg"; "Influence of drinking Water on Cholera epidemics"; "Considerations on the Cholera epidemic of 1866 in East London, in reference to Soil and Sock-water conditions"; "Apparent evidences against the 'Soil and Water theory' and for the theory of 'Contact and Idiosyncrasy,'" &c. &c. It concludes with a series of aphorisms, "On the Origin and Spread of Cholera"; "On the Influence of Variations in Sock-level on the Enteric Fever of Munich"; and, "On the Causes of the Immunity of Lyons."

SOCIETIES AND ACADEMIES.

Zoological Society.—The first scientific meeting for the session will be held on Thursday the 11th inst., when Prof. Flower, F.R.S., will read a paper on the Anatomy of the Aard-Wolf (*Proteles cristatus*). The following communications have been received since the last meeting:—Dr. J. Anderson: Letter received from, describing a living specimen of the Pigmy hog of Terai (*Porcula salvania*).—Mr. P. L. Sclater: Remarks on the condition of various Zoological Gardens on the Continent recently visited by him, and on new and rare animals observed in those establishments.—Dr. B. Simpson. Notes on *Ailurus fulgens*.—Mr. John Brazier: Note on the Egg of a species of *Megapodius* from Bank's Islands.—Surgeon Francis Day: Remarks on fishes in Calcutta Museum.—Mr. John Brazier: Notes on the Localities of two Species of Land-Shells.—Mr. R. B. Sharpe: Additional Notes on the genus *Ceyx*.—Dr. George Bennett: Letter received from, on the habits of the Wood Hen of Lord Howe's Island.—Dr. J. E. Gray: On the Guemul or Roe Buck from Tinta, South Peru.—Dr. A. Günther: Report on two collections of Indian Reptiles.—Mr. Morton Allport: Letter received from, on the introduction of Salmon into the Australian Colonies.—Rev. O. P. Cambridge: Notes on some Spiders and Scorpions from St. Helena, with descriptions of new species.—The Secretary: On additions to the Menagerie during June, July, August, and September.—Mr. W. T. Fraser: Letter received from, respecting the Existence of the Rhinoceros in Borneo.

MANCHESTER.

Literary and Philosophical Society, October.—Mr. E. W. Binney, F.R.S. in the Chair. The following extract of a letter from Dr. Joule, F.R.S., dated Southport, October 5th, 1869, and addressed to the Chairman, was read:—"I enclose a rough drawing of the appearance of the setting sun. Mr. Baxendell noticed the fact that at the moment of the departure of the sun below the horizon, the last glimpse is coloured bluish green. On two or three occasions I have noticed this, and also near sunset that just at the upper edge, where bands of the sun's disk are separated one after the other by refraction, each band becomes coloured blue just before it vanishes."

PARIS.

Academy of Sciences, October 25.—M. L. Pasteur communicated a note relative to the dispute which has arisen between him and M. Thenard on the subject of his patented process for preserving wines by the application of heat. A paper was read by M. Phillips on the Movement of similar solid Elastic Bodies, supplementary to a memoir on the equilibrium of such bodies, read in January last.

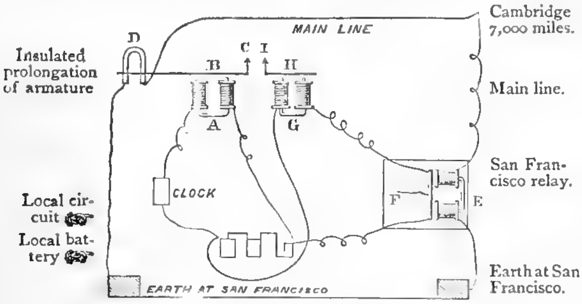
A memoir on the fundamental Equations of the mechanical theory of Heat, by M. F. Reech, was presented by M. Regnault. In a note on the illumination of transparent bodies by polarised Light, M. A. Lallemand described some new experiments with transparent solids. On passing a ray of polarised light horizontally through a polished cube of glass in a direction perpendicular to two of its faces, the maximum of illumination is horizontal, the light emitted is white, is entirely polarised in a horizontal plane, and gives the principal lines of the solar spectrum. When viewed vertically, the illumination is nil, unless the glass be fluorescent. The light observed in a vertical direction in the latter case is more or less coloured, is neutral to the polariscope, and gives none of the lines of the solar spectrum. The author noticed the behaviour of various other substances, such as crystal, fluor spar, Iceland spar, &c., M. Dumas communicated a letter from M. P. Volpicelli on the Heat of the Lunar Radiation containing an historical sketch of the researches upon this subject, and showing that both Melloni and Herschel have demonstrated the calorific action of the Moon. M. H. Marie Davy, whose previous statement (September 20, 1869) that the calorific effects of the Moon's rays were inappreciable called forth M. Volpicelli's remarks, now communicated a note on the Calorific Power of the Lunar Rays, in which, after noticing that Melloni was the first to demonstrate the existence of such a power, and that his results had been confirmed by Prof. Piazzi Smyth; he goes on to describe his own recent experiments, in which, by the employment of the thermo-electric pile, he has been able to obtain a series of results perfectly confirmatory of those of his predecessors. He found that the heat furnished by the moon is quite appreciable, and that its amount increases rapidly as it advances towards the full. M. C. Dareste communicated a memoir on the notion of Type in Teratology, and on the distribution of monstrous type in the division of vertebrate animals; the argument of which is, that the type of monstrosities is correlated with the type of organisation, so that if uniformity of type occurs in monstrosities throughout any wide range in all classes of the vertebrata, for example, the origin of such monstrosities dates from a very early period of embryonic development, and the more limited the range of a monstrosity, the later in the life of the embryo will be its origin. A paper was read by M. P. P. Dehérain on the influence exerted by different luminous rays upon the decomposition of carbonic acid and the evaporation of water by leaves. The author states that, with equal intensity, the yellow and red rays act more energetically than the blue and violet rays, both in producing evaporation, and in causing the decomposition of carbonic acid; in the latter respect he found that the leaves of *Potamogeton crispus* emitted 26·2 cub. cent. of gas under yellow light; they gave off only 5·8 cub. cent. in the same time under blue rays of equal intensity. M. E. Decaisne communicated some remarks on the various conditions of the production of goître; M. Landrin, a note on the physiological action of Chloral; M. Jaliwski, an account of a process for bronzing iron; M. Delaurier, a note on the manufacture of manganate of calcium, and M. Mehay, a note on the Infinitesimal Calculus.

PHILADELPHIA.

American Philosophical Society.—We select the following extracts from the reports of the recent meetings of this Society :—

Prof. Trego has communicated an extract from a letter from Mr. Davidson of the Coast Survey, to Mr. D. B. Smith of Germantown, detailing the method employed to obtain the recent determination of longitude and the velocity of the electric current between Cambridge and San Francisco.

"I give you the first written news not only of our telegraph longitude success, but of the success of my plan for determining the *time of transmission of clock signals from my clock to Cambridge and back*, over 7,000 miles of wire, through 13 repeaters and a multitude of relays. Through the liberality of the Western Union Telegraph Company, I had two trans-continental lines placed at my use, and last night I succeeded beautifully. My circuit was as follows. My clock breaks the local circuit every second, depriving the helix A of its electricity, and the magnet of its magnetism. This relieves the armature B, which is drawn away by a spring, and the pen C makes its record on the revolving cylinders of the chronograph. At the same instant the main current to Cambridge and back is broken by the insulated prolongation of the armature at D, and the break transmitted to Cambridge and back, through 7,000 miles of



C. Sending pen. I. Receiving pen.

SAN FRANCISCO CHRONOGRAPH.

wire, to my relay E, which relieves the armature F, and the local circuit is broken ; the helix G deprived of its electricity and the magnet of its magnetism, relieving the armature H, which is drawn away by a spring, and the pen I makes the record on the revolving cylinders of the chronograph. These two pens are on the same horizontal line. Our experiments show that it took 0·87 of a second to traverse the above circuit. I also made experiments through to Buffalo, Chicago, Omaha, Cheyenne, Salt Lake, and Virginia, and back. All successful. As this experiment was not contemplated by the programme of the longitude experiments, I have the satisfaction of seeing my ingenuity successfully proved."

Prof. Kirkwood has communicated through Mr. Chase a discussion of the periodicity of the Sun's spots. We shall return to this communication.

Mr. Dubois presented a specimen and analysis of silver ore, accompanied with the following note from the Assay Office, United States Mint :—

"In the Report of the British Commission on International Coinage, lately published, we find an extract from the *Journal des Debats*, of November 13, 1866, stating that the German assayers had found the average fineness of French gold coins of that year to be 898 thousandths, and a fraction. It adds that this is an unworthy source of gain to Government, whose ambition it should be to have the coins *correct*. The *Moniteur* of November 20 (official organ) replies, that this is as near to standard as can be expected from the defects of practical operation; and that it is the duty of Government to prevent these 'ill-founded criticisms.' Our own assays, for many years, have proved a deficiency in the French coins, averaging about one-thousandth. The apology of the *Moniteur* has no just foundation. Both at this Mint, and at San Francisco, the gold coins are kept close to the mark, scarcely varying the tenth of a thousandth ; as is proved by annual assays, and by foreign reports. British coinage is equally exact.

"This fact affords an argument against the project of International Coinage. If we work to 900, and France to 899 or less, and both pass alike, the difference is against us."

DIARY.

THURSDAY, NOVEMBER 4.

LINNEAN SOCIETY, at 8.—On some Brazilian Plants from the neighbourhood of the Campinas : J. Correa de Mello. On two Indian Plants : N. Dalzell. On the Occurrence of a Luminous Insect near Buenos Ayres : R. Trimen.

CHEMICAL SOCIETY, at 8.—Discussion on Dr. Williamson's Discourse on the Atomic Theory.

FRIDAY, NOVEMBER 5.

GEOLOGISTS' ASSOCIATION, at 8.—Comparative Anatomy as applied to Geology : Dr. C. Carter Blake, F.G.S.

MONDAY, NOVEMBER 8.

LONDON INSTITUTION, at 4.—Elementary Physics : Prof. Guthrie.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—President's Address. Journey to the Yellow River : Mr. Elias.

TUESDAY, NOVEMBER 9.

ETHNOLOGICAL SOCIETY, at 8.—On the Chinese Race ; their Language, Government, Social Institutions, and Religion : Mr. Gardner.

WEDNESDAY, NOVEMBER 10.

GEOLOGICAL SOCIETY, at 8.—Australian Mesozoic Geology and Palæontology : C. Moore, F.G.S. On some Plant and Insect-beds in New South Wales : C. Moore, F.G.S. Further Evidence of the Affinity between Dinosauria and Birds : Prof. Huxley, F.R.S. On the Dinosauria of the Trias, with observations on the Classification of the Dinosauria : Prof. Huxley, F.R.S.

ROYAL MICROSCOPIC SOCIETY, at 8.—On High Power Definition, with Illustrative Examples : Dr. G. W. Royston Pigott, F.R.A.S. On the Structure of the Scales of certain Insects of the Order *Thysanura* : S. J. McIntire.

THURSDAY, NOVEMBER 11.

LONDON INSTITUTION, at 7.30. — On Architecture, or the Fine Art of Building : Prof. Robert Kerr.

ZOOLOGICAL SOCIETY, at 8.—On the Anatomy of the Aard-Wolf (*Proteles cristatus* : Prof. Flower, F.R.S.

LONDON MATHEMATICAL SOCIETY, at 8.—General Meeting at Burlington House.

BOOKS RECEIVED.

ENGLISH.—Chemistry : Prof. Attfield (Van Voorst).—Scenery of England and Wales ; D. Mackintosh, F.G.S. (Longmans).—Practical Chemistry : Harcourt and Madan (Clarendon Press).—The Three Kingdoms of Nature : R. S. Haughton (Cassell).—Flora of Middlesex : Trimen and Dyer (Hardwicke).—Natural Philosophy in Easy Lessons : John Tyndall (Cassell).—Vegetable Physiology : Dr. Lankester (Cassell). — Our Bodies : E. A. Davidson (Cassell).—Scientific Chemistry : F. S. Barff (Groombridge).—Science of Heat : T. A. Orme (Groombridge).—Mechanical Philosophy : R. Wormell (Groombridge).—How Crops Grow (Macmillan).—Travels in Central Africa : Mr. and Mrs. Petherick (Tinsley).—New Tracks in North America : W. A. Bell (Chapman and Hall).—Intelligence of Animals : E. Menault (Cassell).—Picture Natural History (Cassell).—Gold Fields and Mineral Districts of Victoria : R. Brough Smyth (Trübner and Co.).—The World of the Sea : A. Frédol (Cassell).—Prehistoric Times : Sir John Lubbock, Bart. (Williams and Norgate).—De la Rue and Co.'s Red Letter Diaries for 1870. —Natural History of British Moths : E. Newman (Tweedie).

AMERICAN. — The Mississippi Valley : J. W. Foster. — Production of Precious Metals : W. P. Blake.—Parsons on the Rose.—System of Mineralogy : Dana and Brush.—Guide to the Study of Insects : A. S. Packard. (Through Trübner and Co.)

FOREIGN.—Echinides : Cotteau et Triger (with atlas).—Ueber Batrachier : Keferstein.—Protozoe Helvetica : W. A. and C. von F. Ooster.—Die Elliptischen Functionen : Hattendorff.—Lecons de Chimie : Alfred Riche.—Der Cultur-Ingenieur : vol. ii. part 2.—Die Chinacultur auf Java : van Gorkom.—Handbuch der Edelsteinkunde : Schrauf.—Die internationale Einigung durch das metrische System : C. Bopp.—Landwirthschaftliche Zoologie : Giebel. —Bibliothèque des Sciences naturelles (Zoologie) : Gervais et Sauvage.—Erratische Bildungen im Aargau : Mühlberg.—Bergbaukunde (2 vols.) : Lottner (posthumous).—Zur Kenntniss der Bryozoen : Nitsche.—Vierteljahrsschrift für öffentliche Gesundheitspflege : vol. i. part 3.—Dictionnaire technologique : Kumpf et Mothes (vols. i. iii). (Through Williams and Norgate : Asher and Co.).

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

*" To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH

No. 2] THURSDAY, NOVEMBER 11, 1869

Registered for Transmission Abroad.]

THURSDAY, NOVEMBER 11, 1869.

THE DULNESS OF SCIENCE

WE have all heard of the fox who, when he had lost his own tail, tried to prevail upon his comrades to dispense with theirs; and we think it must surely have been in a congress of the blind that the question was first started, "Is it dull to use your eyes and look about you?"

For, in fact, what is science but this? We come unexpectedly into a great mansion, of which we know nothing; and if it be dull to seek out the various inmates of the house, and to ascertain its laws and regulations, then is science dull; but if this be important and interesting, then so also is science interesting.

But, alas! the blind in this sense are numbered by myriads; and as they, for a time, almost threaten to carry their point, a few remarks upon the dulness of science, or rather, perhaps, the dulness of men, may not be out of place.

We have in our mind's eye at the present moment several notable specimens of blind men. One of these lives not very far from where we write—a most hopeless individual; we had better not inquire too narrowly concerning his occupation; he will be found somewhere in the purlieus of this great city. His one sense is the sense of gain. We remember once seeing through a microscope the animalcules of a drop of water, and we noticed that one of the largest of these had one end fixed to the side of the vessel, while its arms and mouth were busy gathering up and swallowing its smaller neighbours. Now, the man of whom we speak is only this animalcule magnified without the microscope. Ignorant of all laws, civil, religious, physical, moral, social, sanatory, he rots in his place until Dame Nature, in one of her clearing-out days, fetches at him with her besom the plague; and he is swept aside and seen no more.

Our country readers are no doubt well acquainted with Farmer Hodge. One day he happened to sit next the poet Coleridge, listening, with that reverence for his betters to which he had been early trained, to the marvellous sayings of the great man, and it was only when the apple dumpling made its appearance that he exclaimed, "Them's the jockeys for me!" Hodge, we fear, maintains no sort of relations with the universe around him. He farms in the same way in which his grandfather did, and has the most profound aversion for the steam plough.

He told Tennyson—

"But summun' ull come ater meä mayhap wi' 'is kittle o' steäm,
Huzzin' an' maäzin the blessed feälds wi' the Divil's oän teäm.
Gin I mun doy I mun doy, an' loife they says, is sweet;
But gin I mun doy I mun doy, for I couldn abear to see it."

Nevertheless, Hodge has some sense of his duty to his neighbour. Indeed, we learn from D'Arcy Thompson, that being once asked What is thy duty towards thy neighbour? he wrote as follows upon a slate:—

"My duty tords my nabers, is to love him as thyself, and to do to all men as I wed thou shall do and to me, to love, onner and suke my farther and mother, to onner and to bay the Queen, and all that are pet in a forty under her, to smit myself to all my gooness, teaches, sportial pastures and marsters, to oughten myself lordly and every to all my betters, to hut nobody by would nor deed, to be trew in jest in all my deelins, to beer no malis nor ated in yours arts, to kep my hands from pecken and steel, my turn from evil speaking, lawing and slanders, not to civet nor desar othermans good, but to laber trewly to git my own leaving, and to my dooty in that state if life, and to each it is please God to call men."

Ascending in the scale, we come next to our friend "Cui Bono;" a very good sort of man, very fussy, very philanthropic, and very short-sighted,—in fact, he sees nothing distinctly that is more than one inch from his face. He called upon us the other day to give us a little good advice: it was about the time when our astronomers were investigating the chromosphere of the sun. "What," he asked, "is the use of all this? will it put one penny in your pocket or mine? will it help to feed, or clothe, or educate your family or mine? Take my advice, sir, and have nothing to do with it." We did not reply to him; indeed we learned afterwards that he had just written an article on the subject in one of the journals. Next day he called upon us in a state of high jubilation; he had just seen a friend of his who had succeeded in making a useful application of some great discovery, which, being within the requisite *inch*, was clearly perceived by "Cui Bono"—"A very useful and practical discovery, sir, which will greatly alleviate human suffering; none of your hydrogen-in-the-sun business." And so the successful adapter got all the praise, while the wretched man of science who discovered the principle was left out in the cold.

Still ascending in the scale, we come to a man of strong mental eyesight, but without leisure to use it; one that it makes us grieve to see, inasmuch as he is capable of far better things. His ears are not altogether stopped to the mighty utterance that all nature gives, nor yet is he wholly ignorant, when at night he looks upwards, of that which the firmament declares; but its utterance is drowned in the tumult of a great city, while its starlight is quenched in the smoke. Our sentiment for such a man is that of pity; for indeed, what with the cares of this world and the deceitfulness of riches, he has a hard battle to fight.

But is it not melancholy to reflect how great a proportion of the energy of this country is devoted to the acquisition of gain, and how small a proportion to the acquisition of knowledge?

We have now arrived at the ranks of the affluent and the nobly-born, where, if anywhere, we might expect to find "tastes refined by reading and study, and judgments matured by observation and experience;" but how seldom is this the case? The mental eyesight is often weak to begin with, and often is it rendered still weaker by poring over classics without end. The unfortunate youth is then sent to make the tour of Europe. He is sent to Switzerland and the Alps to see all that is grand in nature, and to Rome and Paris to see all that is great in art, and he comes home wretched and disgusted, and no wonder. He has been made the unfortunate subject of a senseless experiment—an experiment much the same as that of turning a man with weak eyes into a picture gallery in order to improve them. His friends forget that appreciation of the beautiful and the true is the product of the coming together of two things—eyesight and nature. In fact, the result is much the same, whether a man with no eyes is carried out into a glorious landscape, or whether a man with good eyes is shut up in a dark room.

It is of this the poet speaks, when he says :—

" O Lady ! we receive but what we give,
And in our life alone does Nature live ;
Ours is her wedding-garment, ours her shroud !
And would we aught behold of higher worth,
Than that inanimate cold world allow'd
To the poor, loveless, ever-anxious crowd,—
Ah ! from the soul itself must issue forth
A light, a glory, a fair luminous cloud
Enveloping the earth ;
And from the soul itself must there be sent
A sweet and potent voice, of its own birth,
Of all sweet sounds the life and element !"

But let us hasten to our friend Philosophus, who is a man of quite a different mould. Once, when he was young, his tutor said to him, " Have the goodness, sir, to solve the following problem : 'A hemispherical bowl is filled with a heavy fluid, the density of which varies as the *n*th power of the depth below the surface ; find the whole pressure and the resultant pressure on the semi-lune of the surface contained between two vertical planes passing through the centre of the bowl, and making with each other an angle 2β.'" But Philosophus thrust the paper violently aside, saying " I will have none of that," and in fact was extremely rude. You may be sure, therefore, that when he came to be a man he had a mind of his own, and carried out his own ideas. He told us lately that he had been studying the laws of energy. It is a mistake, he said, to suppose that these laws are difficult of comprehension ; they are merely remote from our ordinary conceptions, and must be patiently pursued until you grasp them. He had studied them, he said, at all times and on all occasions—in the railway carriage, on the thoroughfare, in the study, on his bed, in the night watches ; and now that he had come to perceive their exceeding grandeur, and beauty, and simplicity, they were a source of great and continual joy to him, and recompensed him more than a thousandfold for all the trouble he had taken. Philosophus lately told us certain truths which may, perhaps, be of service to the readers of NATURE. He said that, not far from London, there was a place where the spirits and understandings of men were annually ground to pieces in a huge machine made of the very best metal ; ay, such is its temper, said he, that were it only made into good broadswords, it might enable us to cleave our way to the very heart of the universe. Again, he said : " No doubt the dulness of science is a cry of the blind ; nevertheless, men of science are much to blame. It is their sense of beauty that leads them to Truth, whom they discover by means of the glorious garments which she wears. But she is immediately stripped of these, and dressed in an antiquated mediæval garb, worse than that of any charity-school girl, and equal to that of any Guy Faux : no wonder that in such guise her beauty is unperceived by those who cannot pierce the veil, and that as a consequence she is slightly esteemed."

There was another thing he told us—a thing of the highest importance. " The priests of Science," he said, " must consent to use the vernacular, before they will ever make a profound impression upon the heart of humanity ; and when they have learned to do this, let them not fear the sneers of their deacons who will call their teaching sensational.

F. R. S.

THE ATOMIC CONTROVERSY

IT is one of the most remarkable circumstances in the history of men, that they should in all times have sought the solution of human problems in the heavens rather than upon the earth. Sixty years ago a memorable instance of this truth occurred when Dalton borrowed from the stars an explanation of the fundamental phenomena of chemical combination. Carbon and oxygen unite in a certain proportion to form "carbonic acid ;" and this proportion is found to be invariable, no matter from what source the compound may have been prepared. But carbon and oxygen form one other combination, namely, "carbonic oxide"—the gas whose delicate blue flame we often see in our fires. Carbonic oxide may be obtained from many sources ; but, like carbonic acid, its composition is always exactly the same. These two bodies, then, illustrate the law of *Definite* Proportions. But Dalton went a step further. He found that, for the same weight of carbon, the amount of oxygen in " carbonic acid " was *double* that which exists in carbonic oxide. Several similar instances were found of two elements forming compounds in which, while the weight of the one remained constant, the other doubled, trebled, or quadrupled itself. Hence the law of *Multiple* Proportions. The question was—in fact, the question is—how to account for these laws. Dalton soon persuaded himself that matter was made up of very small particles or *minima naturæ*, not by any possibility to be reduced to a smaller magnitude. Matter could not be divisible without limit ; there must be a barrier somewhere. No doubt, as a chemist, he would have rejected the famous couplet—

Big fleas have little fleas, upon their backs, to bite 'em ;
And little fleas have smaller fleas, and so *ad infinitum.*

" Let the divisions be ever so minute," he said, " the number of particles must be finite ; just as in a given space of the universe, the number of stars and planets cannot be infinite. We might as well attempt to introduce a new planet into the solar system, or to annihilate one already in existence, as to create or destroy a particle of hydrogen." All substances, then, are composed of atoms ; and these attract each other, but at the same time keep their distance, just as is the case with the heavenly bodies. The atoms of one compound do not resemble those of another in weight, or size, or mutually gravitating power. But as they are indivisible, it is between them that we must conceive all chemical action to take place ; and an atom of any particular kind must always have the same weight. The atom of carbon weighs 5 ; the atom of oxygen weighs 7. Carbonic oxide, containing one of each must therefore be invariably constituted of 5 carbon, and 7 oxygen : carbonic acid must in like manner contain 5 carbon, and 14 oxygen. Here, then, Dalton not only states that he has accounted for the two laws we have mentioned by making a single assumption ; but he evidently intends his theory to be used as a criterion or control in all future analytical results, and already views it as the birth-place of chemical enterprise.

Such, and so great, was the atomic theory of Dalton ; founded, certainly, on erroneous numbers, but containing in itself the germ of their correction ; aspiring to the command in innumerable conquests ; and setting itself for the rise or fall of the chemical spirit.

It is hardly necessary to make any detailed review of the history of the atomic theory. Berzelius made it a starting-point for researches which, on the whole, have been unsurpassed in their practical importance, and engrafted upon it his celebrated electrical doctrine. Davy and Faraday refused to admit it; Laurent and Gerhardt accepted it doubtfully, or in a much modified form. Henry declared that it did not rest on an inductive basis. There can be no doubt, however, that the atomic theory has been accepted by the majority of chemists, as may be seen on even a cursory inspection of the current literature of their science. Our present intention is to give such a summary of the atomic question as may be serviceable to those who take an interest in the discussion at the Chemical Society on Thursday last.

The modern supporters of the atomic theory agree with Dalton in the fundamental suppositions we have given above; but assert that they have a much stronger case. The phenomena of gaseous combination and specific heat have indeed changed the numerical aspect of the theory, but not its substance. The simplicity of all the results we have accumulated with respect to combining proportions is itself a great argument for the existence of atoms. They all, for example, have the same capacity for heat; they all, when in the gaseous state, have a volume which is an even multiple of that of one part by weight of hydrogen. But bodies in the free or uncombined state—such, in fact, as we *see* them—more commonly consist of many clusters of atoms (*molecules*) than of simple atoms. These molecules are determined by the fact that when in the gaseous state they all have the same volume. Again, select a series of chemical equations, in which water is formed, and eliminate between them so as to obtain the smallest proportion of water, taking part in the transformations they represent. It will be found that the number is 18; which necessarily involves the supposition that the oxygen (16) in water (18) is an indivisible quantity. To put this last point another way: hydrochloric acid, if treated with soda, no matter in what amount, only forms one compound (common salt). Now we know that the action in this case consists in the exchange of hydrogen for sodium. But if hydrogen were infinitely divisible, we ought to be able to effect an inexhaustible number of such exchanges, and produce an interminable variety of compounds of hydrogen, sodium, and chlorine; hydrochloric acid being the limit on the one side, and common salt (sodic chloride) terminating the other. No such phenomenon occurs; and, since matter must be infinitely or finitely divisible, and has been thus proved not to be the former, it must be the latter. Atoms, therefore, really exist; and chemical combination is inconsistent with any other supposition. Those who hold the contrary opinion are bound to produce an alternative theory, which shall explain the facts in some better way.

Now let us hear the plaintiff in reply.

The atomic theory has undoubtedly been of great service to science, since the laws of definite and multiple proportions would probably not have received the attention they deserve, but for being stated in terms of that theory. Yet we must discriminate between these laws, which are the simple expression of experimental facts, and the assumption of atoms, which preceded them historically, and therefore has no necessary connection with them. For it was the Greek atomic theory which Dalton revived. Nor has any substance yet been produced by the atomists, which we cannot find means to divide. If, moreover, we have no alternative but to admit the infinite divisibility of matter, even that is consistent with the simple ratios in which bodies combine; for two or more infinites may have a finite ratio. Therefore, the observed simplicity, if used as an argument, cuts both ways. Possibly we are mistaken in connecting the ideas of matter and division at all; at any rate, the connection has never been justified by the opposite side. Again, admitting the argument based on the formation of common salt, the atomic theory does not tell us why only one third of the hydrogen in tartaric acid can be exchanged for sodium; why, indeed, only a fraction of the hydrogen in most organic substances can be so exchanged. Yet, the explanation of the one fact, when discovered, will evidently include that of the other. On the whole, it appears that the atomic theory demands from us a belief in the existence of a limit to division. No such limit has been exhibited to our senses; and the facts themselves do not raise the idea of a limit, which Dalton really borrowed from philosophy. The apparent simplicity of chemical union we do not profess to explain, but to be waiting for any experimental interpretation that may arise. The atomists, in bringing forward their theory, are bound to establish it, and with them lies the *onus probandi*.

The above are a few broad outlines of the existing aspect of the atomic controversy, and may somewhat assist in forming an estimate of it. The general theoretical tone of the discussion last Thursday must have surprised most who were present. Our own position is necessarily an impartial one; but it will probably be agreed that between the contending parties there is a gulf, deeper and wider than at first appears, and perhaps unprovided with a bridge.

LECTURES TO LADIES.

WHAT is the meaning of the present stir about the "Higher Education of Women"? We have before us announcements of courses of lectures intended to be given during the coming winter to the ladies of Edinburgh, London, Glasgow, Manchester, and Bradford; and we believe that similar courses are to be delivered in several other towns. The organisations under whose auspices these lectures are to be delivered, seem all of them to have come into existence at nearly the same time. Edinburgh and Professor Masson, so far as we know, have the credit of having taken the lead in the movement; but this was only two winters ago, and none of the towns we have named were more than one year behind.

What is the cause of this sudden and wide-spread demand on the part of our countrywomen for access to a different and, presumably, a higher kind of intellectual culture than has hitherto been within their reach? Or rather, first of all, is the apparent demand a real one? Is it such as to indicate that a real step has been taken, or is likely soon to be taken, towards an improved method and a higher standard of female education in England? Or is it more reasonable to suppose that the interest now manifested in the subject will disappear in the same proportion as the novelty of it? For our own part,—after making what seems full allowance for the influence which the love of novelty, and the liking to do as other people are doing, have no doubt exerted in gaining for these "Ladies' Lectures" greater popularity, and a larger share of public attention than they would otherwise have obtained,—we believe that their rapid spread, and the success which has so far attended them, are mainly due to a serious effort on the part of the women of this country to improve their intellectual condition, coupled with the conviction of the inefficiency of the facilities for mental culture that have been hitherto open to them.

An explanation of the appearance just now of such efforts and convictions must be sought for among those facts of our present social condition which are making the Woman's Question in all its aspects one of the foremost problems of the time. It is obvious enough what some of these facts are, but we should have little confidence in an attempt to enumerate them all, and to estimate exactly their relative importance. But without undertaking to explain fully the movement under discussion, we think there are evident signs that it is a natural and spontaneous outcome of existing social and intellectual conditions, and not the result of artificial stimulus. If this view is correct, it is obvious that the importance of the movement must be judged of rather by what it indicates than by what it is,—by future results that may be hoped for, rather than by successes already achieved. Looked at in this way, it claims the serious attention and support of every one who desires the intellectual advance of the community, in order that the present opportunity may be turned to advantage, and that efficient plans of future action may be founded on the experiments now being tried with more or less of what must necessarily be temporary enthusiasm.

We venture to assume that in this, as in most other cases, the first condition of permanent success is that the object aimed at should be one in which it is worth while to succeed. If both lecturers and students are in earnest in trying to make these lectures really educational and serious, they cannot fail of producing valuable results. But this will require a good deal of determination on both sides. The most obvious, and perhaps the most serious, danger besetting the teachers, is the temptation—arising from an unconscious want of respect for their audience—to make their lectures *interesting*, instead of trying to impart the greatest possible amount of solid instruction. We confess that one or two very attractive-looking programmes that we have seen have suggested the thought, that possibly the lectures they announced might be equally well described as essays, such as constitute the more thoughtful kind of magazine articles; and that, if this were the case, it was not obvious what greater advantage would arise from their author reading them aloud to an assemblage of ladies than would result if the same ladies could be induced to read them to themselves at home.

But, though we have no reason to believe that such a criticism would be really applicable to any of the actual courses, it is none the less desirable that all concerned should be on their guard against the tendency for it to become so. Thorough teaching, and not entertainment, of however high a kind, is what we trust that every lecturer will strive to give, and every student to obtain. And, after all, the spirit and quality of these lectures will depend as much on the students as on the teachers. No doubt a thoroughly earnest teacher may do a good deal towards producing earnest pupils; but, in the long run, the kind of instruction given will be that for which there is a demand. Ladies who intend to join any of the classes now forming will not expect to get any benefit from them, unless they give up for them all other engagements, at least so far as to be able to attend with regularity. If they only go to the lectures when in want of other occupation, they had better not go at all. Moreover, we have not much faith in the educational value,—at any rate for residents in London,—of courses in which only one lecture is given in a week. There are few persons who can keep up any vivid interest in a subject which occupies their thoughts for only one hour a week; and we imagine that ladies, who are unwilling to spare the time for two lectures a week on a subject which they wish to study, will scarcely be found among the number.

In conclusion, we may remind our readers of two sets of lectures to ladies which begin this week in London: one of them at the South Kensington Museum, and the other, by Professors of University College, partly at St. George's Hall, Langham Place, and partly at University College. We heartily wish success to them all, and urge all our readers to do what they can to promote it.

GEOLOGY AND AGRICULTURE

WHEN man penetrated into Western Europe and Britain, he found the country clothed with dense forests interspersed with fresh-water lakes, peat-mosses, and bogs, relieved by few open glades, heaths, or moors. The native rocks could only be seen here and there, in crags and escarpments, sea-cliffs, river-banks, or mountain-heights; whilst herds of wild cattle, deer, and lesser game occupied the country, and afforded food to numerous beasts of prey.

In such a country, at first thinly populated, man could subsist by the chase alone, and a long period elapsed ere he added, first the horned sheep, and then the *Bos longifrons*, to his earliest domesticated animal, the dog, and thus entered on the pastoral stage of his existence.

The shepherd's life, however, although a great step in advance of that of the hunter, necessitates wandering from one point to another in search of fresh pasturage or water. The early shepherd was a nomad, while agriculture proper necessarily dates from the period of fixed residence; for, even admitting that early man might clear for himself—if not with his axe of stone, at least by the aid of fire—a tract of land suited for the growth of cereals, yet he would hardly toil for even such scanty return as he could gather from his little patch of corn, unless he had some kind of fixed habitation, and a recognised right of occupation.

In Britain the art of agriculture, and indeed of all the arts of civilisation, really commenced with the Roman occupation, but the Saxons and Danes who followed, though doubtless good soldiers, sailors, and fishermen, were scarcely less barbarous than the early Britons, and no advance was made in agricultural pursuits until after the introduction of Christianity, the members of the religious establishments, once so numerous, and into whose hands most of the landed property passed, having done much to improve the cultivation of land.

While the population was comparatively small, the amount of land under cultivation was also limited, only the better class of soils in the most fertile districts being chosen for corn, and the remainder used for pasturage or common-land; whilst large tracts of country, capable of producing abundant crops, were left wild, or still covered with woods: but as people congregated in centres of trade, the demand for corn arose and increased. Although, however, the farmer was thus encouraged to attempt the tillage of waste lands hitherto neglected, little improvement is noticeable in the method of farming until the beginning of the present century; for agriculture, like all venerable arts, has been—until very lately—strictly conservative; so much so, indeed, that many of its practices and precepts have come down to us but little altered since the days when Virgil wrote the Georgics.

But this century, so pregnant with change to all our industries, has not permitted agriculture to escape innovation; and notable among the signs of the time was the establishment, in 1838, of the Royal Agricultural Society, under whose auspices much has been done towards the removal of long-cherished and old-established prejudices, and the acceptance and adoption of numberless improvements.

The chemist has been, and indeed is still, hard at work for the agriculturist, analysing the soils on his farm, and advising him what artificial remedies to apply to improve their fertility, or to fit them for special crops. He has told him the reason why a rotation of crops is beneficial; because a green-crop, a root-crop, and a grain-crop each take different ingredients from the soil; and thus, by a knowledge of their requirements, he may apply to each that special ingredient—if not already in the land—at the period when it is required by the plant. Nor has Geology neglected to tender her aid to agriculture, by pointing out that there exists a direct relation between the soil of a given area and the subsoil upon which it rests; and that thus, by a knowledge of the geological features of a country, the farmer, in the selection of land, may not only be guided to the most permanently productive soil, but also to that which rests upon a subsoil calculated to enhance rather than depreciate its value.

Anyone who will take the trouble to examine a geologically coloured map of the British Isles, will see at a glance the general distribution, at (or *near*) the surface, of all the various geological formations, from the Pliocene and Eocene in the east and south-east, to the Granites and Trap-rocks of the west and north, with the relative superficial extent of each. But let us take a nearer view. In Britain, as in almost every country in the world, and in all latitudes, superficial accumulations of clay, sand, and gravel occur, sometimes forming a mere coating of the rocks beneath, but often of very considerable thickness, and covering large areas. The earlier geologists classed the whole of these deposits under the general name of *Diluvium*, and attributed their irregular occurrence and wide distribution to the effects of one great and universal deluge. They have, however, of late years, received careful attention from many able geologists, and it is now ascertained that they sometimes contain fossils.

Thus, some are named "pre-glacial," as marking by their animal and vegetable remains a coldly-temperate climate, and comprise marine sands and gravels, the lignite clays, and the forest-bed, with its elephant-remains, which are seen cropping out on the Norfolk coast. Younger than these, and overlying them—in Norfolk at least—come the accumulations of the "glacial" period itself, marked by the Arctic character of its fauna, its ice-worn erratic blocks, and its vast deposits of boulder-clay, often 100 feet in thickness, and covering large areas in the eastern, central, and northern counties of England. It presents most anomalous appearances, the fine clay or "till" being unstratified and mostly devoid of fossils, but containing rounded and angular fragments of rock, having one or more of their sides ground down and striated. The laminated beds which accompany the "till" in Norfolk are highly contorted, and much false-bedding and irregularity exists in their mode of deposit. To these succeed the "post-glacial" period, marked by a more temperate climate, and represented by deposits which have been formed since the land assumed its present level, or nearly so; including lacustrine and river-sediments, turf-moors, ancient forests—sometimes converted into peat-bogs, and now again reclaimed by man; valley-sediments, resulting from meteoric causes, and, in fact, all the most modern surface-deposits, including remains of man and his works.

Although what we have already said about the direct connexion between the soil and the sub-soil does relate to the regularly stratified deposits, such as the Chalk, the Oolite, Lias, New Red sandstone, &c., yet it is found by careful observation that those modern and superficial patches of clays, sands, and gravels scattered over the face of the country far and wide, take such an important part in modifying the general character of the soil, that to the agriculturists of some districts, they actually surpass in interest and importance the more regular geological formations of the country.

When the Geological Survey of Great Britain was first undertaken, more than thirty years ago, the Director-General had to consider and decide which would be the most desirable plan to pursue,—whether to show on the geologically-coloured maps these "detrital" or "superficial" deposits, lying upon and concealing the more regularly stratified formations, or only to map the latter; and bearing in mind the fact already stated, that only the most vague notions existed in the minds of the earlier geologists as to the age or origin of these later deposits, and that they were commonly looked upon as the result of the deluge; it is easy to see that there were at that time good grounds for their omission. It can, however, readily be shown that, from an economic point of view, these deposits deserve to be mapped, in the interest of the farmer, with as much accuracy as the older rocks have been for the miner.

The advantages to be derived by the farmer from the mapping of all surface-deposits—irrespective of age or mode of occurrence—are exemplified in the pages of the last number of the Journal of the Royal Agricultural Society, in which the system commenced many years ago by the Council of that Society, and carried out so ably on their behalf by Mr. Joshua Trimmer, of making reports upon the agricultural geology of lands in various districts of England, has been again resumed. In this instance, most of the reports are the result of personal inspection of the districts by Mr. H. M. Jenkins, the recently elected Secretary of the Society; who, fresh from his labours as Secretary to the Geological Society of London, has given, in addition to an insight into the methods employed for improving the land, very clear and accurate sketches of the geology of each farm over which he has gone, illustrated in each case by a shaded map, expressing

Subsoil Map. Scale—Two inches to a mile.

the nature of the subsoil, and its bearing upon both the lithological nature of the soil, and its retentiveness of moisture—this latter point having a most important bearing upon its fertility.

In illustration of the various conditions under which the surface soil is cultivated, we may refer our readers, first of all, to the recently issued number of the journal referred to. We there find, in an essay on Forest-farming, by Mr. Jenkins, that "the site of the ancient forest of Sherwood furnishes some of the best examples in England of successful farming, under circumstances of great natural difficulty. The subsoil consists of a sandy conglomerate, and is covered by a very light sandy loam of poor and hungry character. Little is yielded by it alone; and the farmer looks upon it more as a vehicle whereby he can convey fertilising materials to his crops, than as a producer of their natural food." Here we have a natural condition of virgin barrenness, forced into fertility by the most advanced appliances of agricultural science; and from this basis of natural poverty we may diverge, on the one side, into fields which, once naturally fertile, and possessing a rich store of accumulated wealth, have been impoverished, and even *denuded*, of their wealthy mantle of soil at any rate, by a very recent degradation; and, on the other side, we may find examples where the wealth and fertility of a district are being continually increased by atmospheric causes. Mr. Jenkins gives us instructive examples of both sets of conditions, in one case both occurring on the same farm, viz. at Eastburn in the Yorkshire Wold: on one portion of the farm "the higher ground exhibits a soil gradually *increasing* in strength and depth as one ascends the hill;" while upon another portion of the farm, the thickness of the soil follows a rule precisely opposite to that just noticed: "instead of the depth and strength of soil increasing with the height, the opposite is now the case. The only essential physical difference in the two cases seems to furnish the explanation of this anomaly, namely, that we now have to deal with a *wet* valley of very slight slope, the soil on the sides of which consists of the mud (or warp) deposited by the stream in times gone by; whereas, in the other case, the valleys are dry, and their slopes have been denuded of any alluvial soil which may formerly have covered them, by an agency which has also deepened the valleys and increased the pitch of their sloping sides." All these practical descriptions, the result of actual survey, show clearly that the formation of soils is not always attributable to the same cause; for we have in them clearly indicated three natural processes by which the surface-conditions have been produced—viz. (1) Soil formed from the subsoil immediately beneath; (2) Soil formed by the denudation of soil and subsoil at higher levels; and (3) Surface denuded of soil by degrading influences. The first two processes are *formative*, while the third is *destructive;* and thus in this, as in every other portion of nature's economy, we at last learn that antagonism produces equilibrium.

H. WOODWARD

VEGETABLE PALÆONTOLOGY

Traité de Paléontologie Végétale. By Prof. Schimper. (Paris, 1869. London: Williams and Norgate.)

IF asked to indicate the most suggestive discoveries in Geological Science that have been made within the last ten years, we should unhesitatingly point to that of the Eozoön,—to the unfathoming of the mysteries of the floor of the ocean,—and to the unearthing, in high Arctic regions, of forests of Dicotyledonous trees, not merely analogous in size, habit, and conditions of life, but specifically closely allied in structure to the forest trees of middle and southern Europe, Asia, and North America. The first of these discoveries carries back the history of life on the globe over a period indefinitely anterior to that which so long marked its starting-point; the second reveals a condition of life far lower than any hitherto discovered, if not the primordial condition of organized matter itself, and is the clue to the history of the chalk, the most complicated in its relations and the richest in animal remains of all known formations; whilst the third, the most simple in its outlines and the most intelligible in its facts, has hitherto checkmated every attempt to reconcile the stubborn conclusions of astronomers, in so far as these relate to the recent history of the globe, with the palæontology of a period comparatively but little antecedent to our own in a geological point of view.

Thus it is that Geology, which in its infancy was the offspring of mineralogy, chemistry, and mechanical laws, has fallen while still young under the step-fatherhood of Biology; even the superposition of strata meaning nothing, if not supported by Palæontology, since the fact that an upper stratum of rock containing organic beings of simpler structure than that it overlies is held to be sufficient proof of their original positions having been reversed, notwithstanding all appearance to the contrary. Biology, in short, supplies the weights, wheels, and pendulum of the geological clock, of which Zoology has hitherto marked the hours, and Botany, at uncertain intervals, the minutes.

Lately, however, owing chiefly to the exertions of Heer, Massolongo, and Saporta, following the footsteps of Unger, Braun and Goeppert, Botany has gained a little of its lost ground in the race with Zoology for precedence as the handmaid of Geology. The number of species collected and arranged in the cabinets of Zürich, Vienna, Breslau, &c., has been prodigious; lucky discoveries of structural specimens have thrown clear light on the affinities of whole groups of obscure fragments; and the constant association of certain leaves with certain fruits, seeds, and flowers has led to many more very probably correct, or at least approximate, identifications. As usually obtains with a science under such conditions, the publication of new species on mistaken and uncertain grounds, or on no grounds at all, has proceeded rapidly, whilst the acquisition of a real knowledge of the objects themselves has been slow. Superficial naturalists, who think they know an oak, a laurel, or a fig-leaf when they see it, but who neither really do know these, nor the multitude of other vegetables whose leaves imitate them, have boldly made fossil species of such genera; shielding themselves under the belief that, let botanists doubt as they please, they cannot contradict.

For years this state of things has gone on; the Devonian, Carboniferous, Eocene, Miocene, and Pliocene floras have been the prey of adventurous systematists; while with the exceptions of Brongniart and Lindley no naturalist eminent for his knowledge of exotic forms of vegetation has attempted a general work on fossil plants; and that these great men simultaneously broke down, is notorious. Thirty-two years have elapsed since the suspension of the "Fossil Flora of Great Britain" by Lindley and Hutton, and of the "Histoire des Vegetaux Fossiles," by Brongniart. In this interval, but one other general work of the same nature has appeared, the "Genera et Species Plantarum fossilum," by Unger, a careful compilation by a very accomplished palæontologist of Vienna; but many excellent treatises on the vegetation of individual formations have been contributed by able men, amongst whom rank especially—on the Continent, Heer, Unger, Ettingshausen, Massolongo, de Gaudin, de Sismonda, Otto Weber, de Ludwig, Goeppert, Saporta, and de Watelet, and the author of the work now under notice,—in England, Bunbury, Binney, Williamson, and Carruthers, —and in America, Lesquereux, Dawson, and Hall. The time, therefore, has fully come for a complete review of the Fossil Flora of the globe, and it has fortunately fallen into hands which in very many respects are the best fitted for carrying it out with success.

Dr. W. Ph. Schimper is Professor of Geology in the Faculty of Science at Strasbourg, and Director of the Museum of Natural History in that city, an institution which is, we are told, largely, if not wholly, indebted to his liberality and energy for its present value and condition. Dr. Schimper is further a correspondent of the Institute of France, and of the Linnæan Society of London; the best living Muscologist, and the author of a monograph of the Fossil Plants of the Vosges, and of a work on the Palæontology of Alsace. In furtherance of his object, which is not a mere compilation, but an original work, in which each order, genus, and species is to be considered in its totality as well as in its details, and to be treated of in a large and general manner, he has visited the principal museums of the Continent, and twice or oftener those of England, making a lengthened sojourn on each occasion.

It remains to add a sketch of the general arrangement of the work, which is lucid and practical. The whole will be comprised in two thick octavo volumes, accompanied by 100 lithographic plates in quarto. Of these the first volume, of 738 pages, and 50 plates, is on sale, at the extremely moderate price of 50 francs, and appears to be exceedingly well done. The commentaries on many of the involved and obscure, though prevalent orders, as Equisetæ, are in particular well worthy of an attentive study; and as a specimen of the condition of the science as Dr. Schimper finds and leaves it, and of the extreme difficulty of the subject, we give an analysis of the contents of one tribe of this order; namely, the Calamiteæ. Of these he retains the nine following genera:—

1. *Calamites*, with seven supposed good species, under which species of three other genera are brought, with twenty-six synonyms, of which fourteen belong to one species alone; and there are, besides, nine doubtful species of the genus.

2. *Calamocladus*, with five species, under which are brought plants previously referred to no fewer than *nine other genera* (two species having respectively seven and eight synonyms).

3. *Calamostachys*, with five species, some of which have been referred to three other genera.

4. *Huttonia*, a monotypic genus.

5. *Macrostachya*, with one species, rejoicing in seven synonyms, of which four are generic.

6. *Bornia*, with three species, of which one has six synonyms.

7. *Sphenophyllum*, with seven species, having thirty-two synonyms amongst them, besides three doubtful species.

8. *Annularia*, with six species, having twenty synonyms, and including plants previously referred to six other genera.

The ninth genus, *Aphyllostachys*, is altogether doubtful.

It needs indeed a bold systematist to attack such a chaos as this reveals, and an able one to deal with it effectively and well.

The work will consist of three parts :—(1) an introduction ; (2) a botanical classification of all known fossil plants ; (3) a synopsis of them in geological sequence ; with a Bibliographical Index.

The introductory part is very full, and is comprised in ten chapters :—

Chap. I.—Historical sketch.
Chap. II.—On the state of preservation of fossil plants.
Chap. III.—Distribution of fossil plants in different formations.
Chap. IV.—Different modes of preservation.
Chap. V.—Principles to be followed in the determination of ossil plants.
Chap. VI.—Of the changes which have taken place in the vegetable kingdom from its first appearance up to the present time.
(§ 1.) Disappearance of species ;
(§ 2.) The renewal of floras by the appearance of new types.
Chap. VII. General *coup d'œil* of the floras of different geological periods.
(1.) First epoch. Reign of the Thalassophytes.—(2.) Second epoch. Reign of the vascular Cryptogams.—(3.) Third epoch. Reign of the Gymnosperms. Appearance of Monocotyledons.—(4.) Fourth epoch. Reign of the Angiosperms. (*a*) First period ; Apetalous plants. (*b*) Second period ; Dialypetalous plants. (*c*) Third period ; Gamopetalous plants.
Chap. VIII.—Application of vegetable palæontology to the climatology of the old world.
Chap. IX.—Application of vegetable palæontology to geology.
Chap. X.—General classification of stratified rocks.

Of the above chapters, the sixth, which deals with the renewal of floras by the appearance of new types, will be the first to be read by many, naturally eager to ascertain the views of so able and so unprejudiced a naturalist as Prof. Schimper, on the subject of the Origin of Species. In this matter his views are explicit, and he sums up his reasons for adhering to the doctrine of evolution in the following terms :—

In spite, then, of the deficiency of palæontological documents, we cannot mistake the general line which Nature has followed through the various geological epochs, from the first appearance of organic beings to the period of their present development. This line may be termed one of evolution, because it marks a progressive change from inferior to superior, from simple to compound, precisely similar to that of every individual with a complicated organisation. All agree that the latter is the result of a continued series of metamorphoses. Every organised being begins as a simple cell ; the embryo itself being a complex organism derived from the generating cell ; wherefore there are naturalists who trace the individual back to the cell. We know, in fact, that each living vegetable cell can give birth to a new individual, of which it is in a certain sense the first representative. Many species of vegetables and animals do not rise above this simple cell ; as soon as this has given birth to a second cell, the latter becomes in its turn a fresh individual. Whenever the derived cells remain united, so that a sort of solidarity is established amongst them, the being which is born from this agglomeration is a complex being. It will be so much the more perfect, it will occupy a step so much the higher in the scale of organisms, as the differentiation of functions produced by the metamorphosis of the cells is more complete, and the organs applicable to these functions are more independent of each other.

Has Nature followed this plan in her organic kingdom? From all that we know, I believe that we are justified in such a conclusion. The only unicellular fossil plants with which we are acquainted are the Diatoms, which have left their siliceous shells in the most ancient of fossil beds. The cellular plants of the family of Algæ are doubtless rare in the palæozoic formations ; with the exception of some little epiphytal fungi, no terrestrial cellular plants have been discovered, either in palæozoic or in mesozoic beds ; this class is even but meagrely represented in the tertiary flora, which has nevertheless much affinity with that of the present day. Nevertheless, these scanty remains suffice to convince us that, if the cellular plants which were to prepare for the arrival of vascular plants have not left numerous and striking traces, they have none the less existed, and doubtless since the earliest periods. The first vegetation on the lands which had just appeared above the waters must have been composed of cellular plants, of Confervæ, of *proembryos* or *prothalliums* of a lower or higher order of Cryptogams, as may be seen at the present day on recently reclaimed land.

The terrestrial vegetation of the Silurian epoch and of the commencement of the Devonian having left no trace, it is impossible for us to judge what were the forms of the plants which then covered the reclaimed land. All that we know is, that the primeval ocean was peopled by a numerous fauna during thousands of centuries before the appearance of vascular cryptogamic acrogens : similarly, if the Thalassophytes of those distant epochs had left no trace, their existence would be none the less infallibly proved by that of the animals whose food they formed.

The rapid glance which we are about to give of the general character of the floras which have succeeded each other on the surface of the earth, from the Devonian period up to the present time, will show better than any reasoning the progressive march which they have followed, and the close links by which they are united to each other.

J. D. HOOKER

HARCOURT AND MADAN'S PRACTICAL CHEMISTRY

Exercises in Practical Chemistry. By A. G. Vernon-Harcourt, M.A., F.R.S., Sec. C. S. ; and H. G. Madan, M.A., P.C.S., Fellow of Queen's College, Oxford. Crown 8vo., pp. 350, 66 woodcuts ; 7*s.* 6*d.* (Oxford : Clarendon Press, 1869.)

WE are glad at last to welcome a really scientific work on Practical Chemistry. Professor Harcourt and Mr. Madan have earned the warm thanks of all interested in the teaching of the science by the publication of their volume. Almost all former works on practical chemistry have been contented either to act the part of illustrated catalogues of chemical apparatus, or else they consist of cut and dried receipts for following out a system of qualitative analysis by reference to a complicated series of paragraphs, ingeniously arranged to bewilder the unfortunate student as much as possible, or they place in his hands tabular statements of reactions which have to be worked through almost always without rhyme or reason.

Mr. Madan's Ten Commandments, or "Memoranda," placed at the commencement of the volume, might well be printed in letters of gold in every laboratory, and repeated as the morning lesson of each first year's student. "Cleanliness," he begins, "stands at *the head* of the *chemist's* scale of virtues." No better advice can be given : if a student can work neatly, he is almost sure to work well. Only rarely can the "messy" beginner be trained to habits of exact experimentation and accurate thought. The second ordinance is equally important : "Do not work in a hurry. What is expended in time is often gained in power and grasp of a subject. Yet, on the other hand, learn to be economical of time." The main object of a certain class of students seems to be to get "through" with their experiments, no matter how clumsily they manipulate, or how small and incomplete may be their knowledge of what the experiment teaches. They are satisfied to have "done the thing," and if they do not obtain the required result, they either think that something in nature has gone wrong, or that the author of the book is fibbing, and they are the last to imagine that they are themselves to blame; it is sufficient for them to have tried—or rather not tried—and they pass willingly to the next operation, most probably again to court defeat. To these the only cure is to act upon the advice, "Do not hurry." Another class of persons, to whom the second part of these "Memoranda" specially applies, are those who confine all their powers to waiting; thus they watch the slow filtration of a single gelatinous precipitate, and with a kind of dreary pleasure either dream away their time, or (more commonly) annoy their more diligent neighbours, thinking that nature is invariably slow to move, and that patience is the only virtue they need to cultivate. These must be made to learn that economy of time is a necessary part of the chemist's duty, and that he, "in spite of the proverb, may do more than one thing at a time by allowing things to do themselves." The chemist's third commandment is fairly given as, "Be economical of materials." Who that has seen beginners work does not value this recommendation? Many seem to think that the more they deluge the substances they have to examine, first with acids, and then with alkalies, the more likely are they to discover the philosopher's stone, or to find their needle in the bottle of hay! How long some students take to find out that every molecule of acid or alkali, added above the required quantity, serves only as a blind to their reactions, and is in reality a most wilful adulteration of their material, with perhaps several thousand times its weight of dirt! "Never begin an experiment," says Mr. Madan, in his fourth article, "until you have looked over all the preparations for it, to make sure that you have everything within reach;" and we would make this advice apply not only to test-tubes and gas-jars, but to the mental preparation also. No experiment ought to be made until the student knows what he is going to do. He must either read a description of what he is to do, or he must see the experiment performed by his teacher; and, above all, he ought to be aware of the theoretical explanation of the changes he is about to witness. The writer for one does not think that laboratory instruction cannot be valuable, unless the student has already acquired a certain knowledge of the subject by attendance on lectures; but the theoretical instruction must then of necessity accompany the practical tuition. The very first experiment which the beginner may make—viz. that of heating oxide of mercury in a test-tube—must be the occasion for an explanation of the laws of definite combination by weight, for a statement of the numerical exactitude of all chemical change. Exercises must at once be given, and continue to be given, in illustration of these laws; and thus from the first the student must be made to grasp the facts of the exact nature of the science. He must be disabused at once of the notion of some who, when they enter the laboratory, "look upon chemistry as a mere amusement, as a means of getting up a few explosions, creating a few unsavoury smells, producing a few striking changes of colour." Unless practical chemistry is taught with these aims, in a manner calculated to afford an exact mental discipline, it is worse than useless. If the student does not cultivate habits of attention, close observation, and patient inquiry, he can gain nothing from laboratory work; on the contrary, he becomes negligent and impatient, he does not care to look for what is going on, and instead of gaining immensely, as he ought, in habits of self-reliance, he loses all confidence, finds physical science a delusion and a snare, and returns (if he has any taste for learning at all) to the more congenial path of literature.

The volume in question will much aid those who teach with this view, and it will afford still more active help to those who, possessing no teacher, have to learn for themselves.

The descriptions of the simpler operations of glass-working in the beginning of the volume, and of the construction of tube apparatus, are clearly given; and these pages are, of course, especially interesting to the self-educated student. The exercises on solution, precipitation, filtration, and distillation, are described with care, and the examples well chosen. It is very difficult to know how far such descriptions should go as regards details. The description of the manufacture of lime-water is as clear as that preparation ought to be. But is such detail needed where a word of explanation can be given? This shows the impossibility of writing a book on practical manipulation exactly fitted for all classes of students.

In the second section, on preparation and examination of Gases, we miss the theoretical explanations which, as we have said, must accompany the practical and manipulating directions; nor do questions, numerical or otherwise, accompany the exercises. This is to be regretted: a book especially written for those who work alone should contain a series of examples such as we find in many of the smaller manuals. With this exception this portion of the book is as good as need be. A chapter on the preparation of Reagents in use in the laboratory is especially valuable to the self-taught student. The solutions are made according to system; and in the preparation the student is familiarised with the metrical system of weights and measures: whilst under each heading the tests for the purity of the reagent are given; thus:—

Barium Chloride ($BaCl_2$ in 20 c.c.). Dissolve 12·2 grms in 80 c.c. of water, and dilute to 100 c.c.

The purity of the salt may be tested as follows. Place about 5 c.c. of the solution in a test-tube, heat it nearly to boiling, and add a slight excess of dilute hydrogen sulphate. While the precipitate of barium sulphate is subsiding, get ready a filter (of Swedish paper), wash it two or three times with warm water, then filter off the barium sulphate and evaporate the filtrate to dryness on a clean watch-glass. No solid residue should be left.

The authors, in their introduction to Qualitative Analysis, commence with the study of the acid radicles instead of the metals. This is, perhaps, the more scientific order of procedure than that beginning with the reactions of the metals; but we must take leave to doubt whether it is so simple, or so likely to conduce to the clear understanding of the reactions as the other older and more usually employed method.

The nomenclature used throughout the work possesses one amongst many advantages over the others (unfortunately too numerous) now in use, in that it is identical with that now employed in Germany. Surely it is a matter of some importance to assimilate as much as possible scientific nomenclature in all languages.

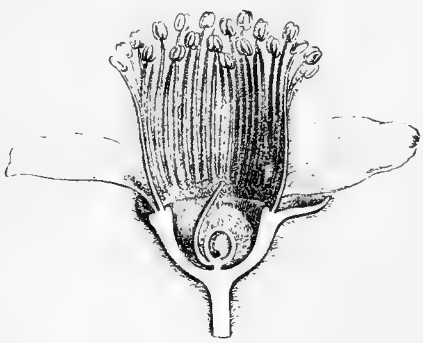
H. E. ROSCOE

BAILLON'S HISTORY OF PLANTS

Histoire des Plantes. By H. Baillon. Vol. I. 8vo, 488 pp. With 503 figures by Faguet, price 21*s.* (Paris and London: Hachette and Co.)

THIS is a fine book—a very fine book, one might say; nevertheless, not wholly satisfactory. Turning over its pages we feel a sense of power wasted in an attempt to bring together too much in a digested form,—far more indeed than any one cares to find in one work. The book, if it goes on, will be a sort of Botanical Encyclopædia, suited rather for adepts and advanced students than for the general reader. No one thinks of turning to an Encyclopædia for the best and most exhaustive information upon anything, and so it will be in this case. M. Baillon brings together Organogeny, Structure, and Taxonomy, including a description of every genus of Flowering Plants. Now this is too much for any single mind to work out. M. Baillon is a man still young and vigorous, and of wonderful assiduity; and if he live, it is quite possible he may bring his work to a close. And it will be no mean monument, though not without its warning, especially to those whose ambition impels them to aim too much at leaving behind a name in large characters rather than deeply cut. As yet, however, our author is hardly out of shallow water. Nearly all the groups which he has touched upon have been quite lately worked up systematically by other eminent botanists, and their material has doubtless afforded him a good bottom.

This first volume consists of a series of Monographs of the following Natural Orders: Ranunculaceæ, Dilleniaceæ, Magnoliaceæ, Anonaceæ, Monimiaceæ (including Calycantheæ), and Rosaceæ. We do not find any general clavis or table of sequence of the Orders, but, from the order followed so far, it would seem as though the characters of the primary divisions of Dicotyledons, usually accepted as most convenient by systematists, depending on the absence or presence of adhesion between the inner and outer whorls of the flower, were regarded as subordinate to characters based simply on cohesion or its absence between the carpels forming the pistil. All the Orders enumerated, and those in the first part of Vol. II. already published, are essentially apocarpous. Four of



CHRYSOBALANUS ICACO (Section of Flower)

them have perfect flowers and hypogynous insertion of the floral whorls; one (Monimiaceæ) is mainly imperfect and monochlamydeous; and Rosaceæ are perfect and perigynous. Now a new system is very apt to be a great bore. Nobody knows what is coming next, nor where to look for a thing; and in the present state of knowledge, in such secondary matters as the mere sequence of Orders, it is better to sacrifice the expression of a supposed affinity by a new juxtaposition in linear series, for the sake of a uniformity with accepted plans of arrangement, which have been tested many years, are widely used in the

CHRYSOBALANUS ICACO

best books, and which adventurers are too glad to fall back upon when they have sense to know when they get out of their depth.

However, waiving all this, let us do M. Baillon the justice to say that he here puts on record many original observations of great value: he is very clear, and, like many of his countrymen, has a neat way of putting things: his pictorial illustrations (in woodcut) are admirable and well-selected, as the accompanying examples will show; and, as we have said above, he is making a very fine book.

By way of sample of the work, let us take a small Natural Order: Magnoliaceæ, the Family of the Magnolias and Tulip-trees. First of all we have the Order divided into what M. Baillon calls *Series*, which, in the main, answer to the Tribes or Sub-orders of other writers. *Canelleæ* we notice is one of these: a group maintained of ordinal value, by Messrs. Bentham and Hooker, near to Bixineæ, on the ground of their syncarpous ovary and parietal placentation,—characters which M. Baillon estimates as analogous, in respect of their departure from the Magnolioid type to the similar conditions of *Monodora* in relation to other Anonaceæ. A good description, with capital figures, is given of what the author treats as type-species of the genuine Magnolias, the beautiful *M. grandiflora.* He has been at considerable pains to examine for himself the curious changes undergone by the ovule in maturation, publishing an account of it in "Comptes Rendus," lxvi. 700, apparently ignorant of Prof. Asa Gray's exceedingly clear and detailed account of the same, given twelve years ago in the Journal of the Linnean Society, ii. 106. The old genera *Talauma*, *Manglietia*, and *Michelia* are all sunk in *Magnolia*, which genus, with *Liriodendron*, constitutes the series Magnolieæ. The three former genera are very briefly disposed of, and whether specimens of each have been examined, is by no means clear. After describing successively the structural features of each Series, M. Baillon gives us a short historical summary of the Natural Order, then he discusses the points in which all, or nearly all, of the genera agree. The only three absolutely constant characters are: the woody stem, the alternate leaves, and the presence of albumen in the seeds. A triad, equally constant, we may remark, in many other Natural Orders, just as flour, suet and salt, may be common to every different sort of pudding. Eight characters are generally prevalent, the exceptions being few or solitary; these refer to the form of the receptacle, concave only in two genera, which same pair are the only exceptions to the otherwise constantly double perianth; polypetaly; direction of the micropyle of the ovule; apocarpy and placentation; stipulation. These we might speak of as the currants, and peel, and spices, and brandy, and what not, which, judiciously blended with the constituents afore-named, give special character and pre-eminence to plum-pudding. Technical diagnoses of the five Series follow. Then we have the histology of the wood and bark; a discussion of the affinities of the order; a paragraph on its geographical distribution; an account of the properties and uses of various species; and lastly, technical descriptions in Latin, of each genus, as maintained by M. Baillon. These technical descriptions, if given at all, should be accompanied by a distinct generic synonymy. It is too much to expect every one to turn back to pages so and so, and unravel it for himself, where the mention of it may read as merely incidental.

D. OLIVER

FICK ON THE TRANSFORMATION OF FORCE

Die Naturkrafte in ihrer Wechselbeziehung. By Adolf Fick. (Würzburg, 1869. London: Williams and Norgate.)

PROFESSOR FICK, who has recently been moved from Zurich to Würzburg to fill the chair of Physiology there, vacant through the untimely death of Von Bezold, is well known not only to physiologists by his many excellent researches, but also to a far wider circle through the now well-known experiments on muscular physics carried out by himself and Wislicenus. In these six popular lectures he attempts to carry an intelligent and attentive audience, not possessing special scientific knowledge, swiftly through the great story of the transformation of force, showing them, in a quiet, lucid way, how the parts are played on those two great stages, the macrocosm of the universe and the microcosm of the human body.

The first four lectures are given up entirely to the consideration of the correlation of purely physical forces. Starting from simple facts about heat, the author works his way through heat as a mode of motion, through concrete conceptions of molecular movements in changing bodies, to the general doctrine of the transformation of force and the numerical relations between one force and another.

In his fifth lecture, treading upon his own ground, he shows that the microcosm is but a stage where forces shift and change; and that no exact researches have at present in any way shown the necessity of believing that in the living body there exists any new force besides those at work in the world around. He is careful to point out that no thoroughly satisfactory balance sheet of the forces that come to and go out from a living body has yet been shown, so difficult is the task; but, though the details have yet to come, the general principle gains daily confirmation. Human force is but a transformation of chemical force, and man steals oxygen to do his work. Plants unburn what the animal burns; and so the heat of the sun brings back oxygen to the world.

And this leads the lecturer in his last lecture to the question, How does the sun get his heat? After quoting and discussing Mayer's hypothesis of the feeding of the sun with meteors, and pointing out the next question, "Whence comes the force which drives the meteors?" he finishes by dwelling on Clausius' theory of the constant loss of force in the shape of heat that cannot be weaned back to any other mode of motion, and on the general conclusions that may be drawn from it. These we prefer to give in his own words:—

If, then, when mechanical force passes into heat, *some* of that heat can never be brought back to be mechanical force, and if the change from mechanical force to heat be ever going on, all the force in the universe must at last take on the form of heat. But if that be so, then at last all differences of temperatures must disappear, and everything end in a universal Death. The whole chain of Cosmic events must therefore be looked upon not as formed of cycles, so that, cycle sweeping round upon cycle, the universe stands for ever the same, but as being a process of Evolution striving towards an End.

We are come to this alternative: either in our highest, our most general, our most fundamental scientific abstractions, some great point has been overlooked; or the universe will have an end and must have had a beginning; could not have existed from Eternity, but must at some date not infinitely distant have arisen from something not forming part of the chain of natural causes, *i. e.* must have been *created.*

M. FOSTER

OUR BOOK SHELF

Theoretical and Applied Mechanics, *for Schools, Colleges, Candidates for University Examinations, &c.* By R. Wormell, M.A., B.Sc. (London: Groombridge and Sons.)

WE are glad to see London University graduates recruiting the ranks of educational writers. Mr. Wormell states in clear and concise language the principles of elementary Statics and Dynamics, in close accordance with the syllabus of requirements for passing the examinations for the B.A. and B.Sc. degree at the London University. He gives hardly more nor less than this, but avoids at the same time an error into which most of our writers on the subject fall, viz. the overcrowding of their books with problems, which the purely didactic portion of the book does not enable even the gifted student to solve. Mr. Wormell adds to his test a great variety of really instructive *solved* problems, which will go far to help the student in finding the solutions of those given with the numerical answers alone. We have no doubt that this excellent little work will be a great success, but we should like the elementary principles of dynamics more amply illustrated. The introduction of the principle of limits on several occasions is highly commendable: the student should make its acquaintance early, but we believe in the old methods of proof to bring the matters more home to students, although they start, in a scientific view, from an inconsistency.—B. L.

Geodesy.—*Studien über höhere Geodasie.* By Dr. C. Bremiker. (Berlin, 1869.)

FROM great scientific undertakings, such as geographical expeditions, or geodetical, geological, and magnetic surveys of large areas, mankind generally derives, besides the utility of the work itself, a vast amount of contingent benefit. The result forms not only a landmark of scientific progress, but the work serves also for applying and testing a number of antecedent theoretical or practical discoveries, for separating what is sound from the unsound, and finally it rouses contemporaneously the mental energy of those more or less intimately connected with it to new exertions.

Of such a wide bearing is the great European arc-measurement now in progress, in which for the first time the curvature of parallels of latitude will be simultaneously determined with that of the meridians, and the question will be decided whether the figure of the earth, as represented by the surface of the ocean, is really an ellipsoid of rotation, or whether a triaxial ellipsoid will have to be substituted for it. Of the mathematical, physical, and geodetical investigations, which the progress of this great work has already created, Dr. Bremiker's ranks among the foremost. It discusses the methods of reduction with reference to deviation of the plumb-line, latitude, azimuth, difference in longitude, latitude, and azimuth, small angles, deduction of triangles; and employs everywhere practical and interesting formulæ. The mathematical attainments necessary for understanding this excellent little work are not too high, and we feel certain that nobody who takes an interest in higher surveying will read it without extending his experience and knowledge. B. L.

Our Bodies. By Ellis A. Davidson. (London: Cassell, Petter, and Galpin.)

WE cannot highly commend this little book, though we would wish to speak well of its author. He is evidently a thoroughly good and earnest teacher; and we have no doubt his oral lessons are far better than his written book, which may be described as "Goody Lessons in Physiology, written in words of either one or of more than five syllables." It consists of many terribly stony technicalities floating in a mass of very pappy information. On one page we find children warned, on physiological grounds, not to crack hard nuts with their teeth, and on another a description of the *axis-cylinder* of *nerves*, the *white Substance of Schwann*, and the *canaliculi* of bone. When will popular teachers of physiology and anatomy find out that these sciences are best taught free from technical hard nuts which splinter the enamel of the mind and worse? In not a few respects, too, we observe that "our bodies" of Mr. Davidson are not the same as *our* bodies.

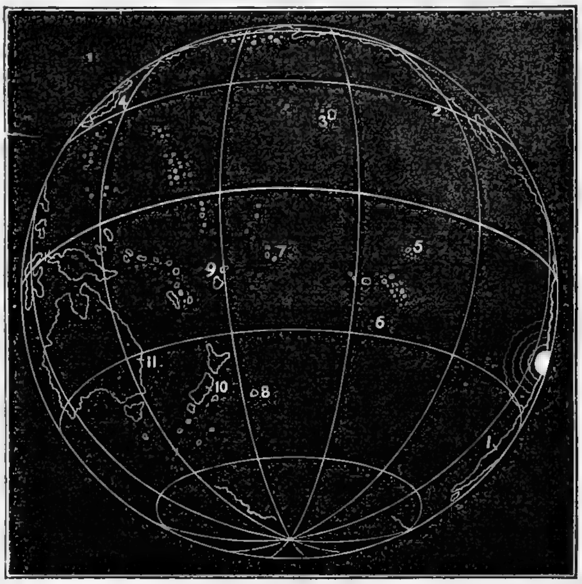
The Intelligence of Animals.—*From the French of Ernest Menault.* (London: Cassell, Petter, and Galpin.)

THE intelligence of animals may be studied in a scientific or in an anecdotal manner. M. Menault has chosen the latter method. We have not been led to form a very high opinion of his physiology or of his general philosophy; but he has compiled a most entertaining volume, crammed with most amusing stories about all kinds of animals, from ants to ourang-outangs. It is illustrated with numerous pictures, some of which are as good as the stories.

EARTHQUAKE WAVES IN THE PACIFIC

UNLIKE their great rivals, the Himalayas, which seem to have upreared themselves to a position where they can remain at rest, the Andes are disturbed from time to time by tremendous throes, whose effects are sometimes felt over a full third part of the earth's surface. To this class belonged the earthquake of August 13–14, 1868, and in many respects it was the most remarkable of all the great earth-throes which have desolated the neighbourhood of the Peruvian Andes. As in the great earthquake which overthrew Riobamba in 1797, a tremendous vertical upheaval seems simultaneously to have affected a region of enormous extent. But terrible as were the direct effects of the first vertical shock and the others which followed, it was the action of the earth-throe on the ocean which caused the greatest devastation. It is hardly necessary to recall to the reader's remembrance the fearful effects experienced at Chala, at Arica, and at other places along the Peruvian shore; for few, doubtless, have forgotten how a countryman of our own described the ominous retreat of the ocean, and the overmastering fury with which it rushed back and swept far inland, destroying at once the shipping it carried with it, and the buildings which it encountered in its course.

So fearful a disturbance of the seas around the Peruvian shores could not but generate a widely-extended oscillation of the waters of the great Pacific Ocean. Yet



it is impossible to hear, without surprise, of the enormous waves which reached the far-off shores of the islands which lie scattered over that enormous ocean-tract. The accounts which came gradually in of waves which had swept past Honolulu and Hilo, into the ports of Yokohama and Lyttleton, and had even disturbed the waters which surround the East Indian Archipelago, seemed at first scarcely explicable as the direct results of a disturbance occurring so many thousands of miles from those places.

But when the accounts are carefully compared together, they are found to point most clearly to the South American shores as the true centre whence the great wave of disturbance had spread over the whole surface of the Pacific. Professor von Hochstetter* has brought together all the accounts which seem to throw light on the progress of the great earthquake-waves from Arica. For the most part, unfortunately, the waves visited the islands and ports of

* Petermann's "Geographische Mittheilungen," part vi. 1869.

the Pacific by night; but still enough evidence remains to exhibit with sufficient clearness the course which the disturbance followed.

Let us first endeavour to form a clear conception of the scene of this great manifestation of Nature's powers. The Pacific Ocean is not commonly chosen as the subject of a single map, and the maps in our ordinary atlases are not calculated to give clear ideas respecting the true shape and dimensions of an ocean which is undoubtedly the most remarkable physical feature of the whole terrestrial globe. I have endeavoured to remedy this defect by the accompanying chart, which represents a perspective view of that half of the globe to which the Pacific belongs, and will serve, I think, to convey a tolerably clear impression of the true proportions of this great ocean.

Near the shore of Peru I have marked the estimated region of central disturbance by a white circle.

The great waves which came surging onwards from the centre of disturbance must presently have lost their circular figure. On account of their enormous dimensions they "felt the bottom," so to speak, and were more or less retarded according as they traversed shallow or deep portions of the great ocean.

At Arica the first great shock of the earthquake was experienced at about five in the afternoon of August 13th. Twenty minutes later an enormous wave fifty feet in height swept in over the shores; and we may assume that about this time the waves which were about to traverse the Pacific started on their vast career.

Along the coast of Chili the wave travelled southwards, reaching Coquimbo three hours after the catastrophe at Arica. One hour later the wave had reached Valparaiso; and yet an hour later the inhabitants of Valdivia—marked (1) in the map—were terrified by an inrush of the sea which threatened to destroy their town.

Northwards from Arica the progress of the wave was not so carefully timed. On the 14th of August, but at what hour is not stated, the shores of Lower California, near San Pedro—marked (2) in the map—were swept by a wave no less than sixty-three feet in height.

At midnight of August 13-14, the sea-wave reached the Sandwich Isles (3), and from that time until the 16th of August the sea around those islands rose and fell in a surprising manner. It appeared as though the islands were first slowly raised as by some irresistible subterranean forces, and then suffered to subside until they seemed about to disappear for ever beneath the waves; nor was it easy to believe that in reality the sea alone was in motion.

Yokohama (4) was visited by the wave on August 14th, but unfortunately the exact hour is not known, otherwise there would have been the means of ascertaining how long a wave takes in traversing nearly a complete half of the earth's circumference.

The Marquesas Isles (5) were visited by waves of enormous dimensions before midnight of August 13th. Some of the islands of this group were indeed completely submerged by the crests of the principal waves.

At Opara (6), the coaling-station for steamships plying between Panama and New Zealand, nine waves came in one after the other, at intervals of twenty minutes, the highest sweeping over the coal depot.

At half-past two on the morning of August 14th, the watchman in Apiu, on the island of Opolu (7), aroused the frightened inhabitants from their sleep with the cry that the sea was coming in upon them; and during the whole of that day the sea rose and fell at intervals of only fifteen minutes. But the waves reached the Chatham Islands (8), though nearly as far from Arica, an hour and a half sooner. Three enormous waves rushed in upon these islands, one of which, the low-lying Tupunga, was completely submerged. Between two and three hours later the wave had reached the Fiji Islands (9).

The shores of New Zealand, and especially those bays of the southern island which face towards the east, were visited by enormous waves. Between three and four o'clock in the morning, the harbour of Lyttleton (10) was left completely dry by the retreat of the water, which did not return until more than an hour had elapsed. At five the water began again to retreat, reaching its lowest point an hour later. But at a quarter-past seven and at half-past nine, and again at eleven, a great sea-wave swept over the bounds of the harbour.

Lastly, the ocean-wave visited the Australian shores near Newcastle (11) at about half-past six in the morning of August 14th, the waves gaining in height at each return until about half-past eleven, from which hour they slowly subsided.

The chief interest of these results lies in the circumstance that they enable us to form an estimate of the depth of the Pacific Ocean. Airy, Whewell, and other eminent mathematicians have shown how the velocity of sea-waves varies with the depth of the part of the ocean they are traversing. Where the breadth of the waves is great, as in the tidal wave, a very simple law connects the variation of the velocity with that of the depth. If a wave travels twice as fast in one part of its course as in another, it may be assumed that the depth of the ocean is four times greater in the former than in the latter part of the ocean. A tripled velocity signifies that the depth is nine times greater, and so on. With waves of different breadth the law is slightly different. But the following table, extracted from a larger one in Airy's paper on sea-waves (*Encyclopædia Metropolitana*), shows how slightly the law is affected for waves beyond a certain breadth:—

Depth of the Water in feet.	*Breadth of the Wave in feet.*		
	100,000	1,000,000	10,000,000
	Velocity of Wave per Hour in Miles.		
100	38·66	38·66	38·66
1,000	122·18	122·27	122·27
10,000	364·92	386·40	386·66
100,000	487·79	1,151·11	1,222·70

Observe, however, how in this table the wave 100,000 feet in breadth remains relatively insensible of a change of depth from 10,000 feet to 100,000.

Now, Professor von Hochstetter has carefully estimated the velocity of the wave which passed from Arica to the points marked (1), (3), (6), (7), (8), (10), and (11) in the illustrative map, and his results may be briefly indicated as follows:—

Rate from Arica to station	(1) . . .	284	sea-miles per hour.
,, ,, ,,	(3) . . .	417	,, ,,
,, ,, ,,	(6) . . .	362	,, ,,
,, ,, ,,	(7) . . .	358	,, ,,
,, ,, ,,	(8) . . .	360	,, ,,
,, ,, ,,	(10) . . .	316	,, ,,
,, ,, ,,	(11) . . .	319	,, ,,

It is well to observe, first of all, how well the low rate of velocity to Valdivia accords with the theory of sea-waves, for this wave travelling along the sea-coast must have passed for the most part over shallows. The voyage to the Sandwich Isles appears to have been accomplished more rapidly than any of the others. Along the line, therefore, from Arica to (3), the Pacific has its greatest depth. Towards stations (6), (7), and (8), the sea-wave sped very swiftly, and here, therefore, the water is still deep, though not so deep as along the former route. But in voyaging onwards from the neighbourhood of the Chatham Isles (8) to New Zealand and Australia, the sea-wave lost a large portion of its velocity, insomuch that the average rate for this distance scarcely exceeds that with which the wave passed to Valdivia.

From these results it would be easy to calculate the mean depth of the ocean along the various tracks pursued by the wave-fronts. It will be found by those who care thus to apply Professor Airy's results, that the following estimates by Professor Hochstetter are approximately correct.

He makes the mean depth—

	Fathoms.
Between Arica and Valdivia (1)	1,190
,, ,, the Sandwich Isles (3)	2,565
,, ,, Opara (6)	1,933
,, ,, the Chatham Isles (8)	1,912
,, ,, Lyttelton (10)	1,473
,, ,, Newcastle (Aust.) (11)	1,501

These results are the more valuable, because the Pacific Ocean has not been so carefully sounded as the Atlantic has. And though the progress of the tidal wave has long afforded similar evidence, yet a certain amount of doubt necessarily rests over conclusions drawn from the progress of a wave which is acted upon throughout its voyage across the Pacific by the attractions which gave it birth.

We may add, in conclusion, that on December 23, 1854, a wave traversed the Pacific from Japan to San Francisco and Diego, or from (4) to the neighbourhood of (2), whose progress, dealt with according to Professor Airy's numbers, showed the mean depth of the sea between Japan and San Francisco to be 2,149 fathoms, and between Japan and Diego 2,034 fathoms. These results agree fairly with those which have been deduced by Professor von Hochstetter.

R. A. PROCTOR

A NEW FORM FOR SCHOOLS

AT the first blush this may seem a trivial subject, but when we consider the immense floating multitude of children who frequent schools, spending at least some 6,000 hours on forms during the time that they are at school, and that their health may be injuriously affected by the use of unsuitable ones, the importance of the subject becomes evident.

Dr. E. H. Schildbach states, in the *Gartenlaube*, that amongst more than a thousand children whom he examined in several schools at Leipsic, he found only a few who did not show some lateral curvature or deviation of the spinal column, traceable to the use of improper forms.

The chief defect in the construction of these forms was the great space between the seat and the table. Seats without backs soon tire out even robust children; they cannot sit upright for several hours together, and after much shifting from side to side, they are constrained to obtain relief by sitting on the very edge of the bench, and resting their arms on the table before them. The position into which they are thus forced is anything but a salutary one. The back is curved, especially in its lower half; the thorax sinks between the shoulders, and chest and stomach suffer a not inconsiderable pressure. To write in this position, one shoulder is raised much higher than the other, and the whole body is twisted unnaturally. With young and growing people the assumption of constrained positions, even for a few hours day by day, soon becomes habitual, and in many cases may lead to real deformity.

Our illustration represents the model form recommended by Dr. Schildbach, invented by Mr. E. Kunze, of Chemnitz, in Saxony, and will scarcely require a detailed description. It will be seen that the table forms an inclined plane without the usual level projection at its upper part. It is divided by cross bars into separate desks, and the boards which form the desks are movable and can be drawn out. A metal button with a lateral motion holds each board in its place, and also fixes it when drawn out. At the top in front are places for inkstands and writing materials, covered by the board when pushed home. Each seat has its separate back, of a shape best calculated to give proper support with the least possible pressure, while it allows the pupil to leave his place by stepping back over the seat without disturbing his neighbour. Underneath the table is a shelf for books, slates, &c., and beneath this there is a foot-board, an important provision against cold. The inexpensive character of this form and simplicity of its construction will be apparent to everyone.

THE NOVEMBER SHOOTING-STARS

THE earth is rapidly nearing the band of cosmical bodies to which the November star-showers owe their occurrence. Whether we are to witness a display or not depends wholly on the nature of that portion of the band through which we are to pass this year. The portion which gave the great display of 1866 has now passed many millions of miles away on its course towards the orbit of the distant planet Uranus. Nearer to us, but still many millions of miles away, is the part which we traversed in 1867, when (in America) there was a short but brilliant display of meteors, which would have afforded a yet more striking exhibition but for the full moon which dimmed their splendour. In 1868 meteors were seen in every part of the earth, and even, in America, on two successive nights. It is clear, therefore, that the portion of the band then traversed was very much wider than the part through which the earth had passed in the two former years. But even the part traversed in 1868 is more than five hundred millions of miles away from us now; and it is difficult indeed to say what may be the character of the portion we are approaching. Most probably it is even wider than the part we passed through in 1868; in which case we are sure (if the weather be but fine) to see a display of the November shooting-stars, though the same process of wide-spreading would of course tend to make the display so much the less brilliant.

It must be remembered that it will be absolutely useless to look for the meteors much before midnight of November 12—13 and of November 13—14. England does not come round to the exposed hemisphere of the earth—that is, to the hemisphere which is bearing directly through the meteor-band—much before ten o'clock in the evening; and she does not turn her full face, so to speak, towards the meteors before midnight. From that time until ten in the morning the rain of meteors is directed upon England without intermission, though no sign of the falling stars can be noticed after sunrise.

Our neighbours across the Channel propose to send observers to the shores of the Mediterranean, there to watch the meteors under more favourable circumstances than in more northern latitudes. Although we already know the principal conditions under which the meteors move, yet all observations directed to the determination of the size, colour, and constitution of these interesting bodies, will be well worth the making. The comet-nucleus of the system has now travelled nearly a thousand millions of miles away since in 1866 he passed his perihelion; and it will be interesting to learn whether the character of his train of followers is at all dependent on their distance from him.

R. A. PROCTOR

[To this note we add the following extract of a letter from Mr. Hind, which appeared in the *Times* of Tuesday.—ED.]

"The elements of the orbit in which the November meteors revolve are as follow, according to the last calculations of the Italian astronomer Schiaparelli, founded upon the accurate data obtained during the grand display in 1866. Heliocentric longitude of perihelion or of the point nearest to the sun, 56° 26′; crosses the plane of the earth's path from north to south in 51° 28′; inclination of orbit to the plane of the earth's path, 17° 45′; eccentricity of orbit, 0·9046; distance from sun in perihelion, 0·9873 (the earth's mean distance being taken as unity); semi-axis major of the orbit, 10·340, similarly expressed; period of revolution, 35·25 years; motion retrograde or opposite to that of the earth. At its nearest approach to the sun the orbit is therefore situate close to the earth's, while in aphelion it is not far distant from that of Uranus. It is well known that these numbers are almost identical with those applying to the orbit of the first comet of 1866, and I have lately ascertained beyond reasonable doubt that the comet of 1366, which became visible three days after the memorable meteoric exhibition in October of that year, when 'there was a movement of the stars such as men never before saw or heard of,' and 'those who saw it were filled with such great fear and dismay that they were astounded, imagining they were struck dead, and that the end of the world had come,' as the exaggerated language of the time has it, also moved in a similar orbit. It was, doubtless, visible during the shower on the confines of Ursa Major and Leo Minor, but the Chinese did not perceive it till three nights later. It was not seen in Europe."

PENNY SCIENCE CLASSES

IN opening the session of the Birmingham and Midland Institute recently, the President, Mr. Charles Dickens, referred to the "penny system" of instruction as "one of the most remarkable schemes ever devised for the educational behoof of the artizan;" and as this system, so far as we know, is adopted only at the Birmingham institution, we have made inquiries respecting its working there. We learn that, soon after the opening of the Science Classes in 1854, the teacher, Mr. Williams, observing that after a few terms the attendance fell off, suggested the establishment of Penny Lectures, as introductory to systematic scientific instruction. This plan answering well, an arithmetic class was commenced by Mr. Rickard, to which students were admitted on payment of one penny at the door. Subsequently other classes were started on the penny system, and now among others even chemistry and physical geography are taught in penny lessons. The chemistry class was formerly conducted on the quarterly plan, the fee being 3*s.* per term of twelve lessons. Though the fee was low, the attendance seldom reached more than 40 or 50 per night; while since the introduction of the penny system it is about 100 during the winter months. The persons attending the class are of all grades of society; but since the change to the penny system the proportion of artizans has much increased. We are not surprised at this, in fact it is what we should expect. The wage-paid class receive their earnings weekly, they pay their rent weekly, their "settlings" are made weekly, and their books they take in in weekly numbers. It is not to be surprised at, then, that a science class in which the fee is paid weekly should be popular with artizans. Where the fee is so low as one penny we do not see how a class can pay; but such institutions as that of Birmingham are not intended, and never were intended, to pay in a commercial sense. The promoters and subscribers are only too pleased to find their efforts successful in inducing attendance at the classes. Viewed in this way we believe the penny system to be the best of any; and the Birmingham and Midland Institute deserves all honour for having introduced it.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents.*]

Scientific Education at Cambridge

I NOTICE a paragraph at page 26 of NATURE, in which, while the facts are correct, a wrong inference is drawn from them. Two gentlemen at Cambridge have been appointed to lecture on subjects in natural science, and one of these has been appointed to lecture on electricity, magnetism, and botany. These facts are correct, and your informant congratulates the University on the increased desire for instruction in these subjects manifested among the members of the University, but says, "is the number of men in the University competent to teach them so small, that it has been found necessary to entrust electricity and botany to the same lecturer?" But the real state of the case is, that in the University there is not a want of those able to teach Natural Science, but a want of those desiring to learn it. In fact, there are so few who want to learn these matters of science, that we cannot afford to pay, and have no need to appoint, more than one man to do the work. The lectures which we have in these subjects are insufficiently attended. The University is not behind the age in the power of teaching these matters, but before the age. If there had been many people coming here desiring to be taught certain subjects, and we had been unable to supply that teaching, we should in that have been behind the age. But we are offering teaching which those to whom we offer it have not yet learned, or do not yet care, to appreciate. I am not saying that we have the power of showing all the wonders that the astronomers of the present day can watch with their spectroscopes. We are not well supplied with apparatus; but our want of it does not arise so much from the inefficiency of our teachers as from the apathy of those who are taught. We have quantities of excellent apparatus exhibited and lectured about daily by several of our professors well able to deal with these matters, and yet these lectures are taken advantage of by only a very few. If these lecture-rooms were once crowded, the University would only be too happy, and would immediately have at its command abundant means to increase the staff of competent teachers. We have in fine more than a sufficient number of people who can teach, and, what is more, are willing to teach, natural science, if only there are those who care to be taught.

But it would seem as if the classes, from whom the University is recruited, were behind the age in their desire to be taught these matters; for if we turn away from the University we find a very different state of things. There can be no doubt that throughout England there is a great demand for scientific education. This demand exists more or less among all classes, and it exists among the working-men of this country to an extent which could hardly be believed by those who have not had some experience in the matter. Among these there is a great desire for scientific instruction, and there is no one to supply it.

The case of the University is exactly reversed. There are 1,500 undergraduates at Cambridge, and there are more men able to teach them science than there is any need for. But look to the non-university classes of England; there are a thousand times that number eager to learn, and not all the men who come forward to teach them unite the qualifications of willingness and of competency. That there is a great demand for scientific education, and that not of a desultory kind, among vast numbers of the various uneducated classes of England, is a most certain fact. If anyone doubts this, let him go to some of our great workshops, and let him give a series of careful lectures on some scientific subject, and I will venture to say he will be simply astonished at the numbers who will come. I have seen crowding to a weekly lecture on Astronomy, or on Light, hundreds of workmen who had all been working for at least ten hours that day, and who are so greedy for instruction that on a summer evening, instead of playing at some game during their only hours of leisure, they will spend one part of it in reading, and the other part in listening to a lecturer, the intricacies of whose demonstrations require the most unhalting attention. Suppose I were to start a lecture on some scientific subject at Cambridge, probably none, or at most a score, would come. I am not setting this down to their blame, for the truth is that they have not the same need, for they have many men able to teach them anything they could possibly want to learn. I am not here stating the reasons why there should be so small a demand for scientific teaching at the University; the reasons are various and complicated, although we have not to go far to seek them; but the fact is certain. Now all this ought not to be so. There is a supply without a demand, and a demand without a supply; and the matter calls for the gravest consideration of those scientific men who care that the benefits which are to be got from the true study of science should be diffused among the people of this country. Of all things in the world, this is a demand which, wherever it exists, it is right to foster and encourage, and it can only be successfully fostered and encouraged by men whose intimate acquaintance with the subjects with which they deal renders them competent for a task at once of such magnitude and of such importance. It is not any want of teachers at the University, but the almost absolute want of teaching and teachers for those classes that presses upon us.

JAMES STUART

Trinity College, Cambridge, Nov. 8

Fertilisation of Winter-flowering Plants

MR. DARWIN has done me the honour of calling my attention to one or two points in my paper, published in your last number, "On the Fertilisation of Winter-flowering Plants." He thinks there must be some error in my including *Vinca major* among the plants of which the pollen is discharged in the bud, as he "knows from experiment that some species of *Vinca* absolutely require insect aid for fertilisation." On referring to my notes, I find them perfectly clear with respect to the time at which the pollen is discharged. My observation, however, so far agrees with Mr. Darwin's, that I find no record of any fruit being produced in January; it was, in fact, the absence of capsules on the *Vinca* which induced me to qualify the sentence on this subject, and to say "in *nearly all* these cases, abundance of fully formed seed-bearing capsules were observed." It is worthy of remark, that the *Vinca* is the only species in my list of apparently bud-fertilised plants not indigenous to this country. The second point relates to the white dead-nettle, with respect to which Mr. Darwin says, "I covered up *Lamium al um* early in June, and the plants produced no seed, although s irrounding plants produced plenty." This again would agree with my conjecture that it is only the flowers produced in winter that are self-fertilised. I may, however, be permitted to suggest that the test of covering up a plant with a bell-glass is not conclusive on the point of cross-fertilisation, as it is quite probable that with plants that are ordinarily self-fertilised, the mere fact of a complete stoppage of a free circulation of air may prevent the impregnation taking place. Has the experiment ever been tried with grasses, which, according to the French observer, M. Bidard are necessarily self-fertilised?

ALFRED W. BENNETT

3, Park Village East, Nov. 8, 1869

A Meteor

THIS evening, at 6.50, Greenwich time, I was called to my door by the letter-carrier, who pointed out a serpentine band in the sky, having a brightness rather above that of the Milky Way. It was about 3° in greatest breadth, and 20° in length. Its longest axis was in the line from the north-west point of the horizon to the pole star, from which, where nearest, it was about 20° distant. Its other extremity was very near the Milky Way, and surpassed every other part in brightness. Its pole-ward termination was faint, filmy, and bifurcated.

The postman said, "About five minutes ago," *i.e.* 6.45 p.m., "whilst waiting at another house, I suddenly became aware of a great light, but on looking up, instead of a shooting star, as I expected, I saw a fixed crooked line, as broad as my finger, and quite as bright as that star" (pointing to Jupiter). It gradually became broader and fainter, but not longer; and I came on here as fast as I could to let you know about it."

I observed it at intervals of five minutes; and observed that it gradually grew fainter and straighter, and moved slowly towards the north-east, its axis remaining apparently parallel to itself throughout. I saw it distinctly at 7.35, but was not satisfied that I did so at 7.40. It must have remained visible from 50 to 55 minutes.

W. PENGELLY

Lamorna, Torquay, Nov. 6, 1869

[It is to be hoped that advantage was taken of this almost unprecedented opportunity to bring the spectroscope to bear upon a meteor cloud. From other accounts the meteor itself appears to have been exceptionally brilliant, and to have burst with noise, as of a rocket (Falmouth); to have changed its colour from yellowish red and lurid red to brilliant green at the moment of explosion, and then from violet to orange (Birmingham.) Another account (Wimborne) states, that at the moment of explosion the colour was dazzling purple and blueish, fading into white at its upper extremity. The cloud was observed to assume a serpentine form both at Bristol and Stokesay. Mr. Pengelly's 50 or 55 minutes' duration was most nearly equalled at the latter place, where it was observed for half an hour. There are ample elements for the determination of the meteor's path.—ED.]

Tempel's Comet

I ENCLOSE an orbit for the comet discovered by Tempel on October 11, of which no elements have yet been published in the *Astronomische Nachrichten*. Indeed, but for an observation kindly sent me by Dr. Winnecke, and not yet printed, it would not have been practicable to work out an orbit.

Elements of the Orbit of Tempel's Comet, 1869, *Oct.* 11.

Elements calculated from an observation at Bonn, Oct. 12, one by Dr. Winnecke, at Carlsruhe, Oct. 17, and a third at Leipzig, Oct. 23:—

Perihelion Passage, 1869, Oct.	8·4421	Greenwich M. T.
Longitude of Perihelion . .	124° 41′ 1″	From appt. Equinox.
,, Ascending Node	311° 24′ 4″	From appt. Equinox.
Inclination to Ecliptic . . .	68° 48′ 8″	
Log. perihelion distance . .	0° 08995	
Heliocentric Motion Retrograde.		

The above orbit does not resemble that of any comet previously computed.

J. R. HIND

Observatory, Twickenham, Nov. 8.

NOTES

THE argument that British manufacturing and commercial superiority cannot be maintained unless the means of a sound scientific education be placed within the reach of all classes all over the kingdom, seems likely to be put to the proof. Oxford and Cambridge local examinations, the examinations by the Society of Arts and the South Kensington Museum, we are told, only serve to show how backward we are in real knowledge, and that we want more schools, more places of instruction. Well, by act of parliament, a number of our Public Schools are to be ruled by new "Governing Bodies," the members of which are to be appointed by different authorities; but we confine ourselves here to the fact that among those authorities are "the President and Council of the Royal Society." These gentlemen, the very head and front of British science, are to nominate a member of the "Governing Body" of each of seven schools, namely, Westminster, Eton, Winchester, Harrow, Charterhouse, Rugby, and Shrewsbury. Here is, indeed, an innovation! The President and Council of the Royal Society will of course nominate men of science. Consequently, science will be taught in all those schools, side by side with the classics. Can the two run together? If science goes up, will Greek and Latin and scholarship go down? We hope not; but these are questions for the future to answer. Meanwhile, we have much pleasure in stating that the two nominations already made by the Council of the Royal Society are such as will command universal approval. Prof. G. G. Stokes, Secretary of the Royal Society and President of the British Association, has been nominated for Eton School, and Mr. W. Spottiswoode, F.R.S., for Westminster School. The interests of science could not be in better hands than these, and we can only hope that the five nominations yet to be made will be equally acceptable. There is movement too in other quarters. The University of Durham is stirring, and desires to establish a school of Physical Science, and to change its humdrum terms of twenty-four weeks in the year, for terms of eight months. All hail to the innovation! Theology at Durham will now have Science for a companion. And the great county of York does not mean to be left behind, for a preliminary meeting of the general council of the Yorkshire Board of Education has been held at Leeds, to talk about the establishment of a Science college. Should this come to pass, the youth of the North of England will have a fair opportunity for scientific education, for Lancashire is already provided with a college at Manchester.

WE learn from the *Astronomical Register* that an Observatory of the first order has been recently inaugurated at Florence with much solemnity, and in the presence of a large number of scientific men of all countries: among them being many astronomers who had come to Florence to discuss the measurement of the great European arc. From the municipality of Florence, the provincial council, the Government, and the King himself, have come the necessary funds : Professor Donati stating that in Italy, at all events, the maxim is well understood that "as private means are insufficient for continuous scientific researches, and as it is clear, that every advance of science, whatever it may be, becomes sooner or later of the greatest public benefit to all classes; it is therefore natural and just that the public coffers, and those of the wealthy, should unite to enrich the patrimony of science, which is the patrimony of all." What a happy day it will be for England when her administrators and statesmen, and Cabinet Ministers, come up to the Italian standard, when the governing classes are sufficiently educated, and single-minded, and far-sighted, to help in the erection of scientific workshops. A crying want at the present moment is a Physical Observatory. He would be a brave man who would suggest that the municipality of London and the Government should supply us with one!

HERE is a welcome piece of news from the *London Gazette* :—"The Queen has been graciously pleased to give orders for the appointment of Joseph Dalton Hooker, Esq., M.D., Director of the Royal Botanical Gardens at Kew, to be an Ordinary Member of the Civil Division of the Third Class, or Companions of the Most Honourable Order of the Bath."

THE Geographical Society commenced work on Monday evening, the *pièce de résistance* being a long communication from Dr. Livingstone, full of interest and important details, to which we may return; the main drift of it is already known to our readers.

MELBOURNE no longer enjoys a monopoly of Australian science. A "Royal Society of New South Wales," to which we heartily wish success, has been established in Sydney, and the first volume of its "Transactions" is now before us. This publication—an octavo of about ninety pages—may be accepted as an earnest of good work yet to come; for, besides the inaugural address by the President (Rev. W. B. Clarke) it contains mathematical, geological, astronomical, and statistical papers. Chief Justice Cockle, F.R.S. (who, by the way, is President of a Philosophical Society in Queensland), contributes a paper on Non-linear Coresolvents; Mr. Gerard Krefft one on the Bones found in a Cave at Glenorchy, Tasmania; Mr. Smalley, the Government astronomer, one on the Mutual Influence of Clock Pendulums; and Prof. Pell one on the Rates of Mortality and Expectation of Life in New South Wales, as compared with England and other countries. In all, there are seven papers in the volume, and we congratulate our cousins at the antipodes on their meritorious contributions to the cause of science.

ON Saturday last the Cambridge Philosophical Society celebrated their jubilee by a dinner, Professor Cayley occupying the chair. It was pleasant to hear the venerable Professor Sedgwick give an account of the formation of the Society, and bless God that he had lived to see it so far on its way.

FROM Saint John's College, Cambridge, we learn that besides seven minor scholarships or exhibitions, there will be offered for competition an exhibition of 50*l*. per annum for proficiency in Natural Science, the exhibition to be tenable for three years in case the exhibitioner have passed within two years the previous examination as required for candidates for honours; otherwise the exhibition to cease at the end of two years. The candidates for the Natural Science exhibition will have a special examination on Friday and Saturday the 29th and 30th of April, 1870, in chemistry, including practical work in the laboratory, physics (electricity, heat, light), and physiology. They will also have the opportunity of being examined in one or more of the following subjects, geology, anatomy, botany, provided that they give notice of the subjects in which they wish to be examined four weeks prior to the examination. No candidate will be examined in more than three of these six subjects, whereof one at least must be chosen from the former group. It is the wish of the master and seniors that excellence in some single department should be specially regarded by the candidates. They may also, if they think fit, offer themselves for examination in any of the classical or mathematical subjects. The exhibitions are not limited in respect to the age of candidates.

WE are promised a new illustrated weekly—the *Graphic*—shortly, and we observe with pleasure that Science is to find a place in it.

THE attention of the Ethnological Society during their last session was directed (in a series of able papers recorded in their journal) to the Megalithic remains—cromlechs, dolmens, stone circles, &c., such as are found in our own island, as well as in all parts of Southern Europe, in India, Arabia, and in Africa along the shores of the Mediterranean. The desirability of collecting evidence of at least relation of race in their builders, which the identity of form and size of these stone wonders suggest, whether found in Kaseem, in Arabia, or in Avebury in Somersetshire—induced the assistant-secretary of the Society to send a competent photographer to take views of the stone circles of Wiltshire. In these views, 12 inches by 10, by a simple method of scale measurement, the exact dimensions are recorded, and the compass bearings noted; enabling the closet student to make careful comparisons. Will not our learned societies, and munificent individuals interested in prehistoric studies, come forward to provide funds to secure a systematic delineation of at least the European Megalithic structures?

WELL-CONSTRUCTED maps are among the most needful appliances of scientific education: we are glad to notice a Physical Map of India, compiled by the Librarian R.G.S. of a size sufficient to render it easy of use, yet showing distinctly the comparative mountain elevations, the great alluvial plains, river systems, &c. This map, which has been adopted by one of our greatest educational establishments, is, we understand, the first of a series.

AT the last meeting of the German Chemical Society in Berlin, the President, Prof. Hofmann, opened the proceedings by referring to the great loss the Society had sustained through the death of their honorary member, Thomas Graham; and remarked: "Graham's was one of those singular minds which create an open new roads of science. Our young society deems itself fortunate to see his name inscribed amongst its members. Let us honour his memory by rising from our seats." On the 9th of October, a German chemist of high standing followed Graham into the grave. Otto Luinė Erdmann was born in Dresden, in

1804. He began his career as a pharmaceutical chemist, but soon embraced pure science with such success that a chair of Chemistry was given to him in the University of Leipzig, in 1830. This chair he occupied until his death; attending to his professional duties with great zeal, although a number of practical occupations (that of director of the Leipzig and Dresden Railway Company, the Leipzig Gas Company, &c.) divided his attention. We owe to him a great number of mineral analyses, a celebrated investigation of indigo, from which he was the first to obtain isatine (in 1840), and several other derivatives, also the analyses of several colouring matters, as jaune indien, euxanthic acid, oxypicric acid, of stearic and of mellitic acid. Together with Marchand he determined a great number of atomic weights with considerable accuracy. With the same chemist, and, after his death, with Professor Werther in Königsburg, he edited the Journal "für practische Chemie"—a journal which will most likely cease to appear, both editors, as well as the publisher, having died during the last few months.

THE Königsburg chair has been offered to Prof. Baryen in Berlin, who declined it, and it still remains open.

PROFESSOR STRECKER of Tubingen has accepted the chair of Chemistry in Wurzburg, in place of the late Professor Schirer, who was known chiefly as a physiological chemist.

IN the Annual Report of the Gardens of the Royal Botanic Society, Regent's Park, recently issued, it is stated that during last season free orders of admission to the gardens for the purpose of study have been granted to 200 students and artists, and 10,653 specimens of plants have been given to professors and lecturers at the principal hospitals and schools of art and medicine. The collection of living economic plants now contains specimens of all the spices and condiments in domestic use, most of the tropical esculent fruits, and many of those from which furniture and other woods are obtained, the principal gums and medicinal products, and the poison-trees of Brazil and Madagascar. The lecturers at the schools of medicine attached to the various metropolitan hospitals are greatly indebted to the liberality of the Botanic Gardens in furnishing them with a copious supply of fresh specimens, so difficult to obtain in London, and without which the lectures would lose so much of their instruction. We may suggest, however, whether some improvements might not be introduced into the so-called "herbaceous" department of the Gardens. A needless amount of space appears to be occupied by the arrangement of British plants in two different classifications, the Natural and the Linnæan, the latter being now entirely abandoned by all teachers of botany. Sufficient care also is not taken that the labels should correspond to the plants really growing beside them. It is confusing to the student to find immediately in front of a label a plant growing in full luxuriance belonging to an entirely different family, which has accidentally strayed there, and has not been weeded out. At Kew this department is kept in much better order. The Royal Botanic Society are now soliciting contributions in aid of the extension of their magnificent winter-garden.

SCIENTIFIC readers who want a treat should read M. Leverrier's masterly argument against M. Chasles in his assertion, based on the forged papers, that Pascal had anticipated Newton's discoveries. How any one could pretend to be unconvinced after such an overwhelmingly true and logical exposition of facts surpasses comprehension. Under the title "Examen de la discussion soulevée au sein de l'Académie des Sciences au sujet de la découverte de l'attraction universelle" M. Leverrier has republished from the *Comptes Rendus* the whole of his argument in ninety-two quarto pages. We recommend all who can to read it.

THERE was an omission—which we are very glad to supply—in our last week's Note on the results of the dredging expedition of the *Porcupine*. A large, if not the greatest share of the labour, both as regards time and work, fell upon Mr. Gwyn Jeffreys, and this fact will make all look forward to the publication of the results with a greater interest.

THE many friends of Professor Morris, who have long admired the zeal displayed by him, not only in giving to the world the sound knowledge which he possesses of geology and palæontology, but in presenting it to his pupils in such a form as to enable them profitably to apply it in after life, now propose to give their recognition and appreciation a substantial form, by presenting him with a suitable testimonial. To carry out this object, a committee has been formed, and Mr. Milnes, F.G.S., of the Coal Exchange, London, has accepted the office of treasurer to the committee, of which Sir Roderick Murchison is president.

THE fruit of the Mango has recently been sold in Covent Garden market, obtained from Madeira. It had previously fruited at Chatsworth, and in the garden of Lord Powis; but, we believe, has not before been offered for sale in this country.

AMONG the books which have reached us this week are two to which we wish especially in the interim to call attention in this column. One of them is the new edition of Sir John Lubbock's "Prehistoric Times," considerably enlarged; and the other is "The World of the Sea," translated from the French of the regretted Moquin Tandon, illustrations which it does one good to see, forming one of the many points of the latter.

THE editors of the new "Journal of Ethnology," published in Berlin, circulate with their first number a hand-bill, in which, after calling attention to the extreme importanc of photography for ethnographical purposes, they request photo aphers of all nations to send to the publishers of the Journal t r addresses, and a statement of the ethnographical types to be fo nd in their neighbourhoods. It may fairly be questioned, whether scientific knowledge is likely to be much advanced by the indiscriminate collection of photographs of individuals, selected by persons totally unacquainted with ethnography. The editors seem, moreover, to be somewhat premature in issuing such a notice as this, as they appear to have taken no steps to arrange for the photographs being published; neither do they undertake to deposit them in any public library or museum. They merely say that men of business will no doubt be found, who will assist in a matter which assures them, as well as the photographers, the renumeration to which they are entitled. We venture to express a hope, that if any general response is made to this notice, the photographers will be at least cautioned to use great care in ascertaining the tribe and parentage of the subjects they select; also that, in all cases, one photograph may be taken i exact profile and another in exact full face.

ASTRONOMY

Winnecke's Comet

THE following ephemeris of Winnecke's comet been calculated by M. Oppolzer.

	R.A. h m s	N. Decl. ° ′
Nov. 11	1 25 40	11 30·0
13	1 24 25	11 12·8
15	1 23 20	10 55·1
17	1 22 24	10 36·9
19	1 21 37	10 18·4
21	1 20 59	9 59·5
23	1 20 29	9 40·4
25	1 20 7	9 21·0
27	1 19 53	9 1·4
20	1 19 47	8 41·5

CHEMISTRY

New Test for Alcohol

LIEBEN has discovered a new and very delicate test for the presence of alcohol, depending upon its conversion into iodoform. The liquid under examination is heated in a test-tube, into which are then introduced a few grains of iodine, and a few drops of potash-solution; whereupon, if alcohol is present, a yellow crystalline precipitate of iodoform is produced immediately or after some time, according to the degree of dilution of the liquid. This test is said to be capable of detecting 1 part of alcohol in 12,000 parts of water. For greater certainty, it is best to examine the precipitate with the microscope, iodoform exhibiting the appearance of hexagonal plates or six-rayed stars.

The test just described is capable of an important physiological application. It is generally supposed that alcohol introduced into the animal organism in the form of wine or other spirituous liquors becomes completely oxidised, and does not pass into the urine as alcohol, but in the form of some product of transformation. Lieben, however, by applying the new test to the urine of a man who had drunk a bottle of wine half an hour before, was able to detect the presence of alcohol in it. A second portion of urine voided by the same individual, an hour later, and a third, after another half-hour, still exhibited the peculiar reaction under consideration. The urine was of course distilled before applying the test, and it had been previously ascertained that none of the other volatile matters contained in it would produce a similar reaction.—[Ann. di Chim. app. alla Med., Sept. 1869, p. 136.]

Preparation of Silver Nitrate

P. SCIVOLETTO proposes the following modification of the process of preparing silver nitrate for use in medicine, photography, &c. This salt is usually prepared from old silver containing copper, by dissolving the alloy in nitric acid, evaporating to dryness, and calcining the residue as long as nitrous fumes continue to escape. The product is a mixture of silver nitrate and cupric oxide, from which the former may be dissolved out by water. The inconveniences of this process are the time it takes, and the difficulty of ascertaining when the cupric nitrate is completely decomposed. To obviate these inconveniences, the author, after evaporating the solution of the mixed nitrates to dryness, redissolves them in water, and precipitates the silver from the neutral solution by means of a clean spiral of copper foil. The precipitated silver is then redissolved in nitric acid, and the resulting nitrate is either crystallised, fused, or left in solution, according to the use to which it is to be applied.—[Ann. di Chim. app. alla Med., August 1869, p. 70.]

A. SAYTZEFF has discovered a new method of converting fatty acids into the corresponding alcohols, namely, by the action of dry sodium amalgam on a mixture of a fatty acid with the corresponding chloride; e.g. acetic acid and acetyl chloride yield ethyl alcohol. In this manner he has prepared ethyl, propyl, and butyl alcohol.—[Zeitschr. f. Chem. (2), v. 551.]

GRUNE has found that the photographic image, as ordinarily produced, is on the surface, and not in the substance of the collodion film. By transferring the film to wood, and then dissolving out the collodion by means of ether, a purely metallic image is left, admirably suited for the purposes of the engraver.

PHYSICS

Thalen's New Map of the Spectra of the Metals

M. ROBERT THALÉN has contributed to the Royal Society of Upsala an important memoir on the determination of the wave-lengths of the metallic lines of the spectrum. Dissatisfied with the pure results of refraction, as not being sufficiently refined to meet the requirements even of ordinary analytical accuracy, the author resolved to construct a new chart, based on the principle of wave-lengths. For the systematic examination of spectra, an electric source of light should always be employed, and entire groups of characteristic lines ought to be observed in all cases. The ordinary spectroscope, with a fine micrometer scale, gives readings which vary sensibly with the temperature and material of the refractive medium; and two such instruments cannot be compared with each other unless by specific tables, or graphically. Accordingly, the highest accuracy can only be attained by direct comparison with the dark lines of the solar spectrum, which themselves furnish an excellent micrometric scale. M. Thalén has therefore founded his experiments on the laborious achievement of Ångström, with whose "normal solar spectrum" he was early associated.

The actual course of operations was as follows. Each bright metallic ray, whose spectrum it was desired to study, was laid down on the plates given by Kirchhoff and Hoffmann (A to G) or by Ångström and Thalén (G to H); these rays were next referred to Ångström's plates of the normal spectrum of the sun, unless a direct comparison with the solar lines could be made; and, lastly, the rays were drawn in the order of their wave-lengths as thus obtained, and sometimes with the assistance of a graphic method, on a map which accompanies the memoir.

The instruments employed in this research consisted of a large Ruhmkorff induction coil, aided by a sufficiently powerful condenser; and a voltaic battery of fifty pairs furnished the light for certain determinations. The spectroscope consisted of two tolerably large telescopes (one being used as a collimator) and a carbon disulphide prism of 60°. In favourable cases, two such prisms or six flint-glass prisms of 60° were employed; but when the intensity was very feeble, only one (of the latter kind) could be used.

The registration in the solar spectrum of the lines of incandescent bodies may be effected by different methods. When the voltaic arc is operated with, or even the induction spark (provided, in this case, that the electrode is made of the metal submitted to experiment), it is convenient to bring the rays from the two sources of light into the slit of the collimator in such a manner that the solar and metallic spectrum are one above the other. If the lines of the latter have sufficient intensity, the reference is effected without difficulty. On the other hand, when the intensity of the electric spectrum is feeble—which is generally the case when the spark is taken between electrodes moistened with saline solutions—it is better that the two pencils should enter the slit in the same direction, so as to be mutually superposed. As the bright lines are now scarcely visible on the illuminated background of the solar spectrum, the latter must be temporarily excluded by a screen; the vertical wire in the eye-piece of the telescope is made to coincide exactly with a bright metallic line; and then, on re-introducing sunlight, its position among the dark lines is seen with precision. It is not unworthy of notice that the exactness of this observation is impaired by a somewhat singular circumstance. If the wire and the Fraunhöfer lines are seen simultaneously in the focus of the eye-piece, the wire being placed among the weaker and narrower lines, it commonly happens that these entirely disappear, or can only be made out with difficulty. The great difference between the intensities of the two objects, and the diffraction fringes produced by the two sides of the wire, are, no doubt, the causes of this curious phenomenon.

M. Thalén gives a table in which the normal spectrum of the sun is recorded in wave-lengths, and compared with the refraction spectrum of Kirchhoff. By its aid, the metallic lines on the chart accompanying the author's paper may be identified with those of the refraction spectra alluded to, and an approximate value can be obtained of the wave-length corresponding to any line. The chart itself gives, in millimetres, the wave-lengths of metallic lines within about 0·0000001 of their true value. It was drawn by hand on paper upon which the scale had already been printed without the usual damping process; in this manner all shrinking was avoided. It is rendered still more valuable by a long appendix of tables, in which all its numerical elements are appropriately distributed among the respective metals. Only the most intense lines, such as are obtained by the induction apparatus, have as a rule, been submitted to measurement.

The following are the names of the metals whose lines coincide with those of the solar spectrum: sodium, calcium, magnesium, iron, manganese, chromium, nickel, cobalt, and *titanium*. The chart contains lines belonging to forty-five metals. Iridium, rhodium, ruthemium, tantalum, and niobium were examined, but without any definite result. The spectrum of air is given at the bottom of the chart, for the sake of reference, and some integers, roughly representing the intensity of the lines.

Some of the lines which show very strongly with metallic electrodes become very weak, when a saline solution is taken, and the more so as this is diluted. Two large and well-marked groups belonging to zinc and cadmium appear only when the metal itself forms the electrode, not the slightest trace of them appearing with a saline solution.

In a concluding note, M. Thalén points out the probable existence of titanium in the sun. Titanic oxide only gave feeble lines, of which a few characteristic individuals were mapped with difficulty. These were afterwards found in the spectrum of calcic chloride, with which some gas-carbon electrodes had been impregnated; but with electrodes of a different material the lines did not reappear. Perfectly pure titanic chloride, however, readily furnished them; and titanium was also obtained, by a chemical process, from the ash of the coal which had yielded the gas-carbon. A direct comparison of the numerous and delicate titanium lines with those of Fraunhöfer, under high dispersive power, left no doubt whatever that titanium must now be added to the list of solar metals.

PHYSIOLOGY

Gases of the Secretions

PFLUGER has investigated the gases of urine, milk, bile, and saliva. The quantity of nitrogen gas is very much alike in all, being in urine ·9, in milk ·75, in bile ·5, in saliva ·75 per cent. in volumes. The quantity of oxygen, on the contrary, varies much more, being in urine ·075, in milk ·095, in bile ·1, in saliva ·5 per cent. Pflüger attributes the larger quantity of oxygen in saliva to the fact that in the much less rapid secretions of bile, &c., the epithelium of the secreting passages consumes, during secretion, a large portion of the oxygen contained in the secreted fluid. In the more swiftly secreted saliva, the oxygen escapes in a large measure this consumption. The quantity of carbonic acid varies according to the reaction of the secretion. In alkaline, bile, and saliva, it reaches 56·1, and 64·7 per cent.; in neutral or acid urine, milk, and bile, it sinks as low as 13·7, 7·6, 5 per cent. respectively.—[Archiv. für Physiol. ii. 156.]

According to Bogoljubow, the carbonic acid of the bile depends largely on the quality and quantity of food taken. It seems to diminish during the stay of the bile in the gall bladder.—[Centralblatt f. Med. Wissen. 1869, No. 42.]

Changes in Milk

KEMMERICH brings forward observations to show that in standing milk, especially at blood-heat, an increase of the *casein* takes place at the expense of the *albumen*. He also confirms the statements of previous observers, that in milk (and cheese) the quantity of fat increases on keeping. He attributes, however, this "ripening of the cheese," to the action of fungi.—[Archiv. für Physiol. ii. 401.]

Effect of Alcohol on Animal Heat

CUNY BOUVIER affirms as the result of experiments on rabbits (apparently carefully conducted with due sense of sources of error) that alcohol lowers the temperature of the body, in small doses to a slight in large doses to a very marked degree.—[Archiv. für Physiol. ii. 370.]

Metamorphosis of Muscle

O. NASSE, extending the previous observations of MacDonnell and others, affirms that *glycogen* is a normal constituent of muscle, the quantity existing in frog's and rabbit's muscle amounting to 3—5 per cent. of the wet mass. He also states that in living quiescent muscle sugar is totally absent, or present in inappreciable quantity only. The conversion of glycogen accompanies rigor mortis, whether natural or artificial, and is also brought about by muscular contraction. Nasse further shows that muscular contraction and rigor mortis are accompanied by a consumption of the total carbo-hydrates of the muscle. The amount of sugar (or glycogen) lost under these circumstances is insufficient, however, to account for the acid (paralactic) produced at the same time; indeed the two processes run by no means parallel, and apparently are not connected.—[Archiv. für Physiol. ii. 97.]

Vertebrate Epidermis

F. E. SCHULTZE describes various modifications of the uppermost layers of the epidermis in vertebrata, distinguishing between *cuticular thickenings* of living cells and *cornification* of dead ones. In particular he describes curious laminated cuticular thickenings of the epidermic cells of various species of *hippocampus*. These cells he proposes to call *flame*-cells, from their curious resemblance to the flame of a candle.—[Max Schultze's Archiv. v. 295.]

Development of Grey Matter of Brain]

ACCORDING to Arndt, the grey matter of the convolutions of the rabbit at birth consists of nuclei imbedded in a protoplasmic matrix, studded with granules, and very faintly fibrillated. After birth the matrix becomes increasingly fibrillated, the granules partly coalesce and partly become dispersed. The nuclei become separated through a greater development of the matrix, and a nucleolus appears in them by coalescence of previously existing nucleolini. Part of this differentiated matrix is directly gathered round various nuclei to form the ganglionic cells and their branches, other parts become arranged in strands to form the axis cylinders of nerves, while the rest remains as the permanent granular faintly fibrillated matrix of the adult brain. Arndt tries to accommodate the "Cell theory" to these new facts.—[Max Schultze's Archiv. v. 317.]

Regeneration of Spinal Cord

MASIUS and VAN LAIR assert that if strong frogs be operated on in early or mid winter, complete reparation of structure with restoration of powers takes place, even when sections of the whole spinal cord 1–2 mm. in length have been removed. Degeneration occurs first at either cut surface: the central end swells by deposition of new tissue into a hollow cup-shaped bulb; the peripheral contracts into a cone fitting into the former; and so union takes place.—[Centralblatt, Med. Wissen. 1869, No. 39.]

SOCIETIES AND ACADEMIES

Syro-Egyptian Society, Nov. 2.—Mr. W. H. Black, F.S.A. in the chair. The latest communication from Dr. Livingstone, that he has found what he believed "to be the true sources of the Nile, between 10° and 12° south (latitude) or nearly the position assigned to them by Ptolemy," was received with much satisfaction; and the passages in the Greek text of Ptolemy's geography, relative to "the mountain of the moon," from which the lakes "of the Nile receive the snows," *twice placed by him in 12½ south latitude*, were read; and the old traditional maps, showing a mountain range of about 10° of longitude in extent, with streams running northward into two lakes (as published in the Amsterdam edition of 1605), were compared therewith. A resolution was then passed, sympathising with Dr. Livingstone in his laborious researches, and congratulating the present age on this confirmation of ancient scientific literature by means of modern exploration.

Mr. Black described the results of his own recent application of the symbolic and mathematic teaching of the great pyramid to the geometric geography of Africa; stating the full conformity of that monument to the geodetic laws and uses of other uninscribed megalithic monuments in Asia and Europe, which have been erroneously assigned to religious and superstitious purposes. He promised to illustrate the subject further, and to demonstrate by diagrams the results then verbally described, at a future meeting of the society.

Anthropological Society, Nov. 2.—Dr. Beigel, V.P., in the chair; the following new members were announced:—*Fellows.*—Captain G. J. D. Heath; Dr. Samuel E. Maunsell, R.A.; Messrs. Thomas Milne, M.D.; E. W. Martin; Robert Watt; Horace Swete, M.D.; Lieut. Wm. Francklyne; and Wm. Pepper. *Hon. Fellow.*—M. Le Baron d'Omalius d'Halloy. *Corresponding Member.*—Professor Dr. August Hirsch.

Mr. Pike read a paper on the Methods of Anthropological Research. He considered it useless to speak of methods of research without some previous definition of the objects of research. The real difficulty in anthropology was to know what to observe, and how to verify. He believed that the science could advance only by a double method of observation—the observation of mankind individually and in masses, and that the conclusions suggested by the observation of masses, races, or nations must be verified by the observation of individuals, and *vice versâ*. For this reason he thought it was a mistake to speak of ethnology as a science, as it consisted only of a series of disjointed observations without conclusions, and without the means of verifying conclusions if made. Mr. Pike then reviewed at considerable length the ramifications of Anthropology into anatomy, physiology, psychology, and the various subdivisions of those studies, suggesting that all kinds of unsuspected correlations were yet to be discovered by a rigorous application of a scientific method. The relations of mind to body, of faculty to faculty, of one part of the body to another, were still removed but little from the realms of mystery from which only anthropology could thoroughly drag them away. Mr. Pike concluded by describing anthropology in one of its aspects as the only kind of philanthropy which could be of service to mankind—philanthropy founded upon science.

BIRMINGHAM

Natural History and Microscopical Society, October 26.—Mr. G. Heaton exhibited a collection of sea urchins, of the species *Echinus Sphæra*, recently taken on the North-West coast of Ireland, and exceeding in dimensions the largest recorded by Professor Forbes. Mr. W. R. Hughes, in reference to these magnificent specimens, gave a general account of the structure and functions of the Echinodermata. He contrasted the mode in which calcareous matter is deposited in the Mollusca and other classes, with that which is characteristic of the Echini. Thus, in the Mollusca it is secreted in various directions by the "mantle" of the animal; in Crustacea it is deposited externally to the epidermis, and is cast off when the animal becomes too large for its covering, and replaced by a new shell reproduced in like manner; while in the tubicular Annelids a similar process prevails. In Anthozoa and Madreporidæ it is secreted at the base of the animal from its gelatinous investment; and again in Spongiadæ innumerable calcareous spiculæ are deposited throughout the mass. In Echinodermata, on the contrary, a method totally different from all the preceding is observed, the calcareous matter really forming a box, as distinguished from a shell, in which the viscera float in a surrounding medium of sea-water, and inasmuch as this box can never be cast off or replaced during the growth of the animal, from its original size of a pea, up to its full dimensions of 13 in. or 14 in. in circumference, a very special and wonderful provision is made for the gradual enlargement of the dwelling. This is effected by the secretion of the calcareous salts, not only on the interior but at the margins of the 600 pieces or plates of which the case is composed; so that by the slow extension of every one of these at its edges, the whole undergoes a corresponding gradual expansion in every direction, commensurate with the development of its tenant. Mr. Hughes referred to the fact that the magical number 5 prevails in a peculiar manner throughout the class, instancing the 5 rayed star-fish, the 5 teeth, 5 jaws, &c., of the Echini. The subject was further illustrated by various recent and fossil Echinoderms, contributed by Mr. R. M. Lloyd; spines of *Sidaris* from the South Sea Islands, the star-fishes *Cribella rosea* and *Uraster rubens*, by Mr. G. S. Tye, &c.

EDINBURGH

Geological Society, November 4.—The president, Mr. Geikie, delivered the opening address. After congratulating the society on its recent progress, he passed on to bring before its notice three special branches of inquiry, wherein much useful work remained to be accomplished. The first of these related to the study of organic remains, which, in the opinion of the speaker, was too much dissociated from that of the strata among which they are preserved. He thought that the palæontology of each geological formation should be as far as possible the natural history of a certain period of the past life of the globe. We should try to discover from the fossil remains more of the general character of the contemporaneous fauna and flora; the nature of the sea-bottom or land-surface on which they flourished; their various modes of growth; their distribution in space as well as in time; the light which they cast upon changes in the organic world, and the influence of these changes upon them; the causes of their decay as individuals and as species, and the circumstances under which they had been finally entombed. Mr. Geikie illustrated this subject from the rocks of the central valley of Scotland. He then passed on to the second topic, which related to the mineral structure of rocks or petrography. That branch of the science had fallen into strange neglect in this country. After indicating what had been done and what was now doing in Germany in that department, he pointed out the special way in which it lay open to observers in Scotland, and pressed upon the society the desirability of cultivating it. The third branch of his address bore on the balance of the various forces which have been instrumental in modifying the surface of the earth. Observers in Britain, he said, enjoyed special advantages when they set themselves to investigate this question. The completeness of their geological series, the diversities of configuration in their country, the extent of their coast line, the multiplicity and variety of their brooks and rivers, all conspired to aid them. On the other hand, they were apt from this very completeness of their opportunities to take a local and limited view of the phenomena. This he thought had really happened in the case of their estimate of the potency of the sea as a geological agent. Their position as islanders had led them to take an exaggerated view of the results attributable to the waves in the general economy of nature, and to undervalue the power of rains, springs, frosts, and rivers, which in this country do not produce the changes which they effect elsewhere. He pointed out how vast was the extent of coast-line where the sea did not reach the solid framework of the land, but was barred back by long lines of alluvial deposit—the waste of the land brought down by the streams. The sea in these instances, although perpetually wasting the sand-bars, did not perceptibly encroach on the land, for the bars were constantly being renewed from behind. The land, though not diminishing in breadth, was inch by inch sinking in height, the power of the sea being no more than equal to sweeping away the detritus brought down to the coast by the drainage from the interior. Although seemingly paradoxical, he yet believed that in the general balance of forces the influence of the ocean is more conservative than destructive, there being a greater area of rock under the sea, preserved there from that universal corrosion and removal which befall every part of the earth's crust that rises above the waves. The concluding portion of the address dealt with the relation at present subsisting between science and religion.

BERLIN

Chemical Society, October 25.—Prof. Fritzsche communicated a paper on the action of cold on tin. Tin was exposed to 40° C., the temperature produced by Carré's refrigerator. It was found changed in colour and structure, the latter becoming granular, and the colour turning from white to grey. By heating it to less than 100°, the white colour could be restored. By prolonging the action of the cold, the tin became so brittle, that it could easily be powdered, and a kind of blister appeared on the surface of the metal. This explains similar changes observed by the same chemist in block-tin and organ pipes exposed to the cold of a Russian winter. Emmerling reported on liquefied oxychloride of carbon. It constitutes a colourless liquid, and boils at 8° above zero. The oxychloride of carbon prepared in the usual way contained an excess of chlorine, which was absorbed by passing it over antimony, before the gas was condensed through cold. Der Müller communicated some observations on the preparation of Chloral. Prof. Kekulé sent in a report on Chemistry at the German Association of Innsbruck. This report being not as yet complete, we shall return to the subject.—A. O.

PARIS

Academy of Sciences, November 2.—MM. Sainte-Claire Deville and Dieudonné communicated a paper on the industrial employment of the mineral oils for heating engines, especially locomotive engines, in which they describe certain experiments made by the company of the Chemins de Fer de l'Est, tending to show that petroleum and coal oils may be advantageously employed to heat the boilers of locomotives. M. P. Thenard read a note in reply to that communicated to the Academy at its last meeting, by M. Pasteur, on the employment of heat for the preservation of wines. M. de Verneuil made some remarks on the conclusion of M. de Tchikatcheff's work on Asia Minor, giving a general account of the contents of the volume, which treats of the physical geography and natural history of that region. A memoir was presented by M. Hébert, entitled "Researches on the Chalk of the North of Europe." He distinguishes in the chalk of the Paris basin some distinct stages, the distribution of which, especially in the north of Europe, he indicates. A paper, by MM. Fougué and Gorceix, containing a chemical investigation of several of the gases with combustible elements of Central Italy, was presented by M. C. Sainte-Claire Deville. The authors have analysed 28 gases, collected in Italy—4 from the Tuscan *lagoni*, 24 from various stations in the Apennines, between Modena and Imola. Their analyses of the former confirm the results of MM. C. Sainte-Claire Deville and Leblanc: they contain free hydrogen. None of the gases contain acetylene, hydrocarbons of the series $C^{2n}H^{2n}$, or oxide of carbon. The gas from Sassuno contains hydride of æthyle, and those from Porretta carbonic acid in considerable quantity, and traces of sulphuretted hydrogen. These gases are characterised by the predominance of marsh gas in their composition, and they are very frequently impregnated with vapours of liquid hydrocarbons of the series $C^{2n}H^{2n+2}$. M. Faivre communicated an account of experiments upon the effects of wounds of the bark by annular incisions under various physiological conditions. In a note upon a measure of length unalterable by changes of temperature, M. H. Soleil proposes to make standard rules of beryl. He remarks that beryl, when heated, dilates in a direction perpendicular to the axis, and contracts in the direction of the axis; there will consequently be an intermediate direction in which no dilatation takes place, and in this he proposes to cut his standard rules. Some observations on the constitution and movement of glaciers, by MM. C. Grad and A. Dupré, were presented by M. Leverrier. The authors investigated the structure of the ice of the great Aletsch and other glaciers at different points of their course, and found that in all cases the size of the grains or constituent elements of the ice gradually increased from above downwards. They also noted the movements of the Aletsch glacier at those points of its course, and the amount of surface loss which it underwent by the action of the sun in the latter part of August, when their observations were made. A note by M. J. B. Baille on the heat reflected by the moon, was presented; the author confirms the results obtained by MM. Piazzi Smyth, Marié Dacy, and Lord Rosse. A notice of a new synthesis of guanidine, by M. G. Bouchardat, was presented. The author, in repeating M. Natauson's experiment for the production of urea by the action of gaseous ammonia upon oxychloro-carbonic gas, found that other amides of carbonic acid were produced, especially guanidine, the sulphate of which he obtained crystallised. Melanuric and cyanuric acids are also produced. M. C. Dareste communicated a note on arrest of development regarded as the proximate cause of most simple monstrosities; M. Bonchut read a note on hydrate of chloral, with especial reference to its physiological action, which led to some remarks by MM. Bussy and Dumas. An extract from a report by M. Gauldrée Boilleau on the recent earthquakes, and a fresh outbreak of yellow fever at Peru, was read, a note on the etiology of goître, by M. D. Brunet; a note on the phosphorescence of the sea, by M. Duchemin; and a note on the causes of the mortality of new-born infants and on the means of restraining it.

Prague

Royal Society of Bohemia—Natural Science Section, October 6.—M. E. Weyr read a memoir on the conic sections inscribed or circumscribed upon a triangle, having a double contact with a fixed conic section.

October 27.—Dr. E. Schöbe read a paper on the discovery of the terminations of the nerves in the wings of the Chiroptera. The well-known power possessed by bats of finding their way thro' gh numerous small obstacles, even when blinded and deafened, has led several anatomists to seek for the nervous apparatus by which this great sensibility is attained. Cuvier described a complete nervous network in the wings; but what he took for nerves, turn out to be elastic trabiculæ. Leydig and Krause have also published upon this subject. The author describes the wings in several genera of bats as composed of a duplication of the general integument, in which the two layers of cutis become amalgamated. The epidermis consists of a single layer of lineagonal cells, and the *rete Malpighianum* of two layers of cells, the upper ones large, polymorphic, and filled with colouring matter. The cutis contains very complete systems of elastic trabiculæ and striated muscles, and a vascular system, which were described in detail by the author, as also the hair-follicles, each surrounded by 7 or 8 sebaceous glands, and a hydrotic gland. Each wing has from 8,000 to 10,000 hairs, with their glandular systems. The nervous system is very highly developed and delicate. The principal branches follow the direction of the great vessels; the last ramifications, composed of from 8 to 12 fibrillæ, issue from the neurilemma, and form bundles, each consisting of 4 fibrillæ. Each bundle runs to a hair-follicle; two of its fibrillæ surround this in a loop, and terminate in a stratiform, *terminal papilla*, formed by the twisting of the fibrillæ into a ball; the other two interlace with the free fibrillæ of adjacent follicles, and form an extremely delicate terminal nervous network. The terminal papillæ are compared by the author to those in the human skin; he has sought and found papillæ also in the mouse, shrew, and mole. Dr. A. Fritsch announced the discovery of a new reptile, or batrachian, in the coal of Nyran, in the south-west of the carboniferous basin of Pilsen. The head is triangular, less elongated than that of *Archegosaurus;* the orbits are large; the lower jaw furnished with denticles; the vertebræ numerous, very close and equal, and the anterior limbs slender, and but little developed. The animal was probably about a foot in length. It is compared by the author with the well-known *Proteus anguinus* (= *Hypochthon Laurentii*).

SCHAFARIK

DIARY

THURSDAY, November 11.

London Institution, at 7.30.—On Architecture, or the Fine Art of Building: Prof. Robert Kerr.

Zoological Society, at 8.—On the Anatomy of the Aard-Wolf (*Proteles cristatus*: Prof. Flower, F.R.S.

London Mathematical Society, at 8.—General Meeting at Burlington House.

FRIDAY, November 12.

Astronomical Society, at 8.

MONDAY, November 15.

London Institution, at 4.—Elementary Physics; Prof. Guthrie.

TUESDAY, November 16.

Statistical Society, at 8.—Inaugural Address by the President: W. Newmarsh, F.R.S. Report on the International Statistical Congress of 1869: Mr. Samuel Brown.

Institution of Civil Engineers, at 8.—Discussion on Mr. Gandard's Paper on the Strength and Resistance of Materials; and, time permitting, Public Works in the Province of Canterbury, New Zealand: Mr. Edward Dobson, Assoc. Inst. C.E.

WEDNESDAY, November 17.

Meteorological Society, at 7.—Lunar Influence upon Rainfall: Mr. J. C. Bloxam, M.R.C.S. On the Summer of 1868; Dr. G. H. Fielding.

THURSDAY, November 18.

Royal Society, at 8.30.

Linnean Society, at 8.—Review of the genus *Hydrolea*, with descriptions of three new species: Mr. A. W. Bennett, F.L.S.

Chemical Society, at 8.

London Institution, at 7.30.—Architecture: Prof. R. Kerr.

BOOKS RECEIVED

English.—Cassell's Technical Manuals: Projection, Linear Drawing, Building, Construction (Cassell).—Our Houses (Cassell).—First Book of Indian Botany: Prof. Oliver (Macmillan).—Via Medica: B. Langley (Hardwicke).—Wonders of Italian Art: Louis Viardot (Sampson Low).—What is Matter? Inner Templar (Wyman and Sons).—Essays on Physiological Subjects: G. W. Child (Longmans).—Phenomena and Laws of Heat: A. Cazin, translated by E. Rich (Low).—Thunder and Lightning: W. De Fouvielle, translated by T. L. Phipson (Low).—Wonders of Optics: F. Marion, translated by C. W. Quin.—Tommy Try and what he did in Science (Chapman and Hall).

American.—Origin of Genera: E. A. Cope (Trübner).—Annual Report of the Trustees of the Museum of Comparative Zoology at Harvard College.

Foreign.—Vierteljahrsschrift der Astronomischen Gesellschaft.—Les Pierres, Esquisses Minéralogique: L. Simonin (Hachette).—Bibliothèque des Merveilles: 4 vols. (Hachette).—Dictionnaire Général des Sciences: Privat-Deschanel et Ad. Focillon.—Untersuchungen über einige merkwürdige Thiergruppen des Arthropoden-und Wurm-Typus: Dr. R. Greeff.—Handbuch der Edelsteinkunde: Dr. A. Schrauf (Through Williams and Norgate).

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"*To the solid ground*
Of Nature trusts the mind that builds for aye."—WORDSWORTH.

THE object which it is proposed to attain by this periodical may be broadly stated as follows. It is intended,

FIRST, to place before the general public the grand results of Scientific Work and Scientific Discovery; and to urge the claims of Science to a more general recognition in Education and in Daily Life;

And, SECONDLY, to aid Scientific men themselves, by giving early information of all advances made in any branch of Natural knowledge throughout the world, and by affording them an opportunity of discussing the various Scientific questions which arise from time to time.

To accomplish this twofold object, the following plan will be followed as closely as possible:

Those portions of the Paper more especially devoted to the discussion of matters interesting to the public at large will contain:

I. Articles written by men eminent in Science on subjects connected with the various points of contact of Natural knowledge with practical affairs, the public health, and material progress; and on the advancement of Science, and its educational and civilizing functions.

II. Full accounts, illustrated when necessary, of Scientific Discoveries of general interest.

III. Records of all efforts made for the encouragement of Natural knowledge in our Colleges and Schools, and notices of aids to Science-teaching.

IV. Full Reviews of Scientific Works, especially directed to the exact Scientific ground gone over, and the contributions to knowledge, whether in the shape of new facts, maps, illustrations, tables, and the like, which they may contain.

In those portions of "NATURE" more especially interesting to Scientific men will be given:

V. Abstracts of important Papers communicated to British, American, and Continental Scientific societies and periodicals.

VI. Reports of the Meetings of Scientific bodies at home and abroad.

In addition to the above, there will be columns devoted to Correspondence.

The following eminent Scientific men are among those who have already promised to contribute Articles, or to otherwise aid in a work which it is believed may, if rightly conducted, materially assist the development of Scientific thought and work in this country:—

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LECTURES TO WORKING MEN

THE workmen of England wish for more education. I speak of the better classes of them; those who can read and write and cast up accounts in some sort of fashion, though it may in many cases be a poor one. There is a great desire, which is very widely spread among them, for some kind of higher education: they wish to learn something of Science. They cannot learn it at school, and they cannot get all they want from books; so that they must look to a great extent for what they require to evening lectures. Now in these there are two things which they dread. The first is that they should only hear a string of technical terms, which they cannot understand; and the second is that they should have what ordinarily go by the name of "Popular Lectures on Science," lectures which are often illustrated by inconsequent "experiments." We have not to go far to find the reason of their dislike to such lectures: the fact is, they distrust them. The English workman is a clear-headed, shrewd man, and he has a good intuition of what is worth having. That is the reason he cares for scientific knowledge. He knows very well that science is "one of the best things going;" and he has also a very thorough appreciation of everything of the nature of humbug in any line whatsoever. Perhaps there is no audience in the world who, on the one hand, recognises readily the existence of humbug, and, on the other, recognises what is genuine, so well as an audience of intelligent English working men. I have often conversed with such men, and while I have heard them express the greatest desire for scientific information, I have heard them also speak most disrespectfully of that which is too often presented to them instead of it; and I have, over and over again, heard this said, "What is the use of our going to lectures, when we are to hear no more of the subject again?" Such sentiments as these find practical expression in the fact that I have found courses of a few consecutive and carefully digested lectures to workmen always well attended by a persistent audience. It is nothing desultory that these men want, but something solid—something which will give them real information. What they want is not a single lecture, or bits of the thing shown to them in a random sort of way, but a piece of real teaching, something which helps them to see their way a little through some subject, and gives them a better grasp of the thing which they are seeking for, namely, the method and facts of science. To be told only a number of the facts and results of science without the method is what workmen do *not* want; they are greedy for the facts of science, but they want something more. On the other hand, to try to impart to them the method of science without doing so by some particular instance, is to engage them in a kind of vague philosophising, suitable perhaps for the learned, but not for the ignorant. Ignorant people do not want, and cannot profit by, abstractions.

I believe, therefore, that a real demand amongst working men is supplied by short courses of lectures on scientific subjects, given in the evenings in some Institute or Mechanics' Hall. The lectures should not occur more than twice, or perhaps once, a week. We must never forget that it is a hard matter for a working man to get to a lecture in an evening. To give such a set of lectures to working men calls for those who are well versed in the subject with which they are to deal; for it is only such who can speak free from technicalities. It must be remembered that workmen have no previous information, no knowledge of mathematics or of technical terms, which may enable us to shorten demonstrations or explanations. Everything requires to be explained to them *ab initio;* and it is only a man well versed in the subject down to the minutest particulars who can do this well. It is only such a man who can bring forward the first rudiments of a subject shortly, distinctly, and so as to interest his audience, *without being superficial.* Others speak from too bare a mind. But a man deeply versed in a subject can put it in a perfectly elementary way, and yet weave about it the interest of its most advanced portions. We have to show workmen the main points of an argument; they cannot come to, nor can we afford to give them, thirty or forty lectures, as we should do at the University. We can only give them three or four, and we must do the best we can in these. The best we can do seems to me to be this, to choose from the branch of science, which we wish to bring before them, some one of its most characteristic parts; and, while following out the great steps of that particular argument, to so illustrate it as to suggest and open up the rest of the subject, at the same time taking care to bring all to bear on one thing. A great point to aim at is, that all that we speak about should have a relation to the subject in hand, and such a relation as our audience will easily perceive—that we should not, in fact, bring before them isolated facts or theories, but always something connected, something logical. This indeed is the great end of teaching science: to get people into a better style of thinking about things; and this is just what, as soon as these men find it, they greedily snatch at; for they aim at some knowledge of science for a reason which is perhaps not quite clear to their own minds; but when they get the thing they want, they recognise that it is what they want.

Our English workmen, in fact, have not quite enough logicalness about them. They are apt to be led away by wrong arguments, by conclusions which do not quite follow from the premises. And, what is more, they (at least the best of them) know that quite well. And that is just the very point where some instruction in science helps them; where the scientific method—the method of getting hold of facts and putting them together, and doing so in a strict and careful way—helps people. And this is just what the workmen of this country need, and what a large number of them feel that they need, and the very reason for which they desire scientific knowledge. Now where this desire exists, do not let us hear them ask for bread and give them a stone. The future of England depends on these men. They are hard-headed, honest, straightforward men; and they think a deal; and they have got their faults, and not the least of them is this fault of being somewhat illogical. I have heard both employers and workmen say, "It is because our men are too apt to be led away by inconclusive arguments, that half the errors which they commit are committed." To any one who has studied the matter of the failure of so many workmen's Benefit Societies, the truth of these remarks will be evident. I am not here expressing any opinion as to the rights or wrongs of many things at which workmen aim, and in which they engage. But totally irrespective of opinion, it is evident that there are many important questions the management and the decision of which are in the hands of the working men, and a right view of the respective importance of facts and of argument is the only safeguard against being misled. It is just at this very point that scientific teaching helps to set men right. I am not saying whether or not I believe that Science is to be the regenerator of mankind. But this is certain, that there is a great benefit to be gained from scientific teaching, that it supplies to working men that which as a class they are deficient, and that which as a class they are desirous of having; and that here there is open before all who care for these matters a wide field of direct and immediate utility.

I have seen six hundred men, on a tempestuous winter evening, come to a lecture on Astronomy at one of our great workshops in the North. It is a wonderful sight to see so many faces intelligent and seeking for knowledge. Working men are a peculiar audience: they are rather fond of cheering; and I have often had to check a piece of applause arising just before the conclusion of a demonstration which was tying together, so to speak, in a knot, several threads of argument. Such applause, coming, as I have so often seen it, *just before* the completion of an argument, indicates the satisfaction which all feel, and which these men are unsophisticated enough to express, when there just begins to dawn upon them the feeling of seeing, without being told, what some things have got to do with one another; the feeling in fact of making a discovery. And I can fancy nothing more encouraging to a lecturer who loves his subject than such facts, and nothing which more bears out the assertion that I have made, that there is among working men a true desire for, and a true appreciation of, something genuine in science. Working men—at least those with whom I am acquainted, and I am acquainted chiefly with the northern districts of England—have a strong perception of right and wrong, a strong moral character, a clear and open way of giving everything a fair hearing—that natural honesty which is the backbone of a nation. And if we add to this the powerful logic and the wide information which the true teaching of science imparts, we bid fair to make the democracy of England a model for that of all other countries.

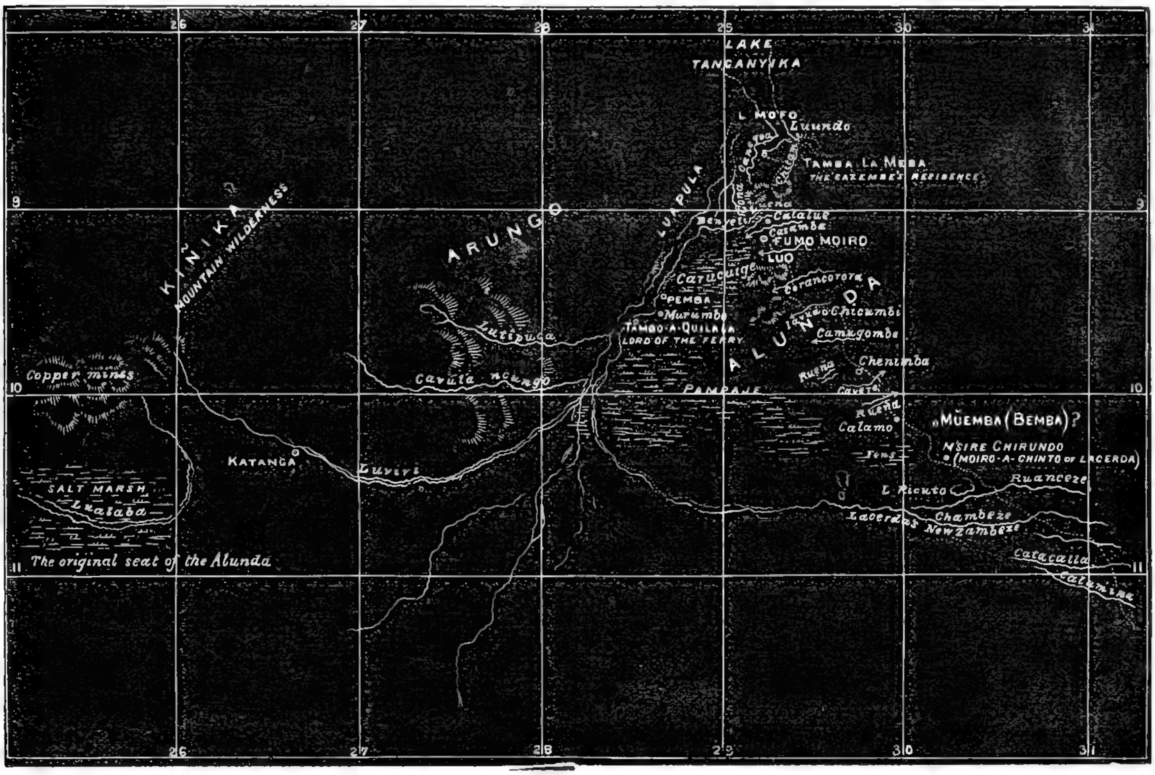
JAMES STUART

DR. LIVINGSTONE'S EXPLORATIONS

THE letters from Dr. Livingstone lately read at the Royal Geographical Society, give the grateful assurance, not only that he was in good health and spirits in July 1868, but also that he was under no apprehension of ill-treatment from the Cazembe. Visiting that chief without a numerous escort, he created no alarm. He has, in truth, notwithstanding seeming difficulties, been singularly fortunate; for his rumoured death and expected captivity have created a sensation of much greater value to him than the discovery of the Nile's sources. Dr. Livingstone's account of his journey northwards from the Aroangoa is in general reconcilable with those given by the Portuguese expeditions, with some difference, however, arising from difference of route. He seems to have crossed that river much further to the west than Monteiro, whose line of march was ten or twelve miles more west than that of Lacerda. He saw mountains, he tells us, and the Portuguese saw none. Herein he is greatly mistaken: Monteiro's expedition crossed over the flanks of a wondrous mountain, supposed to be a Portuguese league (about 20,000 feet) high, with trees, population, but no snow on its broad summit. The account of this mountain, called by mistake Muchingue (the glen or defile), given by a writer in the Journal of the Royal Geographical Society (vol. xxvi.), improves the original by a precise statement of longitude and latitude, and by a description of the panoramic view from the summit to a distance of 200 miles.

The high land which culminates towards the east in Muchingue was ascended on leaving the valley of the Aroangoa. The traveller then came in lat. 10° 34′ S., to the river Chambezi, called by Lacerda the New Zambezi, flowing from east to west, and rarely fordable. He remarks that it resembles the Zambezi, not in name only, but also in the abundance of food found in the stream or on its banks. He forgets that the critic who denied his explanation of the name Zambezi (river *par excellence*), showed that in all its forms, Liambegi, Chambezi, Yabengi, &c., it means simply (river) "of meat" or animal food. The Chambezi abounds in oysters, but we know nothing of their flavour. This river, according to Dr. Livingstone, forms in the west the great Lake Bengweolo, from which it again issues to the north under the name of Luapula; but we believe it would be more correct to say that it joins the Luapula, a much larger river, the great marsh Pampage, which is, doubtless, often overflowed and converted into a lake, lying in the angle between the two rivers. Then we are told—"The Luapula flows down north past the town of Cazembe, and twelve miles below it enters the Lake Moero." From this it might be concluded that the river flows by the chief's town, and that twelve miles lower down, or further north, it enters the lake, but this cannot possibly be the traveller's meaning. Lake Moero forms a remarkable feature in Dr. Livingstone's latest discoveries, but his account of it is singularly perplexed and obscure. We know that the Luapula flows to the north or N.N.E., some eight or ten miles west of the Cazembe. Lake Moero, by our traveller's account, is fifty miles long, and from 30 to 60 miles wide. "Passing down," he says, "the eastern side of Moero, we came to the Cazembe;" and again he states that "the Cazembe's town stands on the north-east bank of the lakelet Mofwe, two or three miles broad and four long, totally unconnected with Lake Moero." In endeavouring to reconcile these statements it is necessary to beware of rash conclusions and inaccurate expressions. It is a hazardous thing to pronounce upon the length, breadth, and boundaries of lakes without surveying them. The Portuguese officers in 1831 obtained leave to examine Lake Mofo or Mofwe, and for that purpose went four and a half leagues N.N.E. along its shore, till they came to the Lounde, a river, as they called it, two miles wide, where they expected to find boats. These, however, had been purposely removed, so that the explorers were brought to a stand. They had proceeded far enough, however, to perceive that the lake turned to the north-west. They did not see the end of it, but state distinctly that it communicates with other large lakes. Dr. Livingstone, describing the flooded state of the country, tells his experience of two rivers which flow into the north end of Moero: the Luo, which was crossed by the Portuguese, thirty miles south of the Cazembe's town; and the Chungu, near which Lacerda died, about ten miles south of that place. From these particulars we cannot help concluding that the Moero of our traveller, who has found the country in a state of flood, is the Carucuige of the Portuguese, or at least that these names apply to parts of the same great marsh or lagoon. At the eastern side of it, visited by Dr. Livingstone, is the Fumo Moiro, whose title is probably taken from his district. Manoel Gaetano Pereira, who first visited the Cazembe, related, that near the chief's town he spent a whole day wading breast-deep through a lagoon. It was subsequently found that the lagoon in question was Carucuige. The strength of the Cazembe's position lies in the difficulty of approaching it through a labyrinth of swamps, lakes, and wide drains. The Portuguese spent some hours in crossing a river, as they called it, two miles wide, on matted vegetation which sank under their feet. This and the Loûnde above mentioned were probably the connecting arms of large lakes.

Our traveller informs us, that "the Luapula, leaving Moero at its northern end by a rent in the mountains of Rua, takes the name of Lualaba, and, passing on N.N.W., forms Ulenge in the country west of Tanganyika." He saw the Luapula only at this gap in the mountains. Ulenge is a lake with many islands, or a separation of the river into many branches. "These branches," he goes on to say, "are all gathered up by the Lufira. . . . . I have not seen the Lufira; but, pointed out west of 11° S., it is there asserted always to require canoes. . . . . This is purely native information." Now it is quite possible that the traveller totally misunderstood his native informants. They spoke of the waters to the S.W., and he understood them to speak of the N. or N.E. The great river Luviri, called by the Arabs Lufira, flows into the Luapula from the west, about 100 miles S.W. or S.S.W. from the Cazembe. The Lualaba, the sacred river of the Alunda, whence their forefathers emigrated, still farther west (a month's journey), falls into the Lulua, and so joins the Zaire. The great salt marshes, which chiefly supply the interior of Africa, are situated on its banks at its southern bend; these may be the Ulenze above described, if it be not a marshy tract lying between the sources of the two rivers. The native information here given cannot be received as perfectly pure. When our author speaks of the Luviri entering Tanganyika at Uvira, he evidently casts the dimly discerned views of the natives into his own preconceived mould, and clothes them in his own language.



Respecting the language of this country, our author informs us that "the people are known by the initial Ba instead of the initial Lo or U for the country." This is not merely confused, but also, we believe, wholly erroneous. The initial U never forms the name of a country, but the collective name of a nation, chief, and people. The Portuguese, who on this point are the best authorities, use the names Alunda, Arungo, Acumbe, not Balunda, &c. They tell us that the Alunda never pronounce the letter r, and that in writing the names Arungo, Moiro, &c., in which that letter occurs, they have adhered to the Maravi dialect. We thence conclude that for the names Rua, Moero, Lufira, &c., and perhaps for the initial Ba above alluded to, Dr. Livingstone is probably indebted to his Arab friends, who rest satisfied with a jargon, in some degree intelligible everywhere, and nowhere perfect.

Dr. Livingstone seems to be elated with the discovery that "the chief sources of the Nile arise between 10° and 12° S. lat., or nearly in the position assigned to them by Ptolemy, whose river Rhapta (?) is probably the Rovuma." Here two different problems are attempted to be solved at once—one touching the Sources of the White Nile, and the other, those of Ptolemy's Nile. With respect to these latter, it will be enough to observe that Ptolemy's Lakes of the Nile, two in number, 8 degrees asunder, are placed by him respectively in lats. 6° and 7° S., but his graduation being defective, through an imperfect estimate of the length of a degree, the positions thus assigned to the lakes fall under true graduation, to 11″ N., and 40″ S. of the equator. Ptolemy's Lakes, therefore, have not been reached by the zealous traveller.

With respect to the sources of the Bahr el Abyad, they may of course be traced to the head waters of the Luapula, provided that the results of Capt. Burton's observations on the altitude of Nyanza and the character of its northern end are completely thrown aside. With a greater elevation, and an outlet through Speke's Mountains of the Moon, the waters of the lake may reach Egypt.

It is to be regretted that Dr. Livingstone missed the opportunity of viewing the highest mountain in this part of the world, now known only by a ridiculously exaggerated description; and also a most interesting point in the centre of Africa. The great town, Katanga, as described by the Arabs, is near the copper mines, where 75 lbs. of copper may be bought for 4 cubits of American sheeting. The town is larger than Roonda (the Cazembe's town), and has good bazaars; it stands on the Rafira (Luvira) which joins the Ruapura (Luapula). The people are peaceable, and kind to strangers. The people from Zanzibar learned the language almost immediately.

F.R.G.S.

[We give a map of the region recently traversed by Livingstone, showing its connection with the known points in this part of Africa. We owe this map to the courtesy of the officers of the Royal Geographical Society. —Ed.]

CUCKOWS' EGGS

SCARCELY any bird has so much occupied the attention, not merely of naturalists, but of people generally, as the Common Cuckow of Europe, and (we might almost add, consequently) scarcely any bird has had so many idle tales connected with it. Setting aside several of its habits wherein it differs from the common run of birds, its strange, and, according to the experience of most persons, its singular mode of entrusting its offspring to foster-parents, is enough to account for much of the interest which has been so long felt in its history. Within the last twenty years a theory (which is, as I shall presently show, by no means a new one) with respect to an important fact in its economy, has attracted a good deal of attention, first in Germany, and latterly in England; and as this theory seems to be especially open to misconception, and in some quarters to have been entirely misunderstood, I shall endeavour to give an account of it in a manner more distinct than has yet (I think) been done; and to show that there is no good ground for believing it to be irrational, as some have supposed, and for scouting it as something beneath contempt.

It has long been notorious to oologists that the eggs of the Cuckow are subject to very great variety in colour, and that a large number of birds laying eggs of very different colours enjoy the doubtful advantage of acting as foster-parents to the young Cuckow. Now the theory to which I refer is that "the egg of the Cuckow is approximately coloured and marked like those of the bird in whose nest it is deposited, that it may be the less easily recognised by the foster-parents as a substituted one."

This theory is old enough, for it was announced and criticised nearly a hundred years ago by Salerne,* who, after mentioning that he had seen two Stonechats' nests, each containing eggs of that bird, as well as a Cuckow's (which was as blue as the others, but twice [?] as large), goes on to say that he was assured by an inhabitant of Sologne (a district in France to the south of Orleans), that the Cuckow's egg is always blue; and then comes this remarkable statement:—"As to the assertion of another Solognot who says that the hen Cuckow lays its eggs precisely of the same colour as those in the nest of which she makes use, it is an incomprehensible thing." Many of my readers will, I doubt not, be at once inclined to agree with Salerne.

Little attention seems to have been paid to this passage by succeeding naturalists;† but in 1853 the same theory was prominently and (I believe) independently brought forward by Dr. Baldamus, then editor of *Naumannia*, a German ornithological magazine, now defunct; so far as I know, however, it was not until April, 1865, that an article in the English ornithological journal, the *Ibis*, by Mr. Dawson Rowley, gave anything like an idea of it to the public of this country. Some months later (14th September) Mr. A. C. Smith introduced the subject to the Wiltshire Archæological and Natural History Society, and the paper he then read, having been since printed in the *Wiltshire Magazine* (vol. ix. p. 57), and elsewhere, has, with Mr. Rowley's article, made the theory very generally known. Mr. Smith also published, subsequently, in the *Zoologist* for 1868, a translation of Dr. Baldamus's elaborate essay; but this translation being unaccompanied by the coloured plate which illustrated the original, unfortunately fails to do justice to the Doctor's theory, for without seeing the specimens on which this is founded, or good figures of them, the evidence in its favour can scarcely be appreciated fully.

Dr. Baldamus's theory had been some time known to me, when in 1861 I had the pleasure of being shown by him his collection of Cuckows' eggs, and I can declare

* L'histoire naturelle, éclaircie dans une de ses parties principales, l'ornithologie, &c. Paris; 1767, p. 42.

† Montbeillard (Hist. Nat. des Ois, vi. p. 309) mentions it, but I am not aware of any one else who has done so, until M. Vian in the *Revue et Magasin de Zoologie* for 1865 (p. 40), referred to it, and from this reference I became acquainted with it.

that his published figures represent the specimens (sixteen in number) from which they are drawn, as faithfully as figures of eggs usually do, and that an inspection of the series convinced me that the belief he entertained was not groundless. All the eggs in question, some departing very widely from what I had been used to regard as the normal colouring, bore an unmistakable resemblance to those of the birds in the nests of which they were asserted (in most cases, I was assured, on very good authority) to have been found; while in some cases there was just enough difference between them and those they "mimicked," to show that it was far more unlikely that they should have been extraordinary varieties of the eggs of the species in question, than eggs of the Cuckow.

Dr. Baldamus's allegation therefore seemed to me to be in part proved. If the history of the eggs before me could be trusted—and I had no reason to doubt it, the fact of the likeness was in many respects self-evident, in others certainly not so striking, and in some perhaps questionable. In further corroboration of the theory also, there were the similar instances cited with much assiduity from foreign sources by Dr. Baldamus in his essay,* and one, apparently not known to him, but given by Mr. Blyth in Sir William Jardine's "Contributions to Ornithology" for 1850 (p. 69 *bis*, pl. 52). Another and very remarkable case had also come to my own knowledge. In the autumn of 1857 I had received from Mr. Tristram all the eggs collected by him in Algeria during the preceding season. When they were unpacked, it appeared that there were two more specimens of the egg of a large North-African Cuckow (*Oxylophus glandarius*) than I had been led by him to expect. On examination, I found that the first two eggs of this species which had been obtained by him so much resembled eggs of the Magpie of the country (*Pica mauritanica*), in the nests of which they had been found, that, skilful oologist as he was, they had passed, even to his practised though unsuspecting eye, as those of the latter bird. Had I known then of Salerne's words, I should have exclaimed with him, "c'est une chose incompréhensible!"

Having said thus much, and believing as I do the Doctor to be partly justified in the carefully-worded enunciation of what he calls a "Law of Nature," I must now declare that it is only "approximately" and by no means *universally* true that the Cuckow's egg is coloured like those of the victims of her imposition. Increase as we may, by renewed observations, the number of cases which bear in favour of his theory, yet, as almost every bird's-nesting boy knows, the instances in which we cannot, even by dint of straining our fancy, see resemblances where none exist, are still so numerous as to preclude me from believing in the generality of the practice imputed to the Cuckow. In proof of this I have only to mention the many eggs of that bird which are yearly found in nests of the Hedge-Sparrow in this country, without ever bearing the faintest similarity to its well-known green-blue eggs. One may grant that an ordinary English Cuckow's egg will pass well enough, in the eyes of the dupe, for that of a Titlark, a Pied Wagtail, or a Reed-Wren, which, according to my experience, are the most common foster-parents of the Cuckow in this country; and indeed one may say, perhaps, that such an egg is a compromise between the three, or a resultant, perhaps, of three opposing forces; but any likeness between the Hedge-Sparrow's egg and the Cuckow's, so often found along side of it, or in its place, is not to be traced by the most fertile imagination. We must keep therefore strictly to the letter of the law laid down by Dr. Baldamus, and the practice imputed to the Cuckow is not universally but only "approximately" followed.

* I do not here enumerate them; they will be found in *Naumannia* for 1853, p. 317, note. The plate which illustrates the paper is in the volume of the same magazine for the following year.

Now, is it possible to give a satisfactory explanation of the process by which the facts alleged are produced? Dr. Baldamus assigns none. He lays down a number of aphorisms, most of which are very interesting, and, I believe, true; but they do not touch the question. A good many people who have only read hastily, and still more those who have to all appearance only read at second or third-hand what has been written on the subject, seem to imagine that the Doctor has wished to assert that the Cuckow can voluntarily influence the colour of her egg, so as to assimilate it to those already in the nest in which she is about to deposit it.* Dr. Baldamus, indeed, mentions such a supposition, but expressly says that he rejects it, and herein I think that nearly every physiologist will agree with him.

It will be admitted, I think, that Dr. Baldamus's inference as to the object of the practice being that the Cuckow's egg should be "less easily recognised by the foster-parents as a substituted one," is likely to be true. This being the case, only one explanation of the process can to my mind be offered. Every person who has studied the habits of animals with sufficient attention will be conversant with the tendency which certain of those habits have to become hereditary. It is, I am sure, no violent hypothesis to suppose that there is a very reasonable probability of each Cuckow most commonly placing her eggs in the nests of the same species of bird, and of this habit being transmitted to her posterity. Without attributing any wonderful sagacity to the Cuckow, it does seem likely that the bird which once successfully deposited her eggs in a Reed-Wren's or a Titlark's nest should again seek for another Reed-Wren's or another Titlark's nest (as the case may be), when she had an egg to dispose of, and that she should continue her practice from one season to another. We know that year after year the same migratory bird will return to the same locality, and build its nest in almost the same spot. Though the Cuckow be somewhat of a vagrant, there is no improbability of her being subject to thus much regularity of habit, and, indeed, such has been asserted as an observed fact. If then this be so, there is every probability of her offspring inheriting the same habit, and the daughter of a Cuckow which always placed her egg in a Reed-Wren's or a Titlark's nest doing the like.

Further, I am in a position to maintain positively that there is a family likeness between the eggs laid by the same bird, even at an interval of many years. I know of more than one case in which a particular Golden Eagle has gone on season after season laying eggs that could be at once distinguished by a practised eye from the eggs of almost any other Golden Eagle; and I know of one case

* Thus Mr. Cecil Smith (not to be confounded with Mr. A. C. Smith, before mentioned) in a work published within the last few weeks, falls into this mistake ("Birds of Somersetshire," p. 265), after having stigmatised the Doctor's theory as "wild," which he well might if it had been as it is represented.

in which the presumed daughter of a particular Golden Eagle, remarkable for having produced eggs of very great beauty, has in two successive years laid eggs which unmistakably resembled those of her reputed mother in the brilliant character of their colouring.

Hence I am not afraid of hazarding the supposition, that the habit of laying a particular style of egg is likely to become hereditary in the Cuckow; just as I have previously maintained that the habit of depositing that egg in the nest of a particular kind of bird is also likely to become hereditary.

Now it will be seen that it requires but only an application to this case of the principle of "Natural Selection" or "Survival of the Fittest" to show that if my argument be sound, nothing can be more likely than that, in the course of time, that principle would operate so as to produce the facts asserted by the anonymous Solognot of a hundred years ago, and by Dr. Baldamus and others since. The particular *gens* of Cuckow which inherited and transmitted the habit of laying in the nest of any particular species of bird eggs having more or less resemblance to the eggs of that species, would prosper most in those members of the *gens* where the likeness was strongest, and the other members would (*cæteris paribus*) in time be eliminated. It is not to be supposed that all species, or even all individuals of a species, are duped with equal ease. The operation of this kind of "Natural Selection" would be most marked in those cases where the species are not easily duped, that is, in those cases which occur the least frequently. Here it is that we find it, for it has been shown that eggs of the Cuckow, deposited in the nests of the Red-backed Shrike, of the Bunting-Lark, and of that bird which for some reason best known to the donor bears the English name of "Melodious Willow-warbler," approximate in their colouring to the eggs of those species—species in whose nests the Cuckow rarely (in comparison with others) deposits her eggs. Of species which would appear to be more easily duped, or duped in some other manner—the species in whose nests Cuckow's eggs are more commonly found, I may have something to say in another paper.

ALFRED NEWTON

THE ORIGIN OF BLOOD-LETTING

THE flamingo in the gardens of the Zoological Society has recently been observed to vomit a red-coloured fluid over certain smaller birds kept with it; and it has been shown that this red fluid contains true blood-corpuscles, and inferred that the flamingo is in the habit of feeding its young by this ejection of a blood-stained "pigeon's milk" into their mouths. Further, the habit of the flamingo has been with great probability connected with the story of the pelican, which, as is well known, is stated to wound its own breast in order to feed its young with the blood. It is not at all improbable that birds so alike in their plumage and habitat as the pelican and flamingo should be confused in the way suggested by Mr. Bartlett, who, I believe, first observed the habit of the captive flamingo. The extravasation of *blood corpuscles* normally from the pharynx or œsophagus of such an animal is a matter of great interest. Mr. Lowne has a paper in the Journal of the Queckett Microscopical Club, in which he gives a full account of the case, having examined the bloody exudation microscopically. To this the reader is referred; but I have something to add to it.

The connection of the flamingo with the classical story of the pelican's self sacrifice is increased in interest, since it appears that the red exudation of the hippopotamus is connected with an equally ancient and more important tradition—namely, the history of the origin of blood-letting. Before giving this tradition, I would mention that two years since, by the kindness of Dr. Murie, I obtained some of the red exudation of the hippopotamus on a slip of glass, and on examining it with the spectroscope, I did *not* obtain a blood-spectrum. Mr. Tomes (Proc. Zool. Society, 1857) described the microscopic appearances of the exudation of the hippopotamus, and stated that he found in it remarkable corpuscles with pigmentary granules, but not *blood corpuscles*. The folds of the skin in various parts of the body of the hippopotamus are coloured bright pink by a distinct pigment, and the same tint suffuses the darker parts of the skin. I believe it is this pigmentary matter which causes the red colour of the exudation of the hippopotamus, and that it is not a sweat of blood at all. The case of Mr. Jamrack's rhinoceros mentioned by Mr. Lowne may be otherwise. Mr. Lowne says that cases of blood-stained sweat from the skin of man are, though rare, well authenticated. This is perhaps true; but many apparent cases of such staining are due to the formation of a purpurate in the sweat, from the decomposition of the uric acid which it contains.

Now, with regard to the hippopotamus, it is important to note how popular tradition has attributed the origin of a very valuable medical art to a totally false inference on the part of Egyptian priests.

M. Milne-Edwards, in the 3rd volume of his "Leçons sur la Physiologie" (p. 3), has the following note:—"Homer, whose poems constitute a sort of encyclopædia of the science which the Greeks possessed about the ninth century before Jesus Christ, does not speak of bleeding: but if we are to believe an author of the fifth century, Stephanus of Byzantium, this operation was known to the surgeons of the army of Agamemnon. In fact, he relates that one of them, Podalirius, son of Æsculapius, and brother of Machaon, on the return from the siege of Troy, practised it on a patient whose cure obtained for him the sovereignty of the Chersonese. This would be the first case of blood-letting of which the remembrance has been preserved; and, on consideration of a fable reported by Pliny, I am induced to believe that this practice had taken its rise in Upper Egypt: in fact, this naturalist tells us that the hippopotami, when they become too obese, have the habit of piercing for themselves the vein of the thigh, by pressing against a pointed reed; and that these animals have thus taught physicians to practise analogous operations. Now, this account does not apply to the sea-horse (or *Syngnathus*), as the author of an estimable work on the history of medicine (Leclerc) supposes, but to the great pachyderm which inhabits the rivers of the interior of Africa, and which is found in Upper Egypt. It is evidently a fable: but this fable could only have reached us from Egypt."

M. Milne-Edwards was not aware of, at any rate does not refer to, the red oozing observed on the skin of the hippopotamus sometimes after emerging from his bath, or when enraged, which gives so marked a confirmation to the Egyptian story. We may conclude fairly enough, either that the Egyptian priests saw this red exudation, and imitated it with the practice of bleeding, or, as is infinitely more probable, that the Egyptian laity noticed the blood-coloured sweat of the great river-horse, and connected it with the practice of bleeding then in operation, by the interpolation of the sharp reed, and an inability to understand that their wise men could discover a remedy untaught. E. RAY LANKESTER

PREHISTORIC ARCHÆOLOGY

Transactions of the International Congress of Prehistoric Archæology, 3rd Session, 1869. Royal 8vo, pp. 419, with 53 illustrations. (Longmans, 1869.)

IN these days of annual gatherings or Congresses intended for the promotion of Science, whether Natural, Social, or Ecclesiastical, we need not be surprised at the numerous observers now engaged in different countries in the various branches of Prehistoric Anthropology and Prehistoric Archæology founding an International Congress for the discussion of questions in which they are particularly interested. It was at a meeting of the *Société Italienne des Sciences Naturelles*, held at La Spezzia in 1865, that this Congress originated, with the more comprehensive than euphonious title of "Palæoethnological." With a slight change in its designation it met at Neuchâtel in 1866, and at Paris in 1867; while the Congress, the transactions of which are recorded in the volume before us, assembled at Norwich last year under the presidency of Sir John Lubbock, and with Colonel A. Lane Fox as organising secretary, contemporaneously with the meeting of the British Association. During the present year it has found a congenial home in the midst of the richly-stored museums of Copenhagen, under the fitting presidency of Professor Worsaae; has dug in the Kjökkenmöddings, and been right royally entertained by the King of Denmark; and next year the gathering is to be at Bologna, with Count Gozzadini as president. Such meetings, especially in the case of the followers of what must be regarded as a comparatively new science, serve at least a double purpose; as social gatherings they promote that intercourse and kindly feeling between those engaged in the same pursuit, which helps the onward progress of knowledge, while the discussions at the meetings tend to elicit truth from what may apparently be conflicting facts and opinions, and when too unruly hobby-horses are introduced into the arena, serve to control their wilder caracoles, if not effectually to break them in.

The success that has attended the institution of this particular Congress, which, by the way, is not to be held during two consecutive years in one country, cannot be better evinced than by the Report of its seven meetings at Norwich, which has just made its appearance, and forms a volume of upwards of four hundred pages, illustrated by more than fifty plates, for the most part presented by the authors of the papers they illustrate.

These Papers range over a wide area, both in space and time. The Pacific and South Sea Islands, the Cape of Good Hope and Southern and Western India, Japan and Algeria, as well as Spain, Portugal, France, Britain, and Ireland, all contribute their *quota* of facts; while various general questions relating to the condition, the arts, the distribution, and other circumstances of early races of mankind are brought forward and discussed. On the whole we may congratulate the Congress on the object of its assembly having been so carefully kept in view by the authors of the papers read before it, since hardly any of them, though varying much in value, can be regarded as having been irrelevant to its general purposes.

The time and space at our command being small in proportion to that ranged over by the Prehistoric Archæologists, we cannot give more than a brief notice of some few of what seem to us the more important papers; but at the outset we must express our regret, which we are sure many others will share with us, that the excellent Opening Address of the President was not more fully reported.

First of the Papers, and among the first in interest, is one by Mr. E. B. Tylor, on the "Condition of Prehistoric Races as inferred from Observation of Modern Tribes," in which some curious anomalies in the degree of knowledge in different branches of art and constructive appliances possessed by certain tribes are pointed out, and the inference drawn that it is unsafe to attempt to fix the stage of civilisation of any given people from the rudeness of one single class of implements in use among them.

Professor Huxley's Paper on the "Distribution of the Races of Mankind, and its Bearing on the Antiquity of Man," appears to have met with more favourable criticism from those present, including Professor Carl Vogt, than the author anticipated. And certainly the connection between some of the changes which in comparatively recent times have taken place in the physical geography of the earth, and the limitation of the areas occupied by different races, such as the Negroid and Australioid, seems, if not susceptible of proof, at least possible; and, if so, Professor Huxley's conclusion that the distribution of these two races of Man affords as strong evidence of his antiquity as the occurrence of his works in the gravel of Hoxne and Amiens is in a fair way of being adopted.

Touching these early works of man, we commend attention to the excellent account given by Mr. R. Bruce Foote, of his discoveries of quartzite implements of Palæolithic types in the Laterite formation of the east coast of Southern India. We know of nothing more striking than the wonderful similarity of these implements to those discovered associated with remains of extinct mammals in the old river gravels of Western Europe. But for the difference in the material there are numerous twin specimens so like each other that they might be thought to have been formed by the same hand, and yet they occur thousands of miles apart, and under what are apparently different geological conditions, though we think that much remains to be unravelled as to the origin and age of the Lateritic deposits of Madras. Still this parallelism of type seems to afford most remarkable proof that the same wants, with the same means at command for fulfilling them, result, so far as tools are concerned, in the production of similar forms, no matter where or when the men live who make them.

This is further illustrated by the stone implements from Japan, described by Mr. Franks, nearly all of which may be matched in form by arrow-heads, lance-heads, and hatchets found in Western Europe; and what is no less remarkable, the former are by the Japanese regarded as of heavenly origin, like the Elf-bolts of Scotland, and the stone-celts are considered to be thunderbolts—a belief so universal in historic times that it may be said to have been held *semper, ubique, et ab omnibus.* There is, in fact, no difference of opinion between the old Greek Sotacus and the Chinese Emperor Kang-hi's encyclopædist (A.D. 1662). The former informs us, through Pliny, as translated by Philemon Holland, that "there be two kinds of Ceauniæ, to wit, the black and the red," and, "that they doe resemble halberds or axe-heads." The latter that "some of the lightning-stones have the shape of a hatchet, others that of a knife, and some are made like mallets. They are of different colours; there are blackish ones, others are greenish."

The curious similarity observed among Megalithic monuments in different parts of the world may possibly be due to some analogous development of thought and feeling rather than to any intimate connection between the races who erected them. The Dolmens of Algeria, described by Mr. Flower, those of Brittany by Mr. Lukis, those of the Aveyron by M. Cartailhac, are all, more or less, closely allied to the ancient sepulchres and Pandukulis of the Nilagiri Mountains in Southern India, described by Sir Walter Elliot.

We cannot close this brief notice without mentioning one of the most carefully illustrated and important contributions to the volume,—the account of the caves of Gibraltar, in which human remains and works of art have been found, by Mr. George Busk, who, in company with the late Dr. Falconer, visited the scene of the explorations of Captain Brome, which are now unfortunately suspended, but of which the record drawn up by himself is here preserved, and additional value given to it by the commentary of Mr. Busk.

We have, we hope, said enough to show the interesting character of this volume of the Transactions of the Congress, and the reports of the meeting at Copenhagen lead us to hope that it may next year be productive of another volume of at least equal value.

JOHN EVANS

THE WORLD OF THE SEA

The World of the Sea. Translated and enlarged by the Rev. H. Martyn Hart, M.A., from "Le Monde de la Mer," by M. Moquin Tandon, Membre de l'Institut, &c. Demy 8vo. pp. 500, with coloured and tinted plates and numerous woodcuts, price 21*s.* (London: Cassell, Petter, and Galpin.)

THERE are two methods of reviewing a book, the ungracious and the gracious. One, and the easier, is to find all possible fault with it; to prove, at least to the critic's own satisfaction, how much better he could have written the book, if he too had had the time, and the money, and the will. As for the talent, the critic has that, as a matter of course; for is not a critic one who judges other men, and is therefore wiser than they? And as for the knowledge, that is not needed. He may acquire that in the very process of reviewing, from the book which he reviews. Thus, following nature in economising force as much as possible, he is at once learner and teacher; judge and—parasite? Taking another man's materials, he shows the world how much better a house he could have built with them; and so has the clear profit of all the author's work, his carrying of the bricks and mortar, even his planning the house, beside all the expenses incident thereto, at the cost on his own part of a few suggestions which he is not even at the trouble of seeing carried out. Thus he leaves the hapless man, who has tried to do something, instead of sitting still like the reviewer, and seeing others do it, to cry *Sic vos non vobis;* and after a few more attempts to write books, to give up in despair, and take to the more easy and profitable employment (at which every lad can now earn an honest penny), of showing how books should have been written.

But the other, or gracious method of reviewing a book, is to ascertain what the book is really worth, at least to the class for whom it is written; and if it be worth anything, to recommend it to them heartily; being sure that attractiveness is no test of value, and that there is no more utter fallacy than that good wine needs no bush.

Unfortunately, this gracious and hearty method of reviewing a book is not only difficult, being contrary to the affections and lusts of the animal within, who delights to bite and devour his kin, while he is indignant at the very notion of his ancestors having been cannibals: but it is also morally dangerous; for if the reviewer begins by being gracious and hearty, he may descend to kindness, even to indulgence. He may be to the author's "faults a little blind, and to his virtues very kind;" and so fall altogether from that boasted impartiality which surely portends detraction.

For the sake, therefore, of preserving the virtue of impartiality, it is most prudent for the reviewer to begin by complaining, and to say that this very beautiful book has certain defects, which he hopes may be amended in future editions (for he must be allowed to be gracious enough to hope for future editions); that several of the most important and novel illustrations have no authority appended; that the very clever drawing of the sea-lions has not only no authority, but no description or notice in the text; that some chapters are meagre, and some of the illustrations bad—for instance, the Holothurians, of which only two very poor and inaccurate cuts occur; that the large drawing of Cuttle-fish is also very bad and wrong; and that there are many misprints and misspellings (possibly mere faults of the printers, but still faults), such as *rostro* for rostrum, *Ottary* for Otary, *a* Poritidæ, *an* Alcyonideæ, &c., which must be corrected; and that, as a whole, the latter part of the book is inferior to the beginning. It may be, of course, that this is owing to the simple fact, too common among other classes besides publishers, that the money did not hold out; or that the book, if finished in the style in which it was begun, would have grown too big to be published at a paying price. But what has a reviewer to do with excuses and with mercy?

Having thus fulfilled his duty, he has something of a right to take his pleasure; and to say—Here is a really beautiful book. It is a pleasure to turn over the pictures; a pleasure to think that it will lie on many tables, teaching folk, especially young folk, a thousand things which those of the last generation did not learn, hard as they worked, each for himself alone, simply because the works which could teach them were not yet written; nay, the microscopes which could show the facts not yet made. The text is, as is to be expected from M. Moquin Tandon, brilliant, interesting, full of feeling for that wonderful and poetic element which runs through nature, and should therefore run through sound physical science. The illustrations are, on the whole, very good indeed; the large tinted plates altogether exquisite; notably one of the development of corals; and many of the cuts are not only accurate, but real works of art; for instance, a drawing

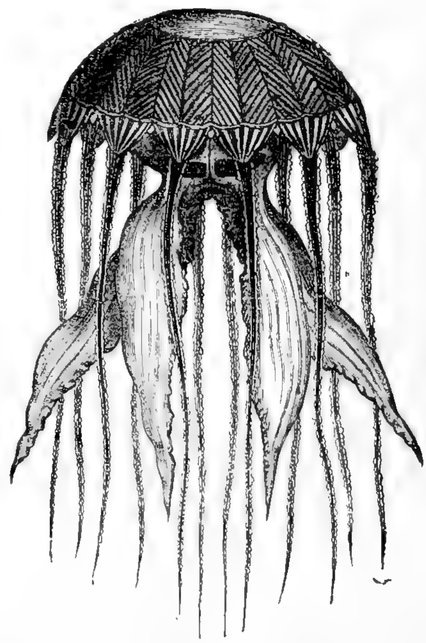
THE BEAUTIFUL-HAIRED MEDUSA (*Cyanæa euplocamia*)

seemingly from a photograph, of sponges, &c., on laminaria stems, and three drawings of medusæ, pp. 132-4, in which the grace and grandeur of the natural outlines has been excellently preserved.

Especially do the author, translator, and publishers deserve thanks for the mere number of the illustrations.

THE CROSS MEDUSA (*Rhizostoma cruciata*)

If the wonder of nature is ever to be got into the heads of the uneducated (rich or poor) it must be done, in the long run, through the eye. "Pictures," said certain men of old, "are the books of the unlearned;" and they used them with effect during the middle ages, to get into the heads of men wonders which—nineteen twentieths of them—never happened at all. Let Science, now her turn is come, use to the utmost of her resources, the same engine, to get into the heads of men—and of children from their earliest years—some of the wonders which are actually happening round them all day long. Let scientific men, therefore, welcome graciously this book, and all books of the kind, in spite of a few defects of haste or of insufficient knowledge. Let them recommend it to their friends—especially to those who have children. And if any shall raise the cry of "book-making," let them answer, "What else would you have?" In this age of "specialisation," when each minute branch of physical science requires a life-time of research, how are the many unscientific to be taught the vastness and beauty of Nature, save by book-makers; by those who take the results of other men's labour, and cast them together into a shape which the many will care to look at? Provided



THE MEDUSA OF GAUDICHAUD (*Chrysaora Gaudichaudii*)

they do not actually steal, allow them to borrow as freely as they will. What they borrow from the scientific writer, they will repay him a hundred-fold, in the form of pupils readers, and enlightened public opinion. Meanwhile, those who wish well to the cause of Truth, may trust that by every book of this kind one more human being will be awakened to the magnificence, as well as the importance, of facts; one more will be saved from the ancient empire of unreason; one more will be inclined to give rational glory to God, as he discovers how glorious His works are, even in the minutest polype; one more artist will discover, in his search for the beautiful, that the world contains a few objects quite as worthy of his pencil, as a Scotch fir-tree, or a country lane; and one school-boy, it may be, or even undergraduate, seeing this book in his sister's hands while he is at home for the vacation, will be led to inquire (not without reason) why he also is not taught something about these strange and beautiful works of God, and something of the science which investigates them, instead of the mispronounced Latin and Greek, in learning which (and most imperfectly) he spends the ten or twelve golden years of youth. He will receive for answer (or rather he will soon learn to answer himself) that those who have the monopoly of education know nothing of these matters, and therefore cannot teach them; while those who do know about them are not asked to teach them, because they will not pay in an examination. But that discovery may make him resolve, for the sake of his children or his younger brothers, to do what in him lies when he grows up, to alter radically the course of instruction now pursued in almost every boys' school in these islands; in which case this book, and others like it, will not have been published in vain.

C. KINGSLEY

BARFF'S HANDBOOK OF CHEMISTRY

An Introduction to Scientific Chemistry; designed for the use of Schools, and Candidates for University Matriculation Examinations. By F. S. Barff, M.A. Second Edition. Fcap. 8vo. pp. xv. and 315, with woodcuts, price 4*s.* (London: Groombridge.)

THE rapid progress of experimental discovery is in itself an obstacle to the elementary teaching of any scientific subject. Nowhere has the truth of this observation been more frequently attested than in chemistry, a science which, during the present century, has had a more brilliant, or at least a more active, career than any of its old companions. We cannot, therefore, be surprised that the superior attractions of research have so far had a depreciating influence on the dogmatic department of this study, that many chemical manuals are meagre, partial, or unsystematic. It is true that a large number of such books has appeared during the last few years, under the powerful stimulus of an increasing demand for chemical education; but their general character is such as we have assigned, and the composition of a treatise for the use of school-boys seems to have been in many cases shelved, as either too humble or too great a task for an author.

Such considerations induce us to welcome very cordially the little handbook which Mr. Barff has just republished. The first edition must be too well known, and too fresh in the memory of many of our readers to render any detailed reference to the present one necessary. The writer's efforts have evidently been directed towards attaining as much as possible of both clearness and brevity in exposition; but his tendency to avoid speculative assumptions is still more meritorious. No one is more sceptical than a boy; no one more difficult to convince by experiment of the truth of a theory. The teacher will therefore economise his time in the most useful manner by putting before his class only the simpler practical illustrations in which he knows he can succeed, and but a few of the most general and securely established laws. Hence Mr. Barff has boldly, but very judiciously, postponed the entire discussion of formulæ and symbols to the concluding portion of his work, using in its former part only absolute units of weight and measure—which, of course, have the advantage over the usual abstract numbers, that an audience can see and handle them. The nomenclature is that first systematised by Berzelius, and introduced into this country by Professor Williamson; it has also been adopted of late in the examinations of the University of London.

The method of imparting elementary instruction in chemistry is, as we have indicated, neither mature nor on the point of attainment. But whatever course may ultimately be decided upon, we can hardly doubt that it will include Mr. Barff's fundamental principle. Meanwhile this little volume, with its business-like spirit and undeniable accomplishment of its design, deserves the general and hearty commendation of teachers.

E. J. MILLS

OUR BOOK SHELF

Contribution to Climatology.—*Klimatologische Beiträge.* By Professor A. W. Dove. (Berlin, 1869.)

ISOTHERMAL Charts like those published by Professor Dove in 1864 derive their chief interest from the fact that they permit a birds'-eye view of the great climatological features of the globe, but they are of comparatively little value to the meteorologist, unless accompanied by the numerical data on which they are founded. These are now supplied by the publication of the present volume, which, however, contains also a great deal of matter of interest to the intellectual community generally. The introductory remarks to the tables on the climate of Western Europe, and on non-periodical meteorological phenomena, will show that the distinguished author has just claims to be considered the greatest master of meteorological generalisations.

B. L.

Wonders of Italian Art.—By Louis Viardot. Small 8vo. Pp. 257. Illustrated with photographs and engravings. (Sampson Low & Co.)

IF photographs were not children of the sun, and if artists were not sometimes—like Leonardo da Vinci—men of science, and would always work the better for a knowledge of it, and if scientific men were not among those who can most highly appreciate works of art, this book would hardly come within our programme. It is a beautiful book, full of beautiful photographs and engravings of the best and most typical pictures of the Italian school, and one altogether refreshing to look upon. We should also add, that it is translated from the "Bibliothèque des Merveilles," which contains so many works on science.

Astronomical Publications.—1. *Astronomische Mittheilungen von der Königlischen Sternwarte zu Göttingen.* (Göttingen, 1869.) 2. *Sammlung von Hilfstafeln der Berliner Sternwarte.* By W. Foerster. (Berlin, 1869.)

THE first publication is an account of some recent astronomical labours at the Observatory in Göttingen, and contains the results of observations with the meridian circle in zone 0° and 1°, made in accordance with the well-known scheme of a zone revision so successfully initiated and established by English and Continental astronomers. The volume, which deserves in every respect the special attention of star observers, contains the mean places of stars up to the ninth magnitude, reduced to 1875·0. A new method of calculating the determinations of time, originally proposed by Gauss, has been for the first time made use of by the observers. It is shown at page ix. of the Introduction, and will be found of the highest merit.

The Berlin publication contains a set of tables for the routine business of the Observatory. Although calculated with reference to the local circumstances of the Berlin establishment, they are likely to be instructive elsewhere, their arrangement being extremely compact and at the same time lucid.

B. L.

The Half-crown Atlas of Physical Geography. By Keith Johnston, jun. 31 maps, printed in colours. Small 8vo. (Edinburgh, Johnston.)

THIS atlas astonishes and delights us. For two shillings and sixpence we at last get beautifully finished maps, showing the land and water hemispheres, and the lands which are blessed with an antipodes; a perspectic view of the globe; physical maps of the continents, Australasia, British Isles, and the Holy Land, a geological map of the British Isles, maps of ocean and river systems, ocean basins, winds and storms, annual isothermal lines, and range of temperature, distribution of earthquakes and volcanoes; the geographical distribution of useful plants and species, the chief animals, and varieties of man himself. There are, moreover, notes as to the preparation of the atlas, and an analytical index. We warmly congratulate Messrs. Johnstons on their last achievement, and advise everybody to buy the atlas.

Cassell's Technical Manuals.—1. Linear Drawing. 2. Projection. 3. Building Construction. By Ellis A. Davidson. Price 2*s*. each. (London: Cassell, Petter, & Galpin.)

THESE little books are intended to promote the technical education of artisans, and seem to be well-adapted to facilitate the work of teachers and learners. The manual of Linear Drawing shows the application of practical geometry to trade and manufactures, and has been appropriately chosen as the first volume of a technical series for craftsmen. The methods of constructing geometrical figures are given without the mathematical proofs which usually accompany such problems. The application of some of the figures to decorative and mechanical work is illustrated in diagrams of the trefoil, quatrefoil, toothed wheel, ellipse, &c. Accuracy is persistently inculcated, and all the figures are admirably executed. The manual of Projection leads the student many steps further, and treats of the drawing of plans, elevations, and sections of solids. The chapter on isometrical projection explains that system of drawing in a clear and concise manner. In some of the more elaborate figures fewer lines of construction might have been used with advantage. The observations on drawing instruments, and their use, are thoroughly practical. The third treatise elucidates the principles of Building Construction, and gives some useful hints on architectural drawing. It is profusely illustrated with diagrams; these are generally good, but the minor details of a few need correction. C. W. W.

Picture Natural History. (London: Cassell, Petter, and Galpin.)

WE have submitted this volume to an abler critic than ourselves—to a little boy. He is delighted with the pictures, and interested in the text. We should like to give it to every little boy and girl we know.

Tommy Try, and what he did in Science. By C. O. G. Napier (of Merchiston), F.G.S. Pp. 302, with 46 Illustrations, by J. D. Cooper, and others. (Chapman & Hall.)

A BOOK for boys, in which science and anecdote chase each other through a pleasant narrative, until Tommy Try takes to consulting phrenologists, and then, fortunately for his young readers, brings his memoirs to a close.

THE SUEZ CANAL

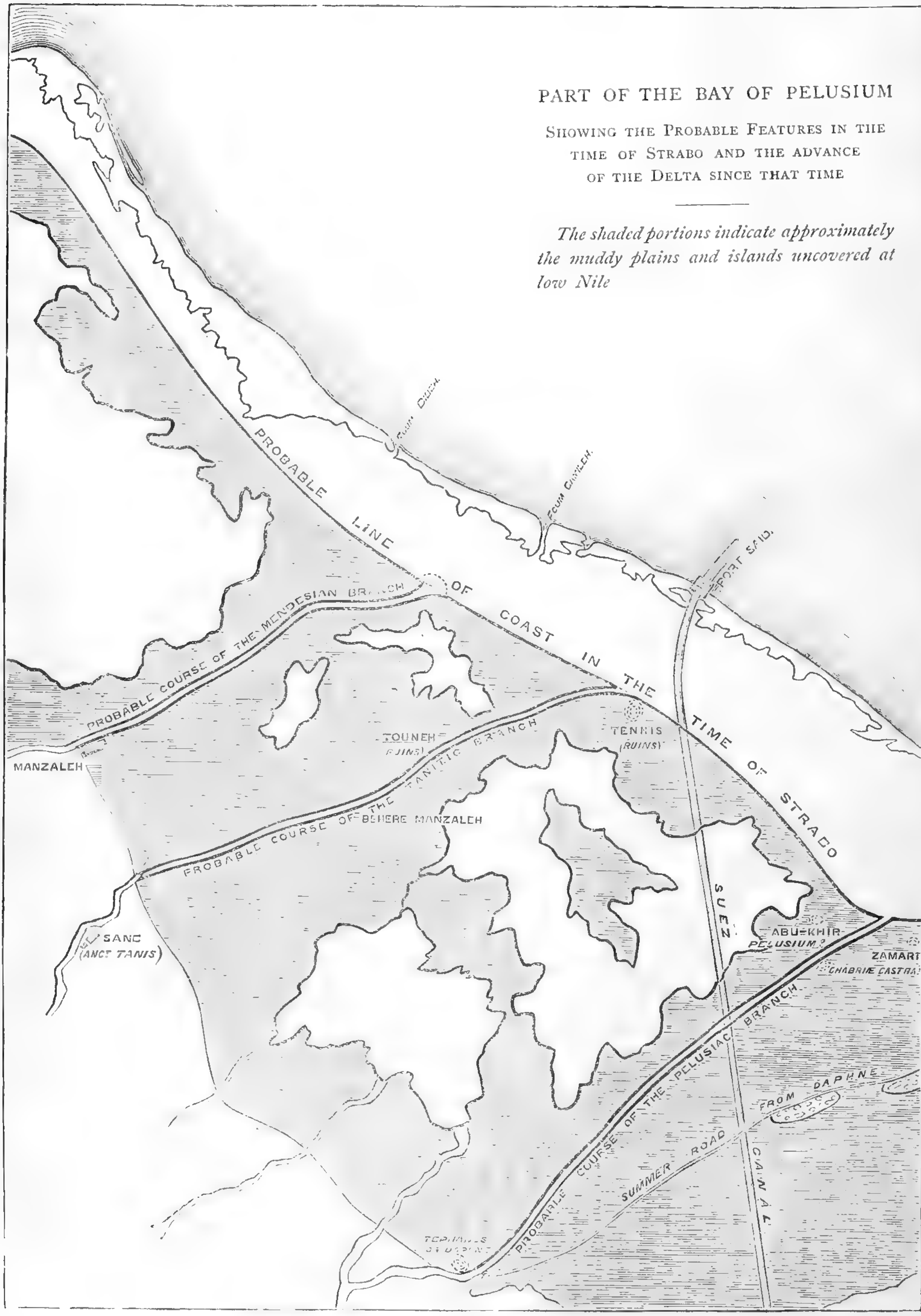
IF all went well, and we hope it did, yesterday witnessed a grand gathering on the sandy shores of a dreary bay in the Midland Sea—that sea around which so much of history has been enacted, and in whose annals the gathering in question will not be the least noteworthy incident. The Suez Canal—that problem of many centuries—is to be opened in presence of emperors, kings, princes, and potentates; of eminent engineers, famous warriors, and distinguished *savants* invited from the East and from the West; and while the ceremonial lasts the very dreariest of the dreary wastes that here and there border the blue waters of the Mediterranean will be animated by a brilliant throng and the sound of music; and speeches will be made and healths will be drunk, and all present will join in wishing success to the memorable enterprise, which, for a time, is to furnish to Arab story-tellers and Frankish newsmongers a topic to talk about.

Dreary as the region is, it has a history. There marched with invading armies the kings whose names are recorded in Scripture; there Artaxerxes was stayed in his victorious advance by the siege of Pelusium; there are yet to be seen relics of cities and towns named in the "Itinerary" of Antoninus; there Titus marched to the siege of Jerusalem; there Baldwin and his Crusaders took the city of Pharamia: the actors in these and other exploits never dreaming that the sands of the desert, drifted by the winds and by the stream of the Nile, would so bury and alter the surface of the land, that after generations should be puzzled to identify its historical localities.

The question of a canal dates from a very early period. In high floods the waters of the Nile spread to within two or three miles of the Red Sea, which would suggest the idea of a permanent communication between the river and the great Arabian Gulf. This communication was actually established, as is said, under Ptolemy Philadelphus; but of course it fell into neglect, and was buried under the drifting sands, until one of the caliphs had it cleared out, after which there was a navigable canal between the Nile and the Red Sea for more than a hundred years. Then it was again lost, and so completely that its ever having existed became matter of doubt and dispute.

But the main project was a ship canal across the isthmus. There is some tradition that Alexander consulted with his engineer officers as to its feasibility, and that they reported against it on account of the difficulty in preventing the mouth of the canal from silting up. In a later age Sultan Selim, who had been baffled in his scheme for a canal to connect the Don and Volga, resolved on cutting one from Pelusium to Suez; and he took an important step towards accomplishing his purpose, for he conquered the country all across, and made his name a terror to the Arabs. But he did not live to cut the canal. The first Napoleon revived the project, and ordered a survey, during which the long-buried remains of the canal above-mentioned were discovered, and the question as to its having existed was settled. From that time the question of a ship-canal became a standing topic, enlisting divers opinions, among which were some to the effect that the project was simply impossible, because, as the level of the Red Sea was so much higher than that of the Mediterranean, the swift current in one direction would prevent navigation.

During this time of debate, Captain Spratt of the Royal Navy was sent, with the ship *Medina*, to make a survey along the shores of Egypt and of the Isthmus, of which an account was published by the Admiralty in 1859, entitled, "An Investigation of the Effect of the prevailing Wave Influence on the Nile's Deposits;" and this was followed by "A Dissertation on the True Position of Pelusium and Farama." Beginning at the western extremity of the Egyptian coast, Captain Spratt found that the Nile there exerted no influence, but that, owing to the prevalent north-westerly and westerly winds, the deposits brought down by the Nile were drifted to the eastward in prodigious quantity, even to the shores of Syria. This was no hasty conclusion: by a careful series of soundings and dredgings, Captain Spratt determined the identity of the sand along the sea bottom, within a given distance of the shore, with that of the deserts through which the Nile flows. Farther out to sea the sand was coralline, and of an entirely different character, while the Nile drift is made up of quartzose sand, with fine mud and particles of mica. The verifications in this particular were too



PART OF THE BAY OF PELUSIUM

SHOWING THE PROBABLE FEATURES IN THE TIME OF STRABO AND THE ADVANCE OF THE DELTA SINCE THAT TIME

The shaded portions indicate approximately the muddy plains and islands uncovered at low Nile numerous and too exact to leave room for doubt. "By this means," writes Captain Spratt, "I was enabled to trace the extent of the Nile's influence both directly off the coast and along it, as well as to ascertain the large quantity of sand—pure silicious sand—it must annually bring to the sea; and to an amount which far exceeded my expectations and experience in respect to other rivers, particularly that of the Danube, which, in comparison, brings a very much less proportion of sand to mud. The Danube sand, also, is of the finest quality. The Nile sand, on the contrary, is much coarser generally, and forms sandbanks off the coast that are composed of quartzose sand nearly as large as mustard seed."

The quantity of solid matter brought down by the Nile when in flood is prodigious, and precisely at this season—that is, for three or four months—the north-west winds blow strongest. Indeed, if the wind did not blow with the violence of a monsoon it would be impossible for sailing-vessels to navigate the river during the time of its rise. The suspended matter is consequently driven to the eastward along the coast, and there accumulating forms dunes or sandhills, which shift their position with every gale, "burying at times the huts of the coastguard men." The hollows between the dunes are cultivated by the Arabs, but the plots must be protected by screens of reeds, against which the sand accumulates by repetition, until in some instances the hill is a hundred feet in height. Captain Spratt here remarks: "The best efforts of a population of several thousand Arabs, who inhabit the villages along this strip of land, fail in permanently fixing these dunes. For as the sea continually reaccumulates the sand upon the beach, onward it moves, in spite of those efforts, and the rate of progress may be imagined when I state that a mosque near Brulos has in about twelve months been nearly buried in one of the dunes" advancing from the westward. "And as the coarse sand of which these hills are composed is not distinguishable in differing from the sands of the desert near the Pyramids, or that on the route to Suez, they must undoubtedly be all the gifts of the Nile."

Besides coarse sand the Nile carries down fragments of brick, pottery, and other heavy substances, which are also drifted along the coast by the combined action of wind and current. When the wind blows its strongest the coastguard men say they cannot walk against it. To test these facts, Captain Spratt one day landed eleven bags of ashes and clinkers, five of the bags containing pure clinkers, the largest of which weighed from four to five pounds. The whole were laid in a heap just above the water's edge, and left to the care of wind and sea. Twelve days later, when the party returned, not a vestige of the heap, which had weighed nearly two tons, was to be seen. The shore was examined towards the quarter from which the wind blew, but without result; while in the other direction, that of the prevailing wave movement, clinkers weighing about two ounces were found dispersed to a distance of fully 1,500 yards, one of $3\frac{1}{2}$ pounds was picked up at 240 yards, and others from 4 to 8 ounces at from 600 to 700 yards. The greater portion had, however, been buried by the movement of the sand. "Thus this evidence," writes Captain Spratt, "of the movement of the beach in only twelve days, in the month of May, during which there was but one strong westerly breeze and several fresh easterly breezes, is a positive evidence of the great easterly movement of the shore and littoral shallows along this coast, but which, during a succession of winter gales, and during the prevailing north-west breezes at the period of high Nile, must cause a continuous progression of an immense quantity of the sands and matter carried out by the turbid river."

We quote another passage bearing on this point. The captain was walking along the coast for the purpose of observation, from the beacon marking the site of Port Saïd, to the head of the bay of Tineh, when he found a great quantity of broken pottery, broken jars, ancient and modern, and broken bricks scattered on the shore, at the highest and lowest surf margin. "On discovering them in such quantity," he continues, "I was naturally anxious to trace out their origin, thinking they must have come from some adjacent ruin. But I found eventually that they had come wholly from the mouths of the Nile, and that they were the positive *débris* from the towns situated on the banks of the river, and brought out by the strength of the current at high Nile, but then dispersed along the coast to the eastward by its littoral currents and prevailing ground swell."

It would be easy to multiply facts, if further evidence were wanted, that the Nile is no exception in the great transforming powers of Nature, washing down the dry land into the sea, and forming there beneath and on the margin of the waves new continents and islands. The Mississippi, the Ganges, the Yang-tse-Kiang, and other rivers of the great continents, carry down millions of tons of solid matter every year. The North Sea is gradually being silted up by the rivers of Belgium, Holland, and the British islands. At the mouth of the Ebro, on the northern side of the Mediterranean, the deposits brought down by the river are in course of reclamation by an eminent English engineer. Hence we need not feel surprise that the Nile—one of the greatest of rivers—has during long ages wrought great changes on the southern shores of the same sea. In the face of facts such as are above adduced, a government or a nation might well be justified in believing the project of a harbour and canal on the Bay of Pelusium to be, if not impossible of execution, at least unprofitable. Places which were on the shore when Strabo wrote are now from four to six miles inland, as is shown on the accompanying map, reduced from that published with Captain Spratt's report; and this modifying action is still going on.

Since the Suez canal was first projected engineering science has advanced; and though the sands will accumulate at Port Saïd as from of old, the piers and breakwaters will be periodically lengthened, made to stretch further and further into the sea, while powerful steam-dredges will scrape away the sand from the mouth of the harbour. Whether heavy gales will effect any more serious choking of the approaches, or drift tons of blowing sand into the canal itself remains to be seen. But while the world is greeting, and worthily greeting, the great work as a triumph of engineering skill, it may be well, at the same time, to bestow a little thought on the facts and conclusions here brought under notice, which in the pre-scientific age rendered man's contests against the works of the winds and sea perfectly hopeless.

MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

IN the last number of *Silliman's Journal* is an account of this year's meeting of the American Association, held at Salem, under the presidency of Mr. J. M. Foster, of Chicago, which seems to have passed off as pleasantly and usefully as did our own at Exeter. Over one hundred and fifty new members were elected. The number of communications entered upon the daily programmes of the Standing Committee was about one hundred and fifty. The range of these papers was considerable, and it was found expedient to have sub-sections on Archæology and Microscopy, to facilitate the disposal of papers which could not be reached in the other sections.

The then recent total eclipse of the sun was naturally a prominent subject of interest; the astronomers being present in considerable force.

The dedication of the Peabody Academy of Science was an occasion worthy to occupy the attention of the Association at its opening session. A few notes on this Academy will be welcome to many readers. The Institution was founded at Salem in the year 1867, by the munificence of George Peabody, with the design of promoting the study of science in his native county of Essex. The first Annual Report of the Trustees of this Academy, made in January, 1869, shows that it is already fully organized, with an able corps of officers and a well-ordered museum, library, &c., and the activity of its Director and Curators is evident not only in the extent and fine condition of the collections, but in the zeal and ability with which the various publications of the Academy are conducted. Advantage was taken of the present occasion to make the formal transfer of the building of the Museum to the Trustees, and its delivery and acceptance by the Director, Mr. F. W. Putnam. In an eloquent address the President of the Academy, Mr. William C. Endicott, gave the history of the Museum from its foundation, in 1801, as the East India Marine Hall, to its purchase and reorganization in its present form. The Essex Institute, which is well known by its Proceedings, Bulletin, and Historical Collections, is now incorporated with the Peabody Academy of Science.

The address of Dr. B. A. Gould, the retiring President of the Association, dealt with the Position of Men of Science in America.

Everything which a hearty good will and an intelligent appreciation of science could do was done to promote the happiness and forward the plans of the Association and its members, alike by the city authorities of Salem, the various scientific bodies, and private individuals. We confess we should have been glad to learn that our English scientific men had been represented at the meeting, as America was represented at Exeter by Professors Newton and Lynan.

The Association will meet next year at Troy, New York, under the presidency of Professor Chauvenet, of St. Louis University.

The following, which were among the papers read at the meeting, will give an idea, not only of the great scientific importance of the congress, but of the direction in which many of the most eminent scientific men in America are working at the present time :—

SECTION A. *Mathematics, Physics, and Chemistry.*—On the Total Eclipse of Aug. 1869; B. Pierce.—On Quintuple Algebra; B. Pierce.—Determination of the Mechanical Equivalent of Heat, by means of the modern ice and cooling machines ; P. H. Van der Weyde.—The Spectral Bands considered as harmonics of one or more fundamental longer waves, lying beyond in the invisible caloric rays ; P. H. Van der Weyde.—On the audible transmission of musical melodies by means of the Electric Telegraph; P. H. Van der Weyde.—Electricity not a self-existent fluid, but a mode of motion of matter ; P. H. Van der Weyde.—Flame Temperatures, in their relations to compositions and luminosity ; B. Silliman and H. Wurtz. — On the relation between the Intensity of Light produced by the Combustion of Illuminating Gas and the Volume of Gas consumed; B. Silliman. —Causes of the Failure of Lightning Rods ; J. Bushee.—Conditions of a perfect Lightning Rod ; J. Bushee.—The Laws of the Deflection of Beams tested by experiment; W. A. Norton.—The physical theory of the Principle of the Lever; W. A. Norton. —Planetary Influence on Rainfall and Temperature ; P. E. Chase. —The use of the Thermometer to determine the period of Solar Rotation ; P. E. Chase.—Some observations on the Solar Eclipse at Montreal, by Dr. C. Smallwood, with Photographs taken by Wm. Notman. Communicated by B. Edwards.—A new method of observing Contacts at a Solar Eclipse by the Spectroscope ; C. A. Young. — The Spectrum of the Solar Prominences and Corona, as observed at Burlington, Iowa, in the last Solar Eclipse, and the coincidence between the bright lines of Corona Spectrum and those of the Spectrum of the Aurora Borealis ; C. A. Young.—The Solar Eclipse, and the Outlines of the Corona as observed at Des Moins ; T. Bassnett. —Remarkable case of freezing Fresh-water Pipes in Salt-water; W. W. Wheilden.—The Thermodynamics of Waterfalls ; A. M. Mayer.—On some further evidence of the existence of a System of Arctic Winds; J. H. Coffin.—The present condition of Lighthouse Illumination in the United States ; J. Henry.—A new method of rendering the Needle of a Galvanometer definitely astatic ; M. G. Farmer.—On an improved construction of the Holtz Electrical Machine, adapted for the analysis of the phenomena of this variety of machine, and for Class-room use ; R. E. Rogers.

SECTION B. *Geology and Natural History.*—Comparison of the Coral Faunæ of the Atlantic and Pacific Coasts of the Isthmus of Darien, as bearing on the supposed former connection between the two Oceans; A. E. Verrill.— On certain Peculiarities in the distribution of Marine Life on the Sea-bottom of the Bay of Fundy ; A. E. Verrill.—American Phyllopod Crustacea ; A. E. Verrill.—The Homologies and general structural relations of the Polyzoa ; A. Hyatt.—Observations on a new genus of Polyzoa ; A. Hyatt.—New Species of Fishes obtained by Prof. Orton in the valleys of the Maranon and Napo ; T. Gill. —Notice of some new Fossil Plants from Gaspé, discovered by Prof. J. W. Dawson ; J. S. Newberry.—On some points in the Geology of North Carolina ; W. C. Kerr.—Preliminary notice of the Lamellibranchiates of the Upper Helderberg, Hamilton and Chemung Groups ; J. Hall. — On the Classification of the Diurnal Lepidoptera ; S. H. Scudder.—The Morphology of the Abdominal Appendages of Butterflies ; S. H. Scudder.—The value of the characters drawn from the external Armature of Lepidopterous Larvæ ; S. H. Scudder.—A classification of the Eggs of Butterflies ; S. H. Scudder.—Two new genera of Extinct Cetacea ; E. D. Cope.—Discovery of the Ammonoosuc Gold Field ; H. Wurtz.—Note upon the Palæotrochis ; H. Wurtz.—Notices of some new Tertiary and Cretaceous Fishes ; O. C. Marsh.—Metamorphosis of Siredon into Amblystoma ; O. C. Marsh.—On some new Mosasauroid Reptiles from the Greensand of New Jersey ; O. C. Marsh.—Homologies of the Palæchinidæ ; Alex. E. R. Agassiz.—On Surface Changes in Maine indicating the length of time since the close of the Quarternary Period ; N. T. True.—Compression as an agent in Geological Metamorphism, with illustrations of distorted pebbles in conglomerates ; G. L. Vose.—On the Plasticity of Pebbles and Rocks ; W. P. Blake.—Flora and Fauna of the Fresh-water Tertiaries of Oregon and Idaho ; J. S. Newberry.—On new species of Fishes obtained by Prof. Orton in the Valleys of the Maranon and Napo ; T. Gill.

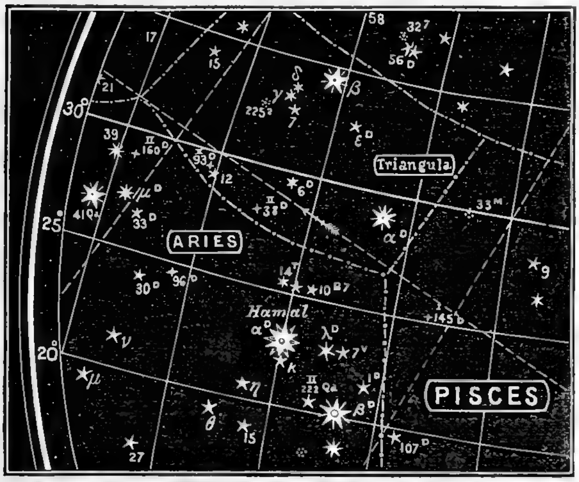
SUB-SECTION C. *Archæology and Ethnology.*—Conjectural explanation of Uses of the Embankments of the Mound Builders ; L. H. Morgan.—Discovery of the Remains of the Horse among the Ancient Ruins of Central America ; O. C. Marsh.—Exhibition of a few interesting Implements collected by R. W. Haskins from Indian Graves on the banks of the Ohio, with special reference to the boring of holes in stone implements; F. W. Putnam.

NEW STAR-ATLAS

MR. R. A. PROCTOR has planned a star-atlas on a plan which presents several advantages. The celestial sphere is to be divided according to this plan into twelve equal parts, each pentagonal in shape ; but, each map being made circular, there is a slight overlapping, which prevents any star-group from being broken off at the edge of a map, as in all the arrangements hitherto adopted. Owing to the equality of the maps and the choice of a central projection (the equidistant) the distortion is reduced to a minimum. In fact, for the first time in the history of star-mapping, a plan is adopted by which, with a moderate number of maps, there is no appreciable distortion or scale-variation. The woodcut which gives (on a reduced scale and with inverted colours) a portion of Map 2 of the series (where it overlaps Map 4), exhibits some of the principal peculiarities of the new scheme. It will be noticed that though this portion belongs to the outer portion of the map (where the distortion is greatest) the figures between the parallels and meridians are of their proper shape. The arrow indicating precession in direction and magnitude (for 100 years) is a novel and very simple mode of exhibiting this important relation. The way in which the constellation-names are introduced is also new, and seems preferable to the old arrangement, in which the name straggling over the whole constellation at once confused the star-grouping, and was itself almost illegible unless printed in very large letters. The figure also includes instances of the mode of marking double, triple, and multiple stars, binaries (known or suspected), variables, Messier's nebulæ, Sir W. Herschel's classification of his nebulæ, and so on.

All stars in the B.A. Catalogue down to the sixth magnitude inclusive are to be introduced, besides all the objects in the Bedford Catalogue, Messier's nebulæ, about 100 variables, red stars, and other objects of interest (in all about 1,500 objects). The scale of the maps is to be that of a 20-inch globe, and each map will be rather more than thirteen inches in diameter.

Mr. Proctor's series of gnomonic maps, in which the sphere is divided into the same set of pentagons, which



are arranged into two sets of six (namely, five northern equatorial maps around the north polar map, and five southern pentagons similarly arranged around the south polar map) will be added as index maps. As in these maps the constellation figures (coloured) are introduced, all necessity of adding these figures to the large maps is avoided, and so the clearness of the maps is much increased.

A letter-press introduction, with a list of star-names, will add to the completeness of the maps. Mr. Brothers, of Manchester, will photo-lithograph the maps if it should appear from the receipt (by him) of a sufficient number of names as subscribers, that the scheme is approved of by astronomers. He will supply to subscribers a specimen of Map 2, which alone is yet completed.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents.*]

Personal Equation of Astronomical Observers

CAN any of your readers inform me whether an attempt has hitherto been made to determine the absolute Personal Equation of Astronomical Observers? The most important of all astronomical observations consists in noting the time of passage of a star across the wires of a transit instrument; but it is found that no two observers exactly agree in the time assigned to the passage. From peculiar habit or bodily constitution some observers almost invariably register the passage of a star a fraction of a second before other observers. From the Introduction to the volumes of Greenwich Observations, we learn that it is the practice at the national Observatory to compare the observations of the junior observers with those of the principal observer, and to assume that the latter is correct. All the observations are thus brought into consistency with each other; but it is not known, I believe, whether all the time observations may not be a fraction of a second too soon or too late.

Cannot this question be determined experimentally in a very simple manner? Imagine an artificial star, formed by a minute electric spark, placed at a considerable distance, say three miles, and made to move across the field of a transit instrument at a rate not very different from the average apparent rate of stars observed (say nine inches per second): very simple mechanism might be devised to register upon the chronograph of the observatory the exact moment at which the star is absolutely upon each of the cross wires of the telescope. At the same time the observer, whose error is to be determined, should endeavour to record in the ordinary way the passage of the star, and the difference of time, as shown on the chronograph, would give the required error. Every observer might thus be put through a kind of exercise, which would inevitably show the degree of his proficiency, or detect any change in his habits of observation.

I need hardly say, that however small may be the remaining personal error unallowed for in the Greenwich observations, the time may come when the determination of some most important astronomical question may depend upon that quantity. And though those observations may at any one time be rendered perfectly consistent *inter se*, by reference to one observer's result, yet they cannot be strictly comparable with the observations of other observatories, or those of the same observatory at distant periods of time, because the one same observer would not be present to give the assumed standard. It might be of considerable importance, therefore, to establish a mechanical criterion of the accuracy of time observations which could be appealed to at any observatory, and at any future time. I have not been able to learn that such an experiment has hitherto been tried.

J.

The Fertilisation of Winter-flowering Plants

WILL you permit me to add a few words to Mr. Bennett's letter, published at p. 58 of your last number? I did not cover up the *Lamium* with a bell-glass, but with what is called by ladies, "net." During the last twenty years I have followed this plan, and have fertilised thousands of flowers thus covered up, but have never perceived that their fertility was in the least injured. I make this statement in case anyone should be induced to use a bell-glass, which I believe to be injurious from the moisture of the contained air. Nevertheless, I have occasionally placed flowers, which grew high up, within small wide-mouthed bottles, and have obtained good seed from them. With respect to the *Vinca*, I suppose that Mr. Bennett intended to express that pollen had actually fallen, without the aid of insects, on the stigmatic surface, and had emitted tubes. As far as the mere opening of the anthers in the bud is concerned, I feel convinced from repeated observations that this is a most fallacious indication of self-fertilisation. As Mr. Bennett asks about the fertilisation of Grasses, I may add that Signor Delpino, of Florence, will soon publish some novel and very curious observations on this subject, of which he has given me an account in a letter, and which I am glad to say are far from being opposed to the very general law that distinct individual plants must be occasionally crossed.

CHARLES DARWIN

Down, Beckenham, Kent, Nov. 13

Elimination of Alcohol

ALLOW me to remark on a statement made in one of the chemical notes of last week's NATURE.

A new test for alcohol discovered by M. Lieben is there described, and its alleged value in solving an important physiological problem is dwelt upon. Now the real course of events has been as follows:—Since the year 1860, when MM. Lallemand, Duroy, and Perrin published their researches on alcohol and anæsthetics, the old belief in the combustion of alcohol within the organism has been almost entirely upset; and it was supposed that this substance was entirely eliminated without change. Dr. Anstie was, I believe, the first who publicly criticised the conclusions of these physiologists, and showed, by a number of experiments, that a small proportion only of the alcohol introduced is excreted by the kidneys. [See Dr. Anstie, "Stimulants and Narcotics," Macmillan, 1864; also further researches recorded in his Lectures on Acute Diseases at the College of Physicians, *Lancet*, 1867, vol. ii.]

The question was next taken up by Dr. Thudichum, who estimated the amount of alcohol excreted by a number of men after they had taken a considerable quantity of wine, and proved it to be only one-half per cent. of the total amount swallowed. Finally, the writer of this, during 1866 and 1867, made numerous experiments in the same direction. In these, not only was it shown that alcohol can be detected in the urine secreted during several hours after the dose had been taken, but it was also quantitatively proved that the total proportion eliminated was an excessively small fraction of what was taken into the body. This was demonstrated both in the case of healthy men, and in that of persons suffering from disease. [See Tenth Report of the Medical Officer of the Privy Council, p. 288.]

Moreover, unknown to either of the above observers, M. Schulinus of Dorpat, in 1866, made elaborate experiments on animals, which also showed conclusively (1) that elimination of alcohol does take place, and (2) that it only represents a fractional part of the alcohol taken. [Archiv. f. Heilkunde, 1866.]

However delicate and useful, therefore, M. Lieben's test may be in itself, it was not needed to decide this question, which was already settled. A. DUPRÉ, Ph.D.

Laboratory, Westminster Hospital, Nov. 15

NOTES

THE Royal Society commences another session to-night. The communication of the results of the recent dredging expedition in the *Porcupine* will most probably take up the whole of the evening.

THE great "Catalogue of Scientific Papers compiled and published by the Royal Society," has now reached its third volume; a fact which we have much pleasure in announcing. In this the names of authors are carried on from GRE to LEZ inclusive, so that the compilers are nearly half-way through the alphabet. We congratulate them on their good progress, and can promise them the cordial appreciation of scientific men all over the world, to whom the work will prove of inestimable value. Does a mathematician wish to know how many mathematical papers have been written by Grunert, the well-known editor of the "Archiv," he turns to this volume, and finds 343. Guérin Méneville, the naturalist, figures for 326; Hagen, entomologist, for 102; the veteran Haidinger has 286 on minerals and meteorites; while Henwood, a Cornish celebrity, shows 55 papers on geological and mining subjects; and Heer, of Zurich, to whom we are indebted for admirable descriptions of fossil flora of the primeval world, numbers 46; Sir William Hamilton heads a list of 69 papers; Hansen, 103, probing deep into astronomy; Hansteen, the Norwegian, who lives to see in Sir Edward Sabine's researches, a grand outcome of his own early investigations of terrestrial magnetism, has 141 papers; Dr. Hooker appears for 58 papers; his late father for 72; and the late W. Hopkins, who did so much in mathematical geology, for 33. Dr. Hofmann, the eminent chemist, has made himself responsible for 156 papers; Mr. Lassell for 66, and Leverrier for 88. Kummer, recently elected a foreign member of the Royal Society, is down for 51; Leuckhart for 64; the indefatigable Isaac Lea, of Philadelphia, for 106, mostly about shells; and Lamont, of Munich, for 90, on magnetism, meteorology, and various questions in physical astronomy. From this brief selection our readers will see what a rich fund of scientific information has been prepared for their use by the Royal Society.

AMONG the recently published state papers of the American Government, is the annual report of the president of the National Academy of Sciences, from which we make the following extracts. It will be seen that in America there is no mistake about what is considered to be the duty of the Government in regard to scientific research—we wish we could say as much for England:—"The members of the Academy consist principally of professors in our colleges, and a few officers of the army and navy, who, from their social position and moral character generally, have the confidence of the public in a degree surpassed by no other class of the community. They are, however, generally men of limited means, receiving no pecuniary reward for their discoveries, and by law allowed nothing for their labours in the Academy, and who can ill afford the expense of assembling, from a distance, in the city of Washington. A small sum appropriated by Congress for the expense of their annual meetings, by which a full attendance could be secured, would be money well bestowed. It would stimulate higher researches, elevate the character of the association, and be productive of more valuable assistance to the Government. I feel myself more at liberty to urge the claims of the Academy, inasmuch as its members generally, including myself, took no step towards its establishment. Indeed, I must confess that I had no idea that the national legislature, amid the absorbing and responsible duties connected with an intestine war, which threatened the very existence of the Union, would pause in its deliberations to consider such a proposition. But Congress, having expressed its sense of the importance of an organisation of this kind, the members designated accepted in good faith the appointment, and have since endeavoured zealously to discharge the obligations thus devolved upon them. *It is now the duty of Congress to do its part, by furnishing the means to enable the Academy to fulfil its mission with credit to itself and the nation.*"

THE Minister of Public Instruction has given orders for the construction of an Agricultural Map of France, on a novel plan. It will be built up of specimens of the various soils, arranged according to locality.

FROM accounts of the last meetings of the Wellington Philosophical Society and New Zealand Institute which have reached us, it is clear that good scientific work is being done at our antipodes, much of it in Dr. Hector's laboratory. The most interesting result recently obtained is the isolation of the poisonous substance in the Tutu plant. Many experiments made for this purpose during the last six years, both in the laboratory of the Geological Survey and by chemists in Great Britain, failed to discover the poisonous ingredient of the plant. A short time ago, Mr. Henry Travers collected for the Museum a large quantity of ripe seeds of the Tutu (*Coriaria ruscifolia*), and on these Mr. Skey has recently experimented. He has discovered the poison to be a greenish oil, unaffected by, and insoluble in, water and mineral acids, but soluble in acetic acid, ether, alcohol, and chloroform. This oil is combined with a red-coloured resin, which is insoluble in ether, by removing which the poisonous oil was obtained in a pure state. The quantity of the poison contained in the seed is 12 per cent. of the weight. A similar oil has been detected by Mr. Skey to be the active poisonous element in the Karaka seed (*Corynocarpus lævigata*), which will account for its having hitherto escaped detection; and he suggests that the discovery might lead to the detection of the active principle of many poisonous European plants that have hitherto eluded research.

ANOTHER item of New Zealand news is that the result of all Dr. Hector's investigations into the geology of the islands is, that New Zealand must be considered as, on the whole, well supplied with mineral fuel. The most valuable description of coal is certainly confined to limited and not very accessible areas; but still there is nothing to prevent their being profitably worked for the supply of the steam service. The great point for congratulation, however, is, that throughout almost every part of the islands, coal of a practically useful description is to be found within a short distance.

WE are glad to see that the Essex Institute—not our Essex, but the American one—is extending its sphere of action by issuing a Bulletin in addition to their ordinary proceedings. The Bulletin is intended to give to the public such portions of communications made to the Institute at its semi-monthly and other public meetings, as are of popular interest. A brief summary of all the proceedings at each meeting will be given, which will contain the titles of all written or oral communications, and the names of their authors. A small space in each number will be used to announce the recent correspondence, and donations to the library and museum, and to state deficiencies existing in the collections, and the methods in which its friends may best aid in rendering them more complete. There will also be inserted a list of some of the duplicate volumes, pamphlets, newspapers, &c., in the library, which will be offered for exchange or sale. It is expected that the variety and interesting character of the communications this volume will contain, will make it a favourite with the public, while its low price will bring it within the means of all. The Bulletin can be obtained of Messrs. Trübner & Co.

A REPORT on excisions of the head of the femur for gunshot injury, by Mr. G. A. Otis, assistant-surgeon United States army, is the latest of a series of elaborate reports on important medical and surgical questions, published by the Surgeon-General of the War Department at Washington. The liberality of the Government of the United States in matters of science is, or at least should be, well known; and the handsome form in which these volumes, illustrated by numerous woodcuts, lithographs, and chromolithographs, are issued, deserves notice at our hands, although questions of practical surgery lie outside the province of NATURE as understood by us. In the volume we have, first, an apparently exhaustive historical survey of the operation of excision at the hip, and then the detailed records of the operation during the late civil war, these records being illustrated by figures of the pathological specimens and lithographs of individuals successfully operated on: finally, the records of temporisation are discussed, and the results compared with excision and amputation. Whether the surgical reader will endorse Mr. Otis' conclusions or not, they will, we are sure, agree that his report is in every way creditable to American military medical science.

PROFESSOR GRANT, the director of the Observatory in the University of Glasgow, has printed two letters, which he addressed to M. Leverrier, on the authenticity of the documents respecting Newton, communicated to the Academy of Sciences by M. Chasles. These letters, which are now more than two years old, have since the exposure of the Newton-Pascal forgeries, become specially interesting. They must be read in connection with M. Leverrier's more recently indited brochure.

THE sixty-eighth annual election of office-bearers of the Philosophical Society of Glasgow was arranged to take place last night (Wednesday). Professor Grant retires from the office of senior vice-president, and the Rev. H. W. Crosskey from that of librarian. The following members of council retire by rotation: Mr. Ramsay, of Kildalton, Professor W. J. Macquorn Rankine, Sir William Thomson, and Mr. William Ramsay.

A LETTER from Gross-Gerau in the *Cologne Gazette*, dated last Saturday, quoted in the *Pall Mall Gazette*, says that on the previous Wednesday a gentle rumbling was observed twenty-five times, but only one shock; on Thursday there were twenty-three rumblings, and a shock about midnight. On Friday there were six violent shocks resembling those of the 30th ult., and in the night, up to 7 a.m., there were nine more shocks, accompanied by frequent thunder. During the morning of Saturday there was again a calm, but in the afternoon two violent shocks were felt, the last of which occurred very suddenly at 4.32. It is a very remarkable fact that these shocks have entirely altered in character from the earlier ones, being announced by a single thunderclap similar to the noise of a cannon shot fired at a distance of some miles, but much stronger. Their direction, too, is vertical instead of horizontal as before. The total number of shocks felt at Gross Gerau during the last three weeks is between seven and eight hundred. Most of the clocks and watches in the place have stopped, and the houses have all been more or less damaged, even those which are built of stone. The earthquake has also destroyed sixty-one chimneys. What if the volcanic region of the Eifel should burst open with its old activities, and the beautiful Laacher See and Pulvermaar, and the Mosenberg among others should favour us with phenomena which formerly one has gone at least as far as Vesuvius to see!

THE Royal Society has just issued Part I. of their 159th volume, the bulk of which is in very fair ratio to the importance of its contents. We have first a paper on Solar Physics, by Messrs. De La Rue, Stewart and Loewy, containing a first instalment of the measurements made with a view of making the solar photographs taken at Kew the basis of a new determination of the sun's astronomical elements: the privately-printed papers, with which all astronomers are familiar, are acknowledged to have been preliminary. The great Melbourne telescope is exhaustively described by Dr. Robinson and Mr. Grubb, and the description is accompanied by admirable and numerous plates, so that all may gain a very ample notion of the grand instrument from which so much may be anticipated. Terrestrial Magnetism is the subject of two papers, one by the Astronomer Royal, the other by Mr. Chambers; while prolific Prof. Cayley has three mathematical memoirs—one on Skew Surfaces otherwise Scrolls, another on the Theory of Reciprocal Surfaces, and the last on Cubic Surfaces. The Formation and Early Growth of the Bones of the Human Face, by Mr. Callender; the Osteology of the Solitaire or Didine Bird of the Island of Rodriguez, illustrated by ten exquisite plates by Ford, by Messrs. A. and E. Newton; the Developments of the Semilunar Valves of the Aorta and Pulmonary Artery of the Heart of the Chick by Dr. Tonge, are the papers which appeal to biologists; and Mr. Gore's paper on Hydrofluoric Acid, and one by Mr. Lockyer on Spectroscopic Observations of the Sun, are the other memoirs included in the volume.

WE have to record the death of an astronomer of European reputation, Mr. W. F. Donkin, F.R.S., Savilian Professor of Astronomy at Oxford, and Honorary Fellow of University College.

ASTRONOMY

Correction of Atmospheric Chromatic Dispersion

THE Astronomer Royal, in his last communication to the Royal Astronomical Society on the Transits of Venus, adverted to the injurious effect on the observations, which might possibly arise from the chromatic dispersion produced by the atmosphere, and suggested that probably an efficient corrective might be found, in the application of a glass prism of small refracting angle in the eye-piece of the telescope. In a subsequent communication on the same subject, after stating the optical theory, Mr. Airy continues:—Suppose, then, that we have a series of flint prisms ground to the angles 2°, 4°, 6°, 8°, 12°, 16°. And suppose that we use a telescope with power 120 or with power 240. Then the following table, showing the zenith distance at which the atmospheric dispersion is corrected, is easily computed; the refraction being calculated by the formula just given, and the zenith-distance corresponding to the refraction being taken from a common table of refractions:—

	Telescopic power 120.		Telescopic Power 240.	
Angle of Flint Prism.	Atmospheric Refraction.	Zenith Distance.	Atmospheric Refraction.	Zenith Distance.
°	′	° ′	′	° ′
2	1·8	61 58	0·9	43 7
4	3·6	75 16	1·8	61 58
6	5·4	80 15	2·7	70 32
8	7·2	82 52	3·6	75 16
12	10·8	85 34	5·4	80 15
16	14·4	87 3	7·2	82 52

For view with the naked eye it would be necessary to use a prism (of appropriate small angle) with its edge downwards; but, for view with an inverting telescope, the edge of its appropriate prism must be upwards.

The object I proposed is completely attained. It is made possible, by this construction, to examine a celestial body with delicacy and accuracy, under circumstances which would, without this construction, have rendered nice observation impossible.

The series of angles of the prism which I have given appears to me well adapted to general wants. I propose to furnish each of the principal telescopes to be used for the transit of Venus with a complete series of such prisms, arranged perhaps on a long slider. Care must be taken to make the thickness of the slider-frame as small as possible, inasmuch as it must be accompanied with another slider carrying dark glasses. It will probably be found best to place both sliders between the two glasses of the eye-piece. This slightly disturbs the elements of the calculation above; but in practice the selection of the best prism will always be matter of trial, and the disturbance of calculations will be unimportant.

Before closing this subject I will advert to a remark made by one of the most acute telescope-observers who have ever been known in this Society, the late Rev. W. R. Dawes. He states that, in general, a telescope performs better with one particular point of the edge of its object-glass upwards than in any other position. The explanation of this singular remark will be found, I think, in the combination of the effect of error of centering of the two lenses of an achromatic object-glass, with the effect of atmospheric dispersion. The centre of one lens (using the word "centre" to denote that part in which the tangent-planes of the two surfaces are parallel) ought to be exactly above the centre of the other lens. But it is not easy to make this adjustment perfect; the centre of one lens is frequently above a part of the other lens where the two surfaces have a slight inclination; and the refraction thus created produces in the image of every star a spectrum which rotates as the telescope-tube is made to rotate. In one position of the tube the atmospheric dispersion is opposed to this, and may wholly or in a great measure correct it; in the opposite position the atmospheric dispersion is added to it, and increases its injurious effects.

The atmospheric dispersion between B and G is about $\frac{1}{60}$th of the atmospheric refraction. At zenith-distance 45° it is nearly 1″, at 63° it is nearly 2″, at 80° about 5″. These are the lengths of the visible spectrum.

The Cause of the Incandescence of Meteors

THE incandescence of meteors was at first ascribed to their friction against the air, until in 1854 M. Regnault showed that this was not probable. M. Govi, of Turin, now affirms that the high temperature is due to the heat disengaged by the compression exercised on the air in front of them. This accounts for the fact that the interior of a meteor sometimes shows no signs of excessive heating, and that the hydrogen is not expelled.—[Bul. Association Scientifique de France, t. vi. 305.]

AMONG the points of interest touched upon at the last meeting of the Royal Astronomical Society was the extension to the approaching transit of Venus of Professor Young's suggestion to observe times of contact in solar eclipses by means of the gradual reduction of the length of the lines of the chromosphere, as observed in a spectroscope.

BOTANY

Spontaneous Motion of Protoplasm

PROF. J. B. SCHNETZLER records in the *Archives des Sciences Physiques et Naturelles*, some observations on the spontaneous motion of the protoplasm in the cells of the leaves of the common water-weed, the *Anacharis alsinastrum*. The writer remarks that whether the cause of the motion is found, as some have maintained, in the successive contractions or vibrations of the exterior layer of the protoplasm, which transmit themselves to the interior layers; or whether the successive displacements of the molecules is produced by causes purely mechanical, as others have held, it still remains to be explained what produces these contractions or displacements. It is incontestable that they are found only in living protoplasm. Prof. Schnetzler believes that the principal cause which provokes the motion is the chemical action of oxygen, which passes through the wall of the cell, and of which a portion is probably transformed into ozone under the influence of light, as occurs also in the globules of blood. The most strongly refracted rays of light have a marked influence on these currents, which are also no doubt affected by the currents of electricity which form, under the influence of water, between the surface of the leaf and the contents of the cells. The energy of the motion depends principally on the temperature, showing the greatest vigour between 16° and 20° C. In the point of view of mechanical theory, we have here evidently an example of the transformation of light and of heat into motion. The *Anacharis* is especially favourable for the observation of these motions; as, in consequence of the transparency of its tissue, they can be watched under the microscope without any preparation.

THE Lucerne crops in several parts of the country have recently been attacked by a species of Dodder, the *Cuscuta hassiaca*, allied to the parasitic Clover-dodder and Flax-dodder, which are so destructive to those crops. It is described as being a beautiful plant, with clear orange leafless stems, and abundant pure white and exquisitely-scented flowers.

THE magnificent "Flora Crasiliensis," the *magnum opus* ot the late Von Martius, published under the auspices of the Bavarian and Brazilian Governments, is not likely to suffer by the death of that distinguished botanist. Under the able editorship of Dr. Eichler, of Münich, two new parts have recently been published, a most valuable and beautifully illustrated dissertation on the curious parasitic *Balanophoræ* by the Editor, and a monograph of the Brazilian *Convolvulaceæ* by the veteran Meissner. In the course of the ensuing winter we are promised a volume on the Ferns, about 350 species, with nature-printed illustrations, by Mr. J. G. Baker, of the Kew Herbarium; and the most eminent European botanists are engaged on other orders which still remain to complete the work. A. W. B.

CHEMISTRY

Italian Mineral Waters

THE following analyses of Italian Mineral Waters have been made by Prof. Purgotti of Perugia [Ann. di Chim. app. July, 1869, p. 59.]

I. Bromo-ioduretted water which collects in a reservoir, five kilometres from the station of Assisi :—

Carbon dioxide	0·44110
Silica	0·01500
Magnesium bromide	0·00124
Magnesium chloride	0·18830
Magnesium sulphydrate	0·07750
Sodium chloride	0·86370
Sodium sulphate	0·15630
Calcium bicarbonate	0·35800
Magnesium bicarbonate	0·25190
Extractive organic matters	0·02150
Total mineral constituents	2·37454
Water	907·62546
	1000·00000

This water likewise contained free oxygen, ozone, ferrous bicarbonate, and alumina (and iodine?), but in quantities too small for estimation.

II. A ferruginous water collected in a square reservoir about half a kilometre from Cannara, near Collemancio, was found to contain :—

Ferrous bicarbonate	0·0300 grm.	Magnesium bicarbonate
Manganous bicarbonate	0·0036	Magnesium chloride
Free carbon dioxide		Magnesium sulphate
Atmospheric air		Silica
Calcium bicarbonate		Calcium sulphate

The temperature of this water is considerably lower than that of the surrounding air.

Sal-ammoniacum Martiale

ANGELO BANIERI has made the following observations on the ammonio-ferric sulphate (*sal ammoniacum martiale*) collected on the lava of Vesuvius. Many naturalists believe that the hydrochloric acid evolved by lavas in their course, unites with the iron of the same lavas, forming ferric chloride, which, together with the ammonia of the air, gives rise to the compound of sal-ammoniac and ferric chloride found in the fumaroles. This view, however, does not appear to the author to be in harmony with facts observed in the Vesuvian lava-current of 1850. It was only in that part of the lava which had overwhelmed a cultivated and manured soil that fumaroles existed, and there they were so numerous as to yield more than 100 measured quintals of sal-ammoniac, whereas, on the other part of the igneous current, which had passed over an older lava of the year 1834, in which there was nothing but dry rock and sterile sand, there were no fumaroles of sal-ammoniac. The silica of the lavas acts at very high temperatures on the common salt contained in the manured soil, liberating hydrochloric acid, which, on the one hand, reacts on the ferric hydrate contained in the same soils, producing ferric chloride, and, on the other hand, decomposes the ammonium carbonate eliminated from the organic substances of the soil, which are subjected to dry distillation by the heat of the invading lava. The hydrochloric acid which gives rise to the sal-ammoniac of the fumaroles of volcanic lavas, cannot be derived from the lavas themselves, inasmuch as its presence is only transient; but it is derived from the decomposition of the chlorides contained in the invaded lands. An inspection of the lava of 1850 shows indeed that the denuded soil has been completely burnt, and nothing is seen but scoria of a reddish sand, which have evidently been subjected to a very high temperature.—[Ann. di. Chim. app. alla Med., July, 1869, p. 61.]

TIGRI has observed that the flowers of the hop have the power of destroying the vitality of the *Mycoderma vini.* A quantity of this fungus situated at the bottom of a vessel full of wine was found to be so completely disorganised by contact with the hop-flower, that it had no further effect in promoting the fermentation of the wine. Tigri accordingly recommends the use of hops for preserving wine.—(Ann. di Chim. app. alla Med., July, 1869, p. 20.)

M. VICTOR MEUNIER communicates to *Cosmos* the result of an experiment made in a Pasteur's flask. Seventy-five cubic centimeters of urine were introduced into a flask of three hundred cubic centimeters capacity, boiled for five minutes, and sealed. At the end of fifty-seven days two clusters of vegetation appeared; they proved to be a new species of Aspergillus, which the author, with some humour, dedicates to M. Pasteur. In another experiment, to the details of which we need not refer, M. Meunier discovered an additional species of Aspergillus, which he has named *gibbosus*.

PROFESSOR ROCHLEDER has found a new colouring ingredient in madder, in addition to alizarine and purpurine, its well-known constituents. The dye is soluble in both water and alcohol, crystallising from the latter in orange-yellow needles. The boiling aqueous solution, mixed with a little acetic acid, communicates a beautiful golden tint to wool or silk. Madder root contains, unfortunately, too small an amount of this substance to render its industrial extraction profitable.

OPINIONS seem still divided as to the poisonous nature of coralline and solferino red. Two cases are reported in *Cosmos*, from which we learn that wool impregnated with these colours produces loss of appetite, distaste for food, and cephalalgia. The wool became harmless after washing.

M. V. MARCHAND proposes to apply a chemical remedy to the newly-discovered disease of the vine. He thinks it certain that a saturated solution of sulphuretted hydrogen in water, or a mineral mixture which gradually evolves the gas, will effectually destroy the grubs which are now, in many vineyards, busily devouring the roots.

THE second part of the third volume of Dr. Kolbe's "Ausführliches Lehrbuch der Organischen Chemie" has appeared. This work, which will be complete in another volume, is a sequel to the well-known Graham-Otto's Chemie. The portion of it now before us treats principally of petroleum and similar oils, resins and balsams, albuminous bodies, biliary and cerebral products, and the constituents of urine.

GEOLOGY

Steneosaurus

MR. J. W. HULKE has published an elaborate description of the remains of a fossil crocodile from the Kimmeridge clay of Dorsetshire, which he identifies with Cuvier's *Deuxième Gavial d'Honfleur*, named *Steneosaurus rostro-minor* by Geoffroy Saint-Hilaire, and also as belonging to Quenstedt's genus *Dakosaurus*. The last-named genus will therefore be synonymous with *Steneosaurus* (Geoff. St.-Hil.).—[Quart. Journ. Geol. Soc., No. 100.]

On Sphærodus Gigas

IN a paper containing descriptions of two new species of *Gyrodus*, Sir Philip Egerton has described and figured the vomer of *Sphærodus gigas*, the discovery of which is interesting as proving the validity of the genus. In its character it is quite distinct from the same part in *Lepidotus*, to which genus the species has been referred on account of the resemblance of the detached teeth. The specimen figured contains a median row of six circular teeth, on each side of which is a row of seven rather smaller circular teeth. Sir Philip Egerton also describes and figures a beautiful specimen of the vomer of a *Gyrodus* from Kimmeridge, which he ascribes to one of his new species.—[Quart. Journ. Geol. Soc., No. 100.]

The Geology of Thrace

DR. A. BOUÉ, who has been investigating the geology of Thrace, announces some of the results of his expedition. He has traced the cretaceous and nummulitic formations from Jarim Brugas to Adrianople, and found crinoids in the shales and limestones near Eski Sara, one of which he is inclined to identify with the carboniferous limestone. The steep southern declivity of the Balkan represents a great fissure of dislocation, the granitic central stock of the ancient Balkan having sunk down bodily during the enormous porphyritic and trachytic eruptions; hot water flows from the fissures of the sunken granite, and forms numerous baths along the foot of the Balkan. In Mechli ravine, near Kisantik, immediately surrounded by mountains 4,000 feet in height, Dr. Boué discovered, resting directly upon gneiss, an old carboniferous formation, with three beds of good coal; but as no fossils were to be detected in the deposit, he was unable to determine whether it belongs to the coal measures. Coal-beds, probably of Eocene age, occur in the Rhodopi.—[Proc. Imp. Geol., Institute of Vienna, 31st Oct., 1869.]

PHYSICS

The Dynamics of Prince Rupert's Drops

PROFESSOR DUFOUR, of Lausanne, has been engaged in a research on the Development of Heat which accompanies the explosion of Prince Rupert's Drops. The examination of bodies which, in modern language, are said to be in a state of "molecular tension" is of the highest importance to dynamics, and the investigation to which we now refer is an example of the kind of work that is really required.

Every one is familiar with the pulverisation and explosion, so disproportionate to the mechanical force exerted to produce them, which are witnessed on the fracture of the point of one of these drops. M. Dufour finds, in addition, that an appreciable amount of heat is evolved at the same time. The simplest mode of exhibiting this effect is to adjust the drop in the cone of a vertical thermopile in such a manner as to prevent the powder produced by the disruption from projection elsewhere than against the upper face of the pile. This is easily accomplished by means of a caoutchouc cover, through which the point of the drop alone projects; and the entire apparatus, abundantly surrounded with cotton, is left at rest for a day. The pile is then connected with a galvanometer, and, after breaking the point, the required observation is readily made. With drops of 4·8 to 7·7 grammes, M. Dufour obtained a deflection of 5° to 9°. The mere friction of powdered glass gave no deflection. Attempts to determine the heat evolved were also made with the calorimeter, turpentine being the liquid employed. In their original form, these did not succeed; but tolerably concordant results were arrived at by effecting the explosion in a cone of pasteboard, having its base uppermost, and forcing the whole of the fragments to fall through the truncated vertex into the turpentine. In this way, it appeared that a weight of the drops, amounting to 11·40 to 20·42 grammes, caused an elevation of temperature of 0·25° to 0·35°. The internal condition of the glass was found, by these experiments, to vary appreciably in drops of different sizes. Sometimes the product consisted chiefly of large fragments, sometimes it was principally powder. M. Dufour compares the state of the drops to a rigid enclosure bound together by highly-heated bars, themselves mutually connected in every direction. After cooling, the bars would all be under strain, from which, if released at one part, the whole would be set free. Now, Joule and Edlund have shown that a strongly-stretched wire, if allowed to return to its original volume, actually evolves an amount of heat, forcibly reminding one of that developed in the present instances.

In order to discover the part of the drop whence the fragments had been derived, its exterior was coloured. Thus it was found that the largest fragments came from the central, the finest powder from the superficial layer; and the pieces that were examined had, as might thence be expected, the form of a very flat wedge. The evolution of heat during the explosion might have been presumed to be accompanied by an increase in the density of the glass; but although this is a point somewhat difficult to ascertain experimentally, M. Dufour's paper is not without evidence in favour of such being really the fact.

PHYSIOLOGY

Kinship of Ascidians and Vertebrates

The number of Max Schultze's *Archiv* (v. 4), just published, contains a letter to the editor from Prof. Kupffer, of Kiel, in which that distinguished embryologist asserts that he has been studying the early history of a species of Phallusia, and that his results in large measure agree with those of Kowalevsky touching the startling vertebrate features of the early condition of these invertebrata. He reserves for the present the details about the exact formation of the nervous system, but quite confirms the fact of the existence of a notochord. He says: "At this stage one could not imagine a more beautiful model of a vertebrate embryo, with the neural tube on one side of the axis and a visceral tube on the other." He, moreover, describes in his species of Phallusia the neural tube as not merely an almost spherical vesicle, but as prolonged in the form of a fine hollow thread into the tail above the notochord or axis. He promises full details shortly, and we hope to be able to return to this most important matter.—M.F.

The Chloral controversy seems likely to terminate. *Pure* chloral, M. Bouchut informs us, is really a good anæsthetic. On the other hand, M. Laborde says that its frequent administration is attended with danger. Chloral, if mixed with blood outside the body, yields no chloroform until traversed by a current of air.

SOCIETIES AND ACADEMIES

Ethnological Society, November 9.—This society held its first meeting for the present session at the rooms in St. Martin's Place. Professor Huxley, the President, occupied the chair. After some remarks by Colonel Lane Fox, the honorary secretary, on the Megalithic Monuments of Stonehenge, Mr. Gardner, of H.M. Consular Service, China, read a paper before the Society, on the Chinese People, Government, &c. The point on which Mr. Gardner laid most stress—in fact, the leading idea of the whole paper—seemed to be the tenacity with which the Chinese had preserved the usages of antiquity, and the skill with which they had adapted them to the exigencies of modern times. They retain, according to him, the patriarchal theory of government, but make it suitable for an empire of 400,000,000 human beings. And if we allow that the ideographic form of writing is the most ancient of all, then the Chinese, in this nineteenth century, preserve an older principle of expressing thought than is to be found in the most ancient Egyptian hieroglyphics extant, and yet no language in the world is more capable of finding appropriate terms for the latest discoveries in mental and physical science, and the newest inventions of art. Mr. Gardner pointed out some analogies which he fancied existed between Chinese, Egyptian, and Hebrew, leaving it to philologists to decide whether these supposed coincidences were fortuitous, or a confirmation of the theory set forward by Hunter and others, of the original unity of the Aryan and non-Aryan languages. In the Chinese religion, Mr. Gardner stated, that whatever might be the nominal creed of individuals, or even masses, ancestral worship (undoubtedly the most ancient form of religious cult) as an act of devotion is most universally practised in the present day. Underlying all religious forms and creeds, Mr. Gardner stated, was an idea, more or less vague, of one Supreme Being; but he did not express an opinion as to whether this idea is a legacy of ancient times, or one of modern development. Besides this leading idea, Mr. Gardner gave a long account of the Chinese social institutions and benevolent societies: these latter are somewhat remarkable, and though not general enough in their organisation to refute the prevailing idea that the enthusiasm of humanity is peculiar to Christianity, tend to show that the Chinese are more philanthropic than any other heathen nation. Mr. Gardner also read some notes, and gave some anecdotes of personal experience to elucidate his main theories. In conclusion, if Mr. Gardner is correct in his premises, we see no reason to doubt his conclusion, that when the theory of division of labour shall be put in practice with regard to races as well as individuals, the Chinese will play an important part in the world's history as ethical philosophers, merchants, mechanics, and labourers; but that they are unfitted for rulers, soldiers, or the higher walks of art, and will not tend to advance physical or mechanical science.

The President referred to the similarity between certain Chinese customs and those of the Polynesians; such as the exclusion of a word occurring in the name of a great chief. In like manner, the prohibition of marriage between persons of the same surname is a custom common to the Chinese and the Australians. In concluding the discussion, he alluded to the popular but erroneous notion that the Chinese were modified Mongols, and pointed to the fact that, although both had long black hair on the head, and only scanty hair on the face, yet the Chinese had a long skull, with prominent brow-ridges, whilst the Central Asiatic had a broad skull, deficient in brow-ridges.—Captain Sherard Osborn advocated the introduction of railways and the opening of mines; and pointed to the many other advantages which the Chinese would receive from their intercourse with Europeans.—The Rev. Prof. Summers, Dr. Hyde Clark, Dr. Leitner, and others, took part in the discussion.

Additional interest was given to the meeting by the presence of the Yarkandi brought to this country by Dr. Leitner, the only native of Yarkand who has ever visited Europe.

Geological Society, November 10.—Prof. T. H. Huxley, LL.D., F.R.S., President, in the chair. Mr. E. Hartley, of the Geological Survey of Canada, Montreal, was elected a Fellow of the Society. The following communications were read:—"Australian Mesozoic Geology and Palæontology," by Charles Moore, Esq., F.G.S. The author referred to the observations of Professor M'Coy and the Rev. W. B. Clark, on the occurrence of fossils of Mesozoic age in Australia, and then proceeded to notice the species which he had obtained from that region. Fossils of Mesozoic type occur both in Western Australia and Queensland, but the specimens have hitherto been found in apparently drifted blocks, and nothing is known of the bedded rocks from which they are derived. The author stated that the Australian Mesozoic fossils agree, not only in genera, but also in many cases in species with British forms; and he gave a list of species from Western Australia, identical with British species, from the Middle and Upper Lias, the Inferior Oolite, and the Cornbrash. Of the fossils from Queensland also, many are said to be identical with, or very nearly allied to, British species, but the author regards the general type of the Queensland remains as referring them to the Upper Oolite. A gigantic species of *Crioceras* is regarded by the author as possibly indicative of the occurrence of Neocomian deposits in Australia. The fossil evidence upon which Professor M'Coy inferred the occurrence of the Muschelkalk in Australia, was said by the author to be nugatory, his supposed *Myophoria* proving to be a *Trigonia* nearly allied to *T. gibbosa* of the Portland Oolite, and his doubtful *Orthoceras* a small *Serpula*. The author had found no indications of the existence of Triassic or Liassic deposits in Queensland. The blocks from Western Australia, referred by the author to the Middle Lias, contain *Myacites liassianus* (Quenst.), and are quite as highly ferruginous as the English Marlstone. The species identified by the author with British Oolitic species would indicate a range from the Inferior Oolite to the Cornbrash; the author suggests that the species may have had a longer range in time in Australia than in England, or that the subordinate divisions of the Oolite were not clearly marked in the Australian Mesozoic deposits. He is inclined to refer the fossils to the period of the Inferior Oolite. The author inferred from the occurrence of these Mesozoic fossils in drifted blocks, at the two extremities of Australia, separated by 38° of longitude, that an enormous denudation of rocks of the secondary series has taken place over a considerable part of Australia. Descriptions of a great number of new species were appended to the paper.

"On a Plant- and Insect-bed on the Rocky River, New South Wales," by Charles Moore, Esq., F.G.S. The organic remains noticed by the author were found by him in a small block of chocolate-coloured, micaceous, laminated marl, obtained from a bed about ten feet thick, at a depth of 100—110 feet, in the auriferous drifts of Sydney-flats, on the banks of the Rocky River. The author found the leaves of two forms of Dicotyledonous plants, fragments of a flat narrow leaf, which he refers to the Coniferæ, a seed-vessel, and the impressions of several seeds. The insect-remains consist principally of the elytra of beetles, among which Buprestidæ appear to predominate. The vegetable remains seem to indicate that the deposit is of Tertiary age.

Prof. T. Rupert Jones mentioned the discovery of a large *Crioceras* in the Jurassic beds near Port Elizabeth.—Mr. W. Boyd Dawkins suggested that we had hardly a right to apply the European standard in judging fossils from all parts of the world, and doubted whether, if these fossils were examined from the purely Australian point of view, the same age would be assigned to them.—Mr. Seeley agreed with Mr. Dawkins, and argued from the existence of natural groups in different areas of the globe, that the same must have been the case in former ages.—Mr. R. Tate remarked that if Mr. Moore had compared the Jurassic fauna with those of India, Africa, and Chili, he would have found the same mixture of forms belonging apparently to different horizons. He considered that the Australian fossils probably represented our Middle Oolite. He did not quite agree with the author as to some of the specific determinations.—Dr. Duncan remarked that the same combination of forms separated in Europe was found in the Tertiary fossils of Australia. He thought that further facts were necessary before forming a decided opinion as to the succession of beds in that continent.—The President remarked that when we talked of identity of fauna in Australia and this country, improbable as it might appear, we must remember that at the present time identical species, and, to a great extent, a similar fauna, were to be found in our seas more than 180° apart.—Mr. Moore, in reply, argued that it was the safest plan to follow the well-established standard of Europe even in remote parts of the world. He was inclined to refer the bulk of the specimens rather to the Lower than to the Middle Oolite, but otherwise he agreed in the main with Mr. Tate.

"On *Hypsilophodon*, a new Genus of *Dinosauria*," by Prof. Huxley, F.R.S., President. The author described the characters presented by the skull of a small Dinosaurian reptile obtained by the Rev. W. Fox from a Wealden bed at Cowleaze Chine in the Isle of Wight. One of the most striking peculiarities of this skull was presented by the præmaxillary bone, which seems to have been produced downwards and forwards into a short edentulous beak-like process, the outer surface of which is rugose and pitted. The author remarked upon the known form of the symphysial portion of the lower jaw in the Dinosauria, and indicated that its peculiar emargination was probably destined to receive this beak-like process of the præmaxillaries, which may have been covered either by fleshy lips or by a horny beak. The dentigerous portion of the præmaxilla bears five small conical teeth. The alveolar margin of the maxilla bears ten teeth, which are imbedded by single fangs, and apparently lodged in distinct alveoli. The summit of the crown, when unworn, is sharp, and presents no trace of the serrations characteristic of *Iguanodon*, but it is sinuated by the terminations of the strong ridges of enamel which traverse the outer surface of the crown. The teeth thus present some resemblance to those of *Iguanodon;* but the author regarded the two forms as perfectly distinct, and named the species under consideration *Hypsilophodon Foxii*. Of the lower jaw the right ramus is present, but its distal extremity is broken off, and its teeth are concealed. On the outer surface of the lower jaw the centrum of a vertebra is preserved. The author then referred to a fossil skeleton in the British Museum, which has been regarded as that of a young *Iguanodon*. It is from the same bed as the skull previously described. The author remarked that, in form and proportions, the vertebræ were quite different from those of *Iguanodon*, and apparently identical with those of his new genus, as shown by the centrum preserved with the skull; the animal had at least four well-developed toes; and other peculiarities were indicated, which seem to prove that it was quite distinct from *Iguanodon*. This skeleton the author identified with his *Hypsilophodon Foxii*, and described its characters in detail, dwelling especially upon the peculiarities of the pelvic bones, which are singularly avian in their structure.

"Further Evidence of the Affinity between the Dinosaurian Reptiles and Birds," by Professor Huxley, F.R.S., President. In this paper the author reviewed the evidence already cited by himself and others (especially Prof. E. D. Cope), in favour of the ornithic affinities presented by the Dinosauria; and discusses at length the recently ascertained facts which bear upon this question, some of the most important of which are derived from the species described by him in the preceding paper under the name of *Hypsilophodon Foxii*. He summed up his paper by a comparison of the different elements of the pelvic arch and hinder limb in the ordinary reptiles, the Dinosauria and Birds, and maintained that the structure of the pelvic bones (especially the form and arrangement of the ischium and pubis), the relation between the distal ends of the tibia and the astragalus (which is perfectly ornithic), and the strong cnemial crest of the tibia and the direction of its twist, furnish additional and important evidence of the affinities between the Dinosauria and Birds.

Sir Roderick Murchison, who had taken the chair, inquired as to the habits of the *Hypsilophodon*.—Mr. Hulke mentioned that Mr. Fox had several blocks containing remains of a large portion of the *Hypsilophodon*, all procured from a thin band of sandstone near Cowleaze Chine. On one the pelvis is almost entire, as well as the right femur, the tibia, which is longer than the femur, four long metatarsal bones, and an astragalus. All the long bones are hollow. Portions of at least eight individuals have been found in the same bed.—Mr. Seeley doubted whether these animals should be called Reptiles at all, as they seemed to him to form a group distinct alike from reptiles, birds, and mammals, but occupying an intermediate position. In the hinder limbs of *Pterodactylus* the analogies were closer with mammals than with birds. He thought it possible that the peculiar structure of the hinder limbs of the Dinosauria was due to the functions they performed rather than to any actual affinity with birds.—The President, in reply, stated that *Hypsilophodon*, from the character of its teeth, probably subsisted on hard vegetable food. He expressed a hope that Mr. Fox would allow a closer examination of his specimens to be made. He was unable to agree with Mr. Seeley's views. He was inclined to think that the progress of knowledge tended rather to break down the lines of demarcation between groups supposed to be distinct than to authorise the creation of fresh divisions.

Specimens illustrative of their respective papers were exhibited by C. Moore, Esq., and Prof. Huxley.

Institution of Civil Engineers, November 9.—At the first ordinary general meeting of the session, held on Tuesday, the 9th inst., Mr. Charles Hutton Gregory, the President, made some observations on the action taken by the council with reference to a notification gazetted by the Public Works Department of the Government of India. In this notification it was alleged that the Governor-General in Council was given to understand, that in the civil engineering profession in England it was a recognised practice for civil engineers employed by public companies and otherwise, to receive, in addition to the salaries paid them by their employers, commission on contracts given out, or stores and materials ordered or inspected by them, and other like pecuniary considerations for services done, or intended to be done, which were considered legitimate sources of emolument. The Council had met, and unanimously passed a series of resolutions, emphatically denying that such practices were recognised in the profession, and asserting that any engineer detected in such practices would be held to be guilty of disgraceful conduct, which would disqualify him from being a member of this Institution. Regret was expressed that so grave a charge should have been received and published by the Government of India without proper inquiry, as such inquiry would have shown that the charge was absolutely untrue; and, having reference to the grievous wrong which such an imputation, stamped with such authority was calculated to do to an honourable profession, an appeal was made to the Government of India to cause the scandalous statement to be withdrawn. This protest was transmitted to the Secretary of State for India, who had received a deputation from this Institution, comprising the President and every member of Council then in London. The Duke of Argyll promised to investigate the case, and has put on record that "he regards with implicit confidence the indignant repudiation by the Institution of any recognition of the practice referred to in the notification."

Mathematical Society, November 11.—The first meeting of the present session was held on Thursday, the 11th inst., Prof. Cayley, F.R.S., President, in the chair, when the following gentlemen were elected to be the council for the session 1869-70:—President: Prof. Cayley, F.R.S. Vice-Presidents: A. De Morgan, F.R.A.S., W. Spottiswoode, F.R.S., Prof. Sylvester, F.R.S. Treasurer: Prof. Hirst, F.R.S. Hon. Secretaries: M. Jenkins, M.A., R. Tucker, M.A. Other members: W. K. Clifford, B.A., T. Cotterill, M.A., M. W. Crofton, F.R.S., Olaus M. F. E. Henrici, Ph.D., S. Roberts, M.A., J. Stirling, M.A., A. Smith, F.R.S. L. and E., Prof. H. J. S. Smith, F.R.S., and J. J. Walker, M.A.

The Rev. James White, M.A., was elected a member. Mr. Tucker read a communication from Mr. G. O. Hanlon, on the "Vena Contracta," and Mr. Jenkins a letter from Mr. Clerk-Maxwell, containing the question, "Can the potential of a uniform circular disk at any point be expressed by means of elliptic integrals? Suppose V is the potential of the disk bounded by the circle $z=0$, $x^2+y^2=a^2$.

Then $$\frac{dV}{dx} = 2x \sqrt{\frac{a}{r}}\ \frac{1}{\sqrt{c}}\ (E-F)$$

where $$r^2 = x^2 + y^2;$$

and if AB be a diameter parallel to r,

$$c = \frac{PB - PA}{PB + PA}$$

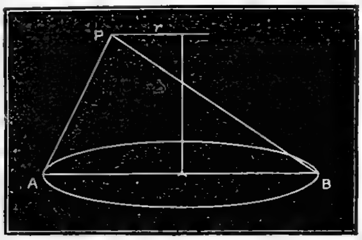
and E, F are complete elliptic functions for modulus c;

also $$\frac{dV}{dy} = 2y \sqrt{\frac{a}{r}} \cdot \frac{1}{\sqrt{c}} (E - F)$$

$$\text{But } \frac{dV}{dz} = w,$$

where w is the solid angle subtended at P by the circle, that is the area of the spherical ellipse on a sphere of unit radius cut off by the cone whose vertex is P, and base the circle.

We have expressions for $\frac{dV}{dx}$ and $\frac{dV}{dy}$, can $\frac{dV}{dz}$ also be expressed by elliptic functions, and if so, can V itself be so expressed? I am writing out the theory of electric currents in which these quantities occur. The expression for $\frac{dV}{dz}$ for an elliptic disk can be found if we know it for a circular one; for the spherical ellipses in the one case are no more complicated than in the other. Can $\frac{dV}{dx}$, or V itself, be found for the elliptic disk?"



The President and Mr. C. W. Merrifield spoke on the question, but could not decide for or against it impromptu.

Mr. T. Cotterill then gave an account of his paper on Opposite Points on a Curve. The subject bore reference to two former papers read before the society by the author and by Prof. Sylvester, the Theory of Residuals, not yet, to the regret of the society, put into a shape for publication. Mr. S. Roberts and Mr. W. K. Clifford took part in a discussion upon this paper.

Royal Microscopical Society, November 10.—Rev. J. B. Reade, M.A., F.R.S., President, in the chair. A communication from Dr. Pigott on high power definition with illustrative examples was read. The paper had special reference to the markings on the Podura scale, of which the writer claimed to have discovered the true nature. As the result of close and protracted observation, Dr. Pigott believes that he has resolved these markings into rows of bead-like bodies essentially differing in their character from the "note of exclamation" markings so familiar to microscopists.—Another paper on a cognate subject, entitled the Scales of certain Insects of the order Thysanura, was read by Mr. S. McIntyre. Mr. McIntyre's examinations of the genus of the family of the *poduridæ* leads him to express conclusions confirmatory of the views hitherto entertained, as to the nature of the markings seen under the microscope; and in the discussion which followed the opinions expressed by the Fellows were entirely in support of Mr. McIntyre's conclusions. Among the donations announced was an interesting specimen of an Amici reflecting microscope, working on the principle of the Newtonian telescope.

Zoological Society, November 11.—Mr. George Busk, F.R.S., V.P., in the chair.—The Secretary made some remarks on the more remarkable additions to the Society's Menagerie during the past summer, amongst which particular attention was called to some Amherst's pheasants, deposited by J. J. Stone, Esq.; an Owen's apteryx, presented by the Acclimatisation Society of Otago, New Zealand; a pair of the newly-discovered Chinese deer (*Elaphurus davidianus*), presented by Sir Rutherford Alcock; and a young male Spanish ibex, presented by Major Howard Irby.—Extracts were read from a letter addressed to Mr. Grote by Dr. John Anderson, C.M.Z.S., containing observations respecting the pigmy hog of the Terai (*Porcula salvania*), and other animals which he is endeavouring to procure for the Society's Menagerie.—A letter was read from Dr. G. Bennett, containing an account of the habits of the wood-hen of Lord Howe's Island, as recently observed by Mr. R. W. Fitzgerald.—Mr. Sclater exhibited a specimen of the so-called wood-hen, which had been forwarded in spirits by Dr. Bennett to the Museum of the Royal College of Surgeons, and stated that it was a rail of the genus *Ocydromus*, apparently hitherto undescribed, which he proposed to call *Ocydromus sylvestris*.—A letter was read from Mr. Morton Allport, F.Z.S., containing an account of the successful introduction of the salmon trout (*Salmo trutta*) into Tasmania.—Mr. Quelch exhibited a remarkable specimen of a fish of the genus *Rhombus*, supposed to be a hybrid between the turbot and the brill.—Mr. J. W. Clark, F.Z.S., exhibited some mounted skeletons of the extinct dodo of the Mauritius, and of the male and female solitaire of the Island of Rodriguez, belonging to the Cambridge University Museum.—Mr. E. Ward exhibited a curious melanoid variety of the woodcock (*Scolopax rusticula*).—Professor Flower, F.R.S., read a memoir on the anatomy of the Aard-wolf (*Proteles cristatus*), founded on a specimen recently deceased in the Society's Menagerie. The result arrived at after a careful examination of every part of this animal was that *Proteles* constituted of itself a distinct family of carnivorous animals, allied to the *Hyænidæ* and *Viverridæ*, but more closely to the former than Mr. Flower had previously supposed when he had only the skull of this remarkable animal to judge by. Mr. Flower's paper was illustrated by the exhibition of the stuffed skin, a complete skeleton, and a full series of anatomical preparations of the internal organs of this animal, all taken from the same individual.—A communication was read from Dr. J. G. Gray on the guemul or roebuck, from Tinta in Southern Peru, which Dr. Gray considered to constitute a new genus of deer, proposed to be called *Xenolophus*.—A second communication from Dr. Gray contained a description of *Emys laniaria*, a new species of fresh-water tortoise, from an unknown locality.—A report was read by Dr. A. Günther on two collections of Indian reptiles, recently received by the British Museum, one of which had been formed by Dr. Leith in various parts of Western India; the second by Mr. Barnes in Ceylon. Both were of much interest, and contained various new species, which were characterised in the present paper.—A communication was read from Dr. B. Simpson, containing notes on the habits of *Ailurus fulgens*, as observed by him during his residence in Nepal.—A communication was read from Surgeon Francis Day, F.Z.S., containing the first part of a series of notes on the specimens of fishes in the Calcutta Museum. Mr. R. B. Sharpe read some additional notes on the genus *Ceyx*, in continuation of a former communication on this subject. The principal object of the present paper was to discuss the question of the identification of the true *Ceyx rufidorsa*, Strickland.

Brighton

Brighton and Sussex Natural History Society, November 8.—Mr. T. H. Hennah, President, in the chair. A rare grass, *Gastidium Lendigerum*, obtained in October, in the Weald of Sussex, by Mr. Davies, was presented by that gentleman.—A paper on Mosses was read by Mr. Smith, in which the development, growth, mode of reproduction, and the several parts of mosses were described and illustrated by enlarged drawings and microscopic preparations, while it was pointed out that to the microscopist they opened out fields of research and questions to be settled, unsurpassed by any other branch of natural history. Prior to reading the paper, Mr. Smith handed in a complete Bryological Flora of the county of Sussex, comprising 298 species and sub-species, a brief account of the soils in which the rarer species grow, together with an enumeration of those which, at present as regards Britain, have been found only in Sussex. This list will be published in the next annual report.

Brussels

Royal Academy of Sciences, October 9.—M. Schwann reported on the memoir by MM. Masius and Vaulair on the anatomical and functional regeneration of the spinal cord, of which a notice was given in the last number of NATURE. Besides the immediate subject of their memoir, the authors treat of the histology of the *filum terminale* of the spinal cord in the frog, and of the cutaneous and medullary distribution of the spinal nerves.—M. A. Quetelet communicated notes on the meteors observed at Brussels in August, 1869, and on that of the 1st October, 1869; and M. Terby noticed the meteors observed at

Louvain in August last.—Storm observations, from the 1st of June to the end of September, were presented; for Brussels by M. Quetelet, for Louvain by M. Terby, for Malines by M. Bernaerts, for Antwerp by M. C. Coomans, and for Gerpinnes, near Charleroi, by M. V. van Geel. M. J. Cavalier also communicated a note of storms observed at Ostend in August and September last.—M. Zantedeschi communicated a note on the employment of the outer armature of the submarine cable, while the inner armature, or isolated conducting wire, transmits the telegraphic despatch. The author remarks that the submarine cable represents a Leyden jar, and hence that when the conducting wire conveys a message, say from Europe to America, the same message is reconveyed to the European station by means of the wires forming the outer portion of the cable. He proposes to establish an apparatus at each station for the purpose of receiving this return message, so as to enable the operator to see that his message is correctly transmitted.—M. L. de Koninck stated, that on the 2nd October last, the day of the earthquakes in the Rhenish provinces, he experienced a slight double shock in Liège at about 11.40 p.m.

MANCHESTER

Literary and Philosophical Society. *Microscopical and Natural History Section*, Oct. 11.—Mr. John Watson in the chair. The President delivered an address, from which the following are extracts:—"It will interest all naturalists, and especially entomologists and lepidopterists, to hear that there has very lately been received in this country a fine specimen of the magnificent butterfly Papilio Antimachus, of which only one specimen was ever before brought to Europe. . . . . The Darwinian theory appears to be making progress among a certain class of naturalists, but its upholders display a disposition to avoid precision of terms, and to enlarge and confuse the meaning of the words they employ, rather than scientifically to limit and define them; they use variability and mutability as having one and the same meaning, instead of distinguishing one as referring to subdivision into varieties, and the other as change of specific forms. Just now, as a development of the theory of natural selection, we hear a great deal from some distinguished entomologists about imitation and mimicry, where resemblance would be the more correct word; and these terms cannot be said to be used figuratively, because it is argued that some species and genera of butterflies mimic the colourings and markings of others for the sake of protection from enemies, and for other aims and ends. Certainly the words imitation and mimicry imply foregone intention. Now it is probable that no butterfly ever saw its parent or ancestor, its offspring or posterity, and it is an absurd stretch of imagination that its own observation could induce and enable it to change the colouring and appearance of its successors; and if it had such ability and reasoning power, it would effect the change for protection from enemies in the larva, and not in the imago. We know that Nature loves to repeat her works, and it is common to find resemblances and repetitions through various and distantly allied families of animals, and they are truly connecting links in the chain of creation. The controversy is still going on between those who affirm and deny the existence of a vital principle of energy or force, and Professor Huxley stands foremost among the latter; very interesting microscopic observations have been made, and ingenious arguments have been deduced from them; but the grand step from the lifeless to the living protoplasm has not been diminished. Physiologists may, perhaps, hereafter discover and explain the difference between organic forms, living and dead; but at present it is not proved that the phenomena of life can be reconciled with the mere functions of matter."

Dr. Henry Simpson exhibited specimens of *Statice spathulata*, gathered by himself this autumn on Hilbree Island, Cheshire.

Mr. Tait sent a portion of the beach from near Alexandria, Egypt, consisting almost entirely of shells. He stated that for many miles along the coast the shore was of a similar character.

Mr. Joseph Sidebotham read a paper on varieties in Lepidoptera, from which the following passage is extracted:—"The questions as to what constitutes a species? where does a species end, and variety begin? and whether a species be a natural or merely an artificial division? are amongst the most difficult of solution in the whole range of natural history, and just at this time are very prominently before the scientific world. With a view to determine the influence which difference of food and light might have in modifying species, the author gives the following as the result of some experiments which he had made. I procured about 2,500 larvæ of the tiger moth, in a young state. I divided them into six lots, keeping each in a separate cage, and feeding them differently. One lot was fed on willow, another on butter burr (*Petasites vulgaris*), another on hawthorn, another on plum, one on dock, and one on nettle, grass, bramble, and various other kinds of food. A considerable proportion of each became perfect insects, and I could detect no difference whatever in the colours, from the food they had lived upon. That is to say, the variations in colour and marking were not to be traced in any case to the food. I kept several batches of eggs, and reared the larvæ carefully through the winter, and then again divided them, giving each lot a different kind of food. Again the same result. I found that one year the larvæ I had brought from the coast had usually the inferior wings more or less of a yellow shade, instead of the bright scarlet of the Cheshire specimens. Having for many years continued these experiments without obtaining any marked results, I this year tried another of a different nature. I selected the tortoiseshell butterfly, as one of the least variable species we have, and I procured several broods of young larvæ just emerged from the egg. These I kept in a dark box until I had all ready, and then I divided each brood into three lots, putting one-third into a box in my photographic room, which is lighted with orange-coloured glass, one-third into a box lighted with blue glass, and the ventilators carefully shaded so that only light of a blue colour could reach the larvæ, the remainder were put into an ordinary cage, in the natural light. The latter fed up and came out into butterflies in the usual time. Those in the blue light were not healthy, and though every care was taken, at least fifty or sixty died before changing, and a considerable number changed into chrysalides, and then died; those that came out into perfect insects were very much smaller than usual. Those lighted by orange-coloured glass fed up very well, but many of the two first lots had come out before one of them changed into chrysalis; scarcely one of them died, and I examined each one before I allowed it to fly, to see what effect had been produced. I retained a few specimens of each lot to exhibit this evening, and now proceed to describe the difference. Those reared in the blue light differ from the ordinary form in being on an average much smaller; the orange brown is lighter in shade, and the yellow and orange run into each other, instead of being distinct and separate. Those reared in the non-actinic, or yellow light, are also smaller, the orange brown is replaced by a salmon colour, the venation more strongly marked, and the blue dashes at the edge of the wings in the usual form, are in these of a dull slatey colour. A series of specimens of these side by side with those reared in ordinary light, are here for exhibition. One evening I found about 60 butterflies out of chrysalis, of those in the photographic room, and taking each one carefully I examined them all and allowed them to fly; shortly afterwards I found the whole of them had settled against the wall of the house, and presented a most remarkable appearance; they remained there more than half-an-hour, the western sun was shining against the wall, and it is not unlikely when, being suddenly brought from the red light, where they had spent all their lives, to the bright daylight, they have been so dazzled as to act in this peculiar manner. The results of this experiment do not show any very startling change in colour, such as one would have expected from the known effects of light on plants and from the occasional occurrence of very much more strange varieties, one now and then meets with, which cannot have been subject to such severe treatment; still, when we consider that even this difference is caused in one generation, and in the course of a month, it is a very suggestive fact, and leads one to think that light has certainly as much or more effect on the colours of Lepidoptera, than the difference of food, and might in a long series of generations lead to very material changes in both form and colour, and perhaps considerably modify our ideas of what constitutes a species."

MONTREAL

Natural History Society, October 25.—An important paper on the Gaspé fossils was read by Principal Dawson. The Peninsula of Gaspé, between the river St. Lawrence and the Bay des Chaleurs, was the first part of Canada explored by the Geological Survey under Sir William Logan, and it contains rocks representing four great geological periods, the Lower Silurian, the Upper Silurian, the Devonian, and the Lower Carboniferous; all admirably exposed in coast cliffs; and in the case of the Upper Silurian and Devonian abounding in characteristic fossils. The visit of Principal Dawson in the past summer had reference to further study of the interesting fossil plants of the Devonian sandstone, many species of which have been described in his papers in the *Canadian Naturalist*, and in the Journal of the Geological Society. With Messrs. G. T. Kennedy and G. W. Dawson as assistants, he explored the whole of the north side and the greater part of the south side of Gaspé Bay, and has obtained very large and interesting collections of fossil plants. Among these are two large trunks of *Protaxites Logani*, a new and beautiful species of *Psilophyton*, and a species of *Cyclostigma*, a genus hitherto found only in the Devonian rocks of Ireland. Several interesting animal remains were also found, including numerous species of large fishes (Mechæracanthus); and Mr. Kennedy was so fortunate as to find a *Cephalaspis*, the first representative of the genus as yet found in America. The animal fossils have been placed in the hands of Mr. Billings and Dr. Newberry for comparison, and the plant will probably be described in detail in the course of the coming winter. Specimens of some of the more interesting fossils above referred to, were exhibited to the society.—Mr. Ritchie read a paper on the small cabbage-butterfly (*Pieris rapæ*), the caterpillars of which have recently been extremely destructive in Canadian gardens. This insect is not indigenous to America, and was first noticed in Canada some years ago by Mr. W. Couper. Mr. Whiteaves made an interesting verbal communication on dredging in Gaspé, and exhibited a large series of marine invertebrates.

PARIS

Academy of Sciences, November 8.—M. Pasteur presented a note in reply to that of M. Thenard on the preservation of wines by heat. A memoir was read by M. H. Marès on the transformations undergone by powder of sulphur (flour of sulphur and powdered sulphur) when it is spread upon the soil, in which the author states that the sulphur which has been abundantly employed in the vineyards of France of late years becomes converted into sulphuric acid which combines with the lime of the soil to form sulphate of lime. The author has not ascertained whether the sulphuric acid is produced by direct oxidation of the sulphur, or by that of sulphuretted hydrogen formed by it in contact with manure, but he states that no odour of sulphuretted hydrogen is perceptible where the sulphur is used. The employment of sulphur appears to be effectual in preserving the vines from disease.—A note by M. J. Personne on the transformation of hydrate of chloral into chloroform in the animal economy was read. The author remarked that whilst M. Liebruch maintains that hydrate of chloral is converted into chloroform by contact with the alkali of the blood, the French observers have generally held an opposite opinion. In his experiments he found that where hydrate of chloral is added to blood, or administered to a dog, no production of chloroform is perceptible, but he obtained chloroform by the distillation of the blood. To avoid the objection that the heat employed in distillation might produce the conversion, he operated at a temperature of 40°—45° C. = 194°—113° F., conveying the vapour by a current of air through a red-hot porcelain tube into a solution of nitrate of silver. The reaction produced demonstrated the presence of chloroform in the vapour, no reaction being caused by vapour of hydrate of chloral conveyed and decomposed in the same way. Unlike M. Bouchet, the author detected no chloroform in the urine of animals to which hydrate of chloral had been administered.—M. J. V. Labordi communicated a note on the ill effects attending the administration of chloral.—In a note on chloride of gold, M. H. Debray remarked that although sesquichloride of gold is decomposed by exposure to a temperature of about 200° C. = 392° F., into proto- and per-chloride, it may, nevertheless, be volatilised by a heat of 303° C. = 572° F., in an atmosphere of chlorine. It then crystallises in long reddish needles.—M. A. Riche communicated a note on the bronze of sonorous instruments, relating chiefly to the production of gongs and cymbals similar to those made in China. Chinese metal contains about twenty per cent. of tin. Alloys made with these proportions of metal are very brittle when cold, but the author found that at a dull red heat they may be forged with ease, and produces very sonorous plates.—M. A. Landrin announced that yellow coralline is not poisonous, so that it may be employed for industrial purposes.—M. Petrequin presented a note on the chemical composition and comparative physiology of the cerumen of the mammalia. Its base is potash in man and the ox, lime in the dog, and magnesia in the horse.—M. A. Petit stated that in the melon the rind contains only glucose, as also the flesh whilst still green. During ripening cane-sugar is gradually developed in the latter, its formation commencing in the most acid part of the pulp surrounding the seeds.

DIARY

THURSDAY, NOVEMBER 18.

ROYAL SOCIETY, at 8.30.—Preliminary Report of the Scientific Exploration of the Deep Sea in H.M. surveying vessel *Porcupine*, during the summer of 1869, conducted by Dr. Carpenter, V.P.R.S., Mr. J. Gwyn Jeffreys, F.R.S., and Prof. Wyville Thomson, LL.D., F.R.S. And other papers.
SOCIETY OF ANTIQUARIES, at 8.30—Ancient British Barrows (Round): Dr. Thurnam.
LINNEAN SOCIETY, at 8.—Review of the genus *Hydrolea*, with descriptions of three new species: Mr. A. W. Bennett, F.L.S.
NUMISMATIC SOCIETY, at 7.
LONDON INSTITUTION, at 7.30.—Architecture, or the Fine Art of Building: Prof. Robert Kerr.
CHEMICAL SOCIETY, at 8.—On Namaqualite and Chemical Researches on new and rare Cornish Minerals—No. 6. A new Ferric Silicate: Prof. Church. On Chloranil and Bromanil—No. 2: Dr. Stenhouse.

FRIDAY, NOVEMBER 19.

PHILOLOGICAL SOCIETY, at 8.30.

MONDAY, NOVEMBER 22.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.
LONDON INSTITUTION, at 4.—Elementary Physics: Prof. Guthrie.

TUESDAY, NOVEMBER 23.

ETHNOLOGICAL SOCIETY, at 8.—On some Quartzite Implements of Palæolithic Type from the Drift of the Cape of Good Hope: Sir George Grey, Bart. On the Races and Languages of Dardistan hitherto undescribed: Dr. Leitner.

WEDNESDAY, NOVEMBER 24.

GEOLOGICAL SOCIETY, at 8.—On the Dinosauria of the Trias, with observations on the Classification of the Dinosauria: Prof. Huxley, F.R.S., President. The Physical Geography of Western Europe during the Mesozoic and Cainozoic periods, elucidated by their Coral-faunas: Dr. P. Martin Duncan, F.R.S., Sec.G.S.

THURSDAY, NOVEMBER 25.

ROYAL SOCIETY, 8.30.
LONDON INSTITUTION, at 7.30.—Architecture: Prof. R. Kerr.
LONDON MATHEMATICAL SOCIETY, at 8.
ZOOLOGICAL SOCIETY, at 8.30—Notes on some Spiders and Scorpions from St. Helena, with descriptions of new Species: Rev. O. P. Cambridge. On a small collection of Birds from the Tonga Islands: Dr. O. Finsch and Dr. G. Hartlaub.

BOOKS RECEIVED

ENGLISH.—Transactions of the International Congress of Prehistoric Archæology (Longmans).—The Universe; or the Infinitely Great and the Infinitely Little: F. A. Pouchet (Blackie and Sons).—Physical Atlas (A. K. Johnston).—Darwinism tested by the Science of Language: Professor A. Schleicher, translated by Dr. A. V. W. Bikkers (Hotten).—The Midnight Sky: Donkin (Religious Tract Society). Æsop's Fables, Illustrated by Ernest Griset (Cassell).

FOREIGN.—Die Befruchtung bei den Coniferen: Dr. E. Strasburger.—Die Maschinenfabrication: H. V. Reiche.—Berichte über die Versammlung der Deutschen Ornithologen-Gesellschaft. (Through Williams and Norgate.)

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH

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THURSDAY, NOVEMBER 25, 1869

A SCIENTIFIC CENSUS

CAN we reduce to the certainty of numbers the amount of interest taken in England in the advance of science? How many are there devoted to its pursuit? How many sufficiently concerned in its progress, as to be willing to make some sacrifices for its promotion? Interested in the results of science, ready to grasp its countless benefits, eager to catch its earliest gifts, we all are; but how many love science for its own sake, and are actively engaged in cultivating and promoting it? Are there not very many in this sordid age ready to exclaim with D'Ailly—

> Dieu me guarde d'être savant,
> D'une science si profonde
> Les plus doctes, le plus souvent,
> Sont les plus sottes gens du monde!

The Census of 1861 gave the number of persons engaged in the learned professions, or in literature, art, and science; and classed as "scientific persons," officers of literary and scientific societies, curators of museums, analytical chemists, and a certain number who styled themselves naturalists, botanists, geologists, mineralogists, chronologists, and civil engineers. These, however, with a number of professors and teachers, pursue science as a vocation. We prefer drawing our materials from the membership of our learned societies. Many of their members are, it is true, professors and teachers, yet they appear in a more congenial character as members of our academies, or fellows of our learned societies; and though it can scarcely be said that their members are in all cases absolutely men of science, or that all the men of science in the country are to be found in their lists, in them we have, at least, a goodly band of men associated together for the advance of science. Judging from the facilities such societies afford for the association of persons of kindred mind and taste, the common use of technical libraries and instruments, and the publication of their transactions, we are safe in assuming that they attract, at least, the greater number of men anxious to labour for the promotion of science.

First and foremost among our learned societies is the Royal. The Institute of France and other foreign academies are, in a manner, the creatures of the State; and their members are mostly all salaried. The Royal Society was, from the first, a voluntary society, and never derived any support from the State, though it administers from year to year a certain amount given by the State for the promotion of science. In 1831 the Royal Society had 791 members, but by a change introduced in 1847 the membership has undergone considerable diminution; and in 1868 the number was reduced to 600, the number admitted every year being considerably less than the number dying or retiring. It is the vocation of the Royal Society to admit within its circle the most distinguished men in all the branches of science, and we might even hope that, like the Institute of France, its membership may be divided into five Academies, such as the "Académie Française" for literature, the "Académie des Inscriptions et Belles-lettres" for history, the "Académie des Sciences" for sciences and mathematics, the "Académie des Beaux Arts" for the fine arts, and the "Académie des Sciences Morales et Politiques" for mental philosophy and jurisprudence. It is not a question of altering the essential character of the Royal Society, as an integral one: it would be only a natural development of its organisation if its members were allowed to constitute themselves into sections for physics, mathematics, philosophy, history, and philology.

Physical and Mathematical Science, however, engages the labour of six other learned societies. There are the Astronomical Society with 528 members, the Chemical with 518, the Meteorological with 306, and the Geological with 1,204 members. We have also a Statistical Society with 371 members, and a Mathematical with 111. Collectively, these form seven societies, with 3,638 members, giving, in relation to the population of the United Kingdom, 1·21 in every 10,000 either a physicist or a mathematician in the highest sense. The next group of societies comprises those engaged in the advancement of the science of life, whether vegetable or animal. Biology is a favourite study, and many are intensely devoted in exploring the many problems which are taxing the mind of the philosopher and moralist. Connected with Vegetable Physiology are the Linnean Society with 482 members, the Botanic with 2,420, the Horticultural with 3,595, and the Agricultural with 5,500 members. And connected with Animal Physiology are the Zoological with 2,920 members, the Entomological with 208, the Ethnological with 219, and the Anthropological with 1,031 members; in all eight societies, having in the aggregate 16,300 members. It must be remembered, however, that the largest of these societies have their Gardens and Exhibitions, which attract numerous members, and it would demand an excess of charity to regard all the members in this group as strictly men of science. Archæology has numerous votaries. There is the Society of Antiquaries, the oldest of our scientific societies, founded nearly 300 years ago, in 1572, having now 651 members, but the number of fellows was in 1862 restricted to 600. We have also a British Archæological Institute with 697 members, and an Archæological Association with 484 members, besides a very large number of other archæological societies. Then comes the Geographical with its 2,150 members, the most popular of societies, owing much to its illustrious president, Sir Roderick Murchison, and still more to the great contributions to geographical science by Livingstone, Speke, Grant, and Baker. And next we find the large group of societies for the Promotion of Applied Science. There is the Society for the Encouragement of Art, Manufacture, and Commerce, so elastic, so active, and so enterprising, having 3,200 members; the Institute of Civil Engineers with 1,700 members, and the Institute of British Architects with 498 members, each of them comprising men engaged in active life, yet deeply interested in the advancement of science. Of a more miscellaneous character are the Microscopical Society with 360 members, the Philological with 200, the Numismatic with 160, the Asiatic with 320 members, and the United Service Institution with 3,800 members. And, besides these, there are the Royal and London Institutions, the British Association, and Social Science Association, each having its thousands of members, to say nothing of the medical societies, and the numerous scientific societies and philosophical institutions in all the leading towns.

Were all who in London and the provinces are associated for the promotion of science carefully calculated, we should find that there are now about 120 learned societies, with an aggregate of 60,000 members; and deducting from the number at least one-fourth for members who belong to more than one society, we arrive at the interesting fact that there are, in the United Kingdom, 45,000 men representing the scientific world, or in the proportion of fifteen in every ten thousand of the entire population; the "upper ten thousand" of the aristocracy of learning being thus three times as many as the "upper ten thousand" of the aristocracy of wealth. But are we satisfied with the result? Are all the societies equally active in encouraging the pursuit of science? Are their terms of admission too loose or too narrow? Without entering into the internal management of our learned societies, we might wish for a fuller and earlier publication of their transactions, for the collection of more complete technical libraries, properly catalogued and classified, and for a better action in the way of granting tokens of recognition to successful discoverers and investigators of the great arcana of Nature.

Within the last twenty years, at least half as many new societies have been formed for the promotion of science, and evidences are not wanting to show that an enormous stimulus has been given to science in every direction. In the number of scientific works published, and in the circulation which they have had; in the variety of scientific journals started and successfully maintained; in the respect paid to Science—ay, in the very popularity which greets Science, wherever it exhibits itself, we see abundant reason for congratulation. A brilliant future opens itself for the cultivation of science. Happy will it be when "many shall run to and fro, and knowledge shall be increased;" happy when men will realise that "pleasure is a shadow, wealth is vanity, and power a pageant; but knowledge is ecstatic in enjoyment, perennial in fame, unlimited in space, and infinite in duration." Truly, in the performance of this sacred office the man of science "fears no danger, spares no expense, looks in the volcano, dives into the ocean, perforates the earth, wings his flight into the skies, enriches the globe, explores sea and land, contemplates the distant, examines the minute, comprehends the great, ascends to the sublime, no place too remote for his grasp, no heaven too exalted for his reach."

LEONE LEVI

THE DEPTHS OF THE SEA

THE opening meeting of the Royal Society on Thursday last was attended by a numerous assemblage of men of science, especially attracted by the announcement that Dr. Carpenter, representing a committee consisting of Professor Wyville Thomson, Mr. Gwyn Jeffreys, and himself, would communicate the results of the deep-sea dredging explorations, carried out in the course of the past summer and autumn in the *Porcupine*, a vessel expressly fitted out and placed by the Government at the disposal of the committee for this purpose.

At the conclusion of Dr. Carpenter's lucid exposition, which was necessarily but a mere *résumé* of the report itself, it appeared quite evident that rumour had not at all exaggerated the scientific value of these explorations, for it is not too much to say that the results of this expedition must be classed with the most important which of late years have been brought before the notice of the scientific world.

More than a quarter of a century ago, the late Edward Forbes, one of the first naturalists who took the common oyster dredge from the hands of the fisherman to convert it into an instrument for extended scientific research, after employing it in the commencement along the shores of his native little Isle, and subsequently in the seas surrounding the British Islands, and in other parts of Europe, found, upon comparing his observations, that there appeared to be evidence in favour of the existence of a succession of natural zones of marine life according to depth, which zones, however, seemed to become more and more sterile in organisms in descending order; until at last it suggested itself that a zone might be arrived at, at a depth roughly estimated as exceeding 300 fathoms from the surface, containing but sparse traces of organic life, or even such an one as might be entitled to the appellation of Azoic.

This latter hypothesis was brought forward by him as a suggestion worthy of consideration, and not as a dogma or established principle, as he was fully aware that in the dredging explorations which he had been able to carry out up to that time, he had never reached so great a depth as even 300 fathoms, below which the sea-bottom was inferred to be comparatively or altogether sterile; on the contrary, whilst advancing the conclusions which seemed to be but natural deductions from the data then at his disposal, he continually kept pointing out that whether such an hypothesis was correct or not, it was of the highest importance to science to prosecute these researches further, so as to ascertain the true nature of the deep-sea bottom, for, to use his own words in his "History of the European Seas," "it is in its exploration that the finest field for marine discovery still remains."

Before the author of this suggestion had time or opportunity for carrying out such explorations as would have verified or disproved his hypothesis, he was unfortunately cut off by an early death; whilst the hypothesis, in the state in which he had left it, was without further investigation eagerly grasped at and accepted by men of science, both at home and abroad, for the special reason that it appeared to afford a simple explanation of various phenomena which had long remained enigmas to both palæontologists and geologists; as, for example, amongst others the occurrence, in various periods of the earth's history, of vast accumulations of sedimentary strata apparently altogether devoid of organic remains.

Although this hypothesis, when somewhat modified, may possibly be found to hold good in respect to certain forms and conditions of life, the results of some casts of the dredge made in depths of from 270 to 400 fathoms in Sir James Ross's Antartic Expedition, and subsequently, the deep-sea soundings described by Dr. Wallich as made in 1860, in the *Bulldog*, in vastly greater depths, demonstrated quite conclusively that it could no longer be retained as a generalisation.

It now appears strange to look back and observe what very little notice was taken of these new data; more especially of the important researches of Dr. Wallich on the North Atlantic sea-bed, which for years, if not all but overlooked, certainly do not appear to have received from zoölogists the full credit which they undoubtedly deserved: geologists and palæontologists were evidently loth to abandon an hypothesis which in many respects suited their requirements.

However long truth may remain dormant, it must eventually assert itself in science as in all other matters, and the advancing strides of Biology and Geology soon demanded that such problems should be definitely and conclusively solved, and that the depths of the sea also should be carefully searched for the missing links of evidence requisite to complete their respective chains of reasoning. This was not felt to be the case in England alone; already in Scandinavia we find the *savants* of Norway and Sweden working with their slender means in the right direction, and assisted by their Governments with a hearty good-will and determination which could not fail to ensure valuable results, such as have already been brought forward by Sars, Nordenschjold, Torrell, and others.

In England, men of science, equally impressed with the importance of this inquiry, wished, with an honourable pride, to see that the country which had so long claimed the empire of the sea, should, in a question of so purely marine investigation, do something worthy of herself; and, being fully alive to the impossibility of doing so without the aid of the Government, applied themselves first to the task of procuring such assistance. Since it is an acknowledged but melancholy fact, that science does not in England either obtain the high position in society, or the influence with the ruling powers of the country which is accorded to it on the Continent in general, it is a subject for congratulation that the urgent appeals made to the Government should have in this instance proved so successful; and after the Government had provided the ships and equipment necessary for the expeditions of last year and this, it is a further subject for congratulation that the direction of these scientific explorations should have been entrusted to such able men as Dr. Carpenter, Prof. Wyville Thomson, and Mr. Gwyn Jeffreys, who constitute the present committee.

The expedition of last year being the first of its kind, had, as might be anticipated, many difficulties to contend with; the ship itself, besides starting at a late season of the year, was ill suited to the undertaking, was provided with but extremely inefficient winding machinery, imperfect appliances and instruments, and moreover, the observers and their assistants had, as it were, to serve an apprenticeship in the management of such operations.

This year, besides being fortunate in securing unusually favourable weather during the major part of the operations, all the above-mentioned difficulties had been provided against; whilst, at the same time, the experience gained during the last year's cruise contributed very greatly to the complete success of the expedition as a whole.

As yet, it would be premature to attempt any description of the results of these explorations, for the Report which was commenced at the meeting of the Royal Society last Thursday is not yet concluded, but is to be continued at its next meeting; sufficient, however, has been already brought forward to prove satisfactorily the great importance of the data obtained to science in general. Besides corroborating, and in some respects correcting the conclusions deduced from the operations of the last year's expedition, many new facts and observations have been collected, whilst the supply of specimens and materials for examination which have been brought home will no doubt give full occupation to the members of the committee for some time to come, besides obliging them to bring to their assistance the services of the physicist, chemist, and mineralogist, each in their several departments.

The practicability of exploring even the deepest portions of the ocean bed may now be considered to be fully established; the conclusive proofs brought forward showing the existence of warm and cold areas of the deep-sea bottom, in close proximity to one another, each inhabited by its distinct and characteristic fauna, is as surprising as it is important in its scientific bearings, and particularly in its relations to geology and palæontology; whilst the investigations into the temperature of the different ocean zones, and the nature of the gases contained in the sea-water at various depths, are intensely interesting and suggestive.

The question as to the existence of an azoic ocean zone at *any* depth, must now be regarded as finally settled in the negative. The hypothesis which appeared to Edward Forbes to be warranted by all the data which the science of his day could supply, must now be abandoned; it is certain, however, that all who knew him will do his memory the justice of believing that, were he now alive, so far from regretting the necessity of withdrawing a suggestion which appeared to explain several important points in science now once more involved in obscurity, he would have been the first of the converts to the views now proved to be more correct, and the first to congratulate the members of the deep-sea dredging committee upon so successful and brilliant a termination of their labours.

David Forbes

PHYSICAL METEOROLOGY

I.—ITS PRESENT POSITION

It is a well-known remark of the historian of science that our progress in astronomy has been made in exact accordance with certain laws which regulate the advancement of knowledge. Neither the march of the sun by day, nor that of the moon by night, is more rigidly surrounded and circumscribed by law than the march of that intellect which has successfully interpreted celestial motions.

We had first of all an observing age. Thousands of years ago in the plains of the East we had astronomers who, albeit with imperfect instruments, lacked neither zeal nor intelligence in their nightly study of the stars. Many of their theoretical ideas were untenable, nay, even absurd, but yet they served to bind together into a formal law the mass of observations which their nightly industry collected.

And so step by step our knowledge of celestial motions progressed, until it culminated in the discoveries of Copernicus and Kepler; and we were presented at last with a bird's-eye view of the solar system, taken, as it were, from without, in which that which appears to be, finally gave place to that which is. Thus the first stage was passed, and astronomers had now another question to put to the universe: it was no longer What are the real motions of the planets? but rather, Why do they move in orbits which we know to be ellipses having the sun in one of the foci? Hardly had this question been put, when a great genius answered it. The immortal Newton told us that the same law which regulates the motions of the planets round the sun, and that of the moon round the earth, determines also the path of a stone thrown by the hand, or the velocity of an apple falling from a tree.

One law was shown to hold throughout, and the expression of that law having been obtained, we were easily led to the third stage in the development of astronomy.

The problem was now—from our knowledge of the present places and motions of the heavenly bodies, and of the laws which regulate these, to determine their future places. In fact, the last or prophetical stage of the science had now been reached, and accordingly we had a race of prophets who compiled our nautical almanacs, culminating in two great prophets—one French and one English—who told us where to look for Neptune.

Thus in the most complete branch of physical inquiry there have been three stages of development. We have, first, the observational stage, the object of which was to discover the real motions of the planets of our system; next, we have the stage of generalisation, assigning the mechanical laws regulating these motions; and, lastly, we have the stage of deduction, which, from a knowledge of the places and laws of motion of the heavenly bodies, predicts their future courses.

Each of these stages had its own peculiar difficulty to encounter. That in ascertaining the actual motions of the heavenly bodies consisted in the fact that our point of view is a movable one, and it was only when this had been surmounted that the true explanation was obtained. Again, the difficulty in the generalisation accomplished by Newton consisted in recognising that the planets in their orbits are subject to the same mechanical laws which regulate motions on the earth's surface, and in ascertaining and applying these laws; while, again, the difficulty in the third or deductive stage was an analytical one, for it was necessary to possess a method of analysis sufficiently powerful to calculate the motions of a set of bodies mutually attracting one another.

Now these historical facts, connected with the progress of astronomy, are of very great value to us, especially with reference to those other branches of science not so far advanced. We have, as it were, given us a standard of growth and development, and by measuring the younger child against the elder, we may be able to know the exact advancement of our latest born, and also the course of discipline best calculated to ensure a vigorous growth. It is by this astronomical standard that I now wish very briefly to measure what has been done in meteorology, and during these remarks I may perhaps venture to suggest a course of diet and discipline. But here, alas! there is little advancement to chronicle: the first stage of progress—the observational one—is yet very incomplete; for, viewing meteorology as that science which treats of the physics of the earth's surface, and more particularly of the atmosphere—its motion, and its physical properties, it must be acknowledged that these are very imperfectly known. At the same time it must be owned, that there are very serious difficulties in the way of obtaining this knowledge, more and greater perhaps than there were in obtaining the true motions of the heavenly bodies.

It is not because, as in astronomy, our point of view is a movable one; but rather that we are so mixed up with the earth and its atmosphere, and the motions of the latter are on so large a scale, that we find the greatest possible difficulty in grasping their true import. We are like a soldier in the midst of a great battle, who can give but a very poor and partial account of it, attaching, as he does, undue importance to those passages of arms with which he is most concerned, and ignorant, as he must be, of the general plan of the whole. What is wanted is a bird's-eye view of the atmosphere, such as it might appear to the inhabitants of the moon, who enjoy peculiar advantages in studying the physical features of our earth, just as we do with respect to the surface of our satellite. But there is another difficulty, at least in oceanic regions. Here the scientific worker is very much in the same position as the Jews of old when rebuilding their temple, that is to say, he must work with the one hand and fight with the other, especially when there is any great commotion going on.

The commander of a vessel during a cyclone must first of all look after his vessel, and then, if he has any time to spare, it may be devoted to his barometer and thermometer. Indeed, whether on sea or land, the grand and interesting phenomena of nature carry in their train so much that is overwhelming, that the mind of the observer is not unfrequently unfitted for calm investigation. There is still a third difficulty, and that is the great improbability (despite the perseverance and industry shown by Glaisher and other meteorologists) of ever obtaining by observation a very complete knowledge of the upper regions of the earth's atmosphere.

So much for the difficulties in the way of observing, and now one word with regard to the instrumental means at our disposal. Of late years these have been greatly improved, and one of the most notable achievements in this way is the anemometer of Dr. Robinson, by means of which we can record continuously the horizontal velocity and direction of the wind. Another is the application of photography to meteorological observations, so successfully advocated and extended by the present distinguished President of the Royal Society, by means of which we obtain a continuous record of the pressure, temperature, and hygrometric condition of the air. Again, by means of certain electrical appliances due to Sir C. Wheatstone and others we may place our instrument, whatever it be, at the top of a mountain, or at the bottom of the sea, or in some equally inaccessible region, while the record of the instrument so placed may be read in the quiet and comfort of our own studies. Thus, instrumentally we are well equipped and rapidly improving, but the observations as yet made with complete instruments are very few indeed.

I come now to a very important point. Has the best use been made of the observations already obtained? Of course we all know that there has been a deplorable want of co-operation among observers, as well as of system in making their observations; but we may hope that, through the meteorological offices and societies established in all civilised countries of the world, a greater amount of method will by degrees be obtained. There is, however, something more than all this, and

I have taken advantage of the late meeting of the British Association, at Exeter, to bring the subject before meteorologists. It appears that the general term meteorology embraces two entirely distinct subjects, one of these having reference to physiology, while the other forms a branch of physical research.

The object of the one is to study the connexion between atmospheric conditions, and the health of such organisms (animal and vegetable) as are subjected to these conditions; while the other or physical question is particularly concerned with the movements of the earth's atmosphere, and with the causes thereof.

On both of these important branches we are in almost entire ignorance. With respect to the first, the amount of vapour present in the air is without doubt a very important element of climate, inasmuch as this affects in a marked manner the skin of the human body, and the leaves of plants; but I am not aware that it has yet been determined by the joint action of naturalists and meteorologists what is the precise physical function expressing proportionally the effect of moisture upon animal and vegetable life. Is it simply relative humidity? or does not a given relative humidity at a high temperature have a different effect from that which it has when the temperature is low? There is, in fact, an absence of information as to the precise physical formula which is wished by physiologists, as expressing the effect of moisture upon organic life.

If we come in the next place to consider the physical branch of meteorology, or that which regards the motions of the earth's atmosphere, this is almost as far behind. The explanation of the trades and anti-trades is the one great generalisation which we have accomplished. Certain laws regarding cyclonic storms have lately been discovered; but to this day we are in ignorance of that exact motion of air which constitutes a cyclone, some holding that the motion is entirely rotatory, while others maintain that there is a considerable indraught of air from the circumference to the centre. Again, there is no fact better established than the diurnal movements of the barometer; but what is the motion of air or its constituents implied by them is still a point open to dispute. Now, these are both matters of fact, and there must be some reason why we know so little about them. Nothing, of course, could be known until the instrumental difficulties of the problem had been surmounted, and a suitable anemometer constructed; but now, we have good instruments, and have begun to make good observations. What, then, is the remaining drawback? I believe it is to be found in the fact that while instrumental appliances and observations have progressed, methods of reduction, which naturally lag behind observations, have not yet progressed, but are only just beginning to move. Those hitherto in use combine the physiological with the physical element,—they are a cross between the two, and are subject, I venture to say, as all such crosses are, to the general law of barrenness. Still not much time has been lost, for in the dark ages of few and bad observations it would have been useless to divide the meteorological field: meteorology, then, might be likened to one of those organisms of very low development that had just begun to exhibit the slightest possible tendency to split into two; the application of the knife would then have been premature; but now it may be used with advantage, and the one half allowed to rush into the arms of physiology, while the other seeks the embrace of physical research. In plain language, if we want to obtain physiological results we must reduce our observations with especial reference to physiology, while if physical results be desired, they must be reduced with especial reference to physical laws.

I must, however, reserve for another article a description of a method of reduction having this latter object in view.

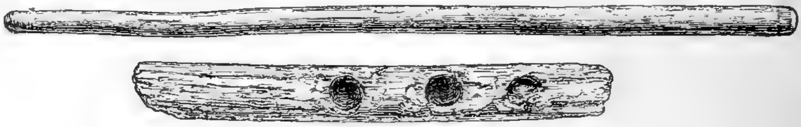
BALFOUR STEWART

PREHISTORIC TIMES

Prehistoric Times, as illustrated by Ancient Remains, and the Manners and Customs of Modern Savages. By Sir John Lubbock, Bart., F.R.S., &c. Second Edition. (London, 1869: Williams and Norgate.)

WE may be pardoned for not being cosmopolite enough to judge books without any regard to their nationality. Too often, though Englishman may have contributed much to some important subject, no systematic English treatise sums up the evidence, so that our students have to depend too much on foreign books of reference. On the present subject of prehistoric archæology, however, it is satisfactory that we have, in Sir John Lubbock's work, not only a good book of reference, but the best. Its well-known plan and argument need not be re-stated here, but it has to be pointed out that the present edition contains much important new matter, especially in the chapters relating to the Stone Age, Megalithic monuments, Cave-men, and the condition of modern savages.

It is a marked character of the recent researches in prehistoric archæology, and it is one of the reasons which justify the reception of the subject as a department of positive science, that the facts disclosed lend themselves to generalisations of a thoroughly scientific character; and that, moreover, when the generalisations are once made, new facts drop in and find their places ready. Various subjects discussed in the present work illustrate this: take, for instance, the stone-implement question. The finding of flakes, scrapers, spear-heads, &c. in different parts of the world, justified a general surmise that the Stone Age had once prevailed in all inhabited districts. A few years ago, however, there were regions whence stone implements seemed hardly forthcoming. India appeared to have none, but when properly looked for they proved abundant, as witness Mr. Bruce Foote's paper in the Transactions of the Norwich Congress of 1868. Africa also seemed almost outside the Stone Age world; but now the finding of stone implements in South Africa, and even legends of their use, give the primal Stone Age possessions there as elsewhere. No sooner, too, were the rude implements of the Drift type thoroughly recognised in the valley of the Somme, than it came into notice that such had long before been collected in England without knowledge of their special importance; and now Spain and India, and other districts, furnish specimens which come under the same class. So it was with the art of fire-making by friction of pieces of wood. Over most of the world, savage or civilised, the traces of its early prevalence were sufficient to justify its being generalised on as one of man's primitive arts. But there were some exceptional cases, as in Tasmania, where the natives were said to have had no means of producing fire before their acquaintance with Europeans, but to have only carried lighted brands from place to place. Sir John Lubbock, however, is now able to give (p. 440) a drawing of a Tasmanian fire-drill. It is just like the well-known instrument of Australia, Africa, and America.



TASMANIAN FIRE DRILL.

So again, in a less degree, with those rude stone menhirs, cromlechs, kistvaens, &c., which are classed under the head of Megalithic monuments. The range over which these interesting structures are found has been continually extending to new districts. Dr. Hooker's account, in his Himalayan Journals, of the modern setting up of Megalithic structures by indigenous tribes in India, received for years little notice, but has now become one of the leading facts of prehistoric archæology. As may especially be seen in Meadows Taylor's recent paper in the Journal of the Ethnological Society, monuments like our own Kit's Coty House, or Dance Main, are known in vast numbers in India, and are made the subject of careful study. A group from the reduced plate in Sir John Lubbock's work (p. 120) is given here.

MEGALITHIC STRUCTURES IN INDIA.

Was the civilisation of the lower races spread from a single centre, or from many? Is the correspondence of savage culture the result of common inheritance, or independent similar invention? This still most obscure problem is intimately connected with the evidence brought forward in Sir John Lubbock's generalisations, and especially with his details of modern savage tribes as representatives of older strata of prehistoric man. The point is one which especially strikes those who notice the surprising similarity of the implements of the lower races in the most different regions, as where, in the present work, three all but identical arrow-heads from modern North and South America and ancient France, are set side by side (p. 99); or modern savage flint scrapers are figured, undistinguishable from those of remote European antiquity. Sir John Lubbock insists with much force (p. 545) on the consideration that this similarity is due especially to similarity of materials; that the pointed bones used for awls are necessarily similar everywhere, that obsidian knives from Mexico are like the flint knives of our own country, not so much because the ancient Briton resembled the Aztec, as because the fracture of flint is like that of obsidian. And his remark (p. 121), that any child with a box of bricks will build dolmens and triliths is a highly reasonable protest against those antiquaries who interpret the similarity of Megalithic structures in different districts as proof that their builders were of kindred race.

With regard to a most interesting topic treated of by Sir John Lubbock, that of the existence of savage tribes destitute of religion, I am disposed to entertain a view different from his. To a great extent, indeed, our difference is rather nominal than real. He adopts a definition of religion more stringent than I do, and thus excludes from the catalogue of religious tribes many which on the same evidence I should include. Dieffenbach's evidence, for instance, is quoted as follows (p. 556): "If we take religion in its common meaning, as a definable system of certain dogmas and prescriptions, the New Zealanders have no religion. Their belief in the supernatural is confined to the action and influence of spirits on the destiny of men, mixed up with fables and traditions." This, from my point of view, is an admission that the New Zealanders have a religion; and, indeed, we know that they are strong believers in a future existence, and regard the names of their ancestors as tutelary spirits. Moreover, the assertions of travellers on this point not seldom break down on closer scrutiny. Thus mention is made here of a statement in the *Voyage de l'Astrolabe* that the Samoans have no religion; but the explorers' information was evidently insufficient, and an elaborate account of the Samoan deities, priests, temples, prayers, sacrifices, may be found in Turner's "Polynesia." Among Sir John Lubbock's list of evidence there are, indeed, cases which cannot be thus easily met. But while admitting theoretically that a state without religion may have prevailed among early tribes of men, and may still be represented by surviving savages, I fail to find as yet any indisputable case.

TERRA-COTTA URN FROM ALBANO

Among the special points of interest introduced in the present volume, it may be mentioned that the habitations men lived in during the Bronze Age are displayed in a very interesting way, in imitative terra-cotta urns of the period, such as this from Albano. We must probably go many ages back from the date of the Italians of the Bronze Age, who dwelt in these neat huts, to the date of the rude Stone Age cave-men of Central France, the contemporaries of the reindeer and the mammoth, which they delineated with such remarkable artistic vigour. One of these people's interesting drawings (p. 324) is given here, representing a snake or eel, two horses' heads, and a human figure (which Lord Monboddo would probably have claimed as special evidence). This may possibly be the earliest known portrait of man.

STONE-AGE SCULPTURES

The advocates of the theory that savages are degenerate descendants of civilised men, have still full scope in pointing out the imperfections of their adversaries' evidence and argument. But the new facts, as they come in month by month, tell steadily in one direction. The more widely and deeply the study of ethnography and prehistoric archæology is carried on, the stronger does the evidence become that the condition of mankind in the remote antiquity of the race is not unfairly represented by modern savage tribes.

E. B. TYLOR.

THE ORIGIN OF SPECIES CONTROVERSY.

Habit and Intelligence, in their Connection with the Laws of Matter and Force. A Series of Scientific Essays. By Joseph John Murphy. (Macmillan and Co., 1869.)

I.

THE flood of light that has been thrown on the obscurest and most recondite of the forces and forms of Nature by the researches of the last few years, has led many acute and speculative intellects to believe that the time has arrived when the hitherto insoluble problems of the origin of life and of mind may receive a possible and intelligible, if not a demonstrable, solution. The grand doctrine of the conservation of energy, the all-embracing theory of evolution, a more accurate conception of the relation of matter to force, the vast powers of spectrum analysis on one side, showing us as it does the minute anatomy of the universe, and the increased efficiency of the modern microscope on the other, which enables us to determine with confidence the structure, or absence of structure, in the minutest and lowest forms of life, furnish us with a converging battery of scientific weapons which we may well think no mystery of Nature can long withstand. Our literature accordingly teems with essays of more or less pretension on the development of living forms, the nature and origin of life, the unity of all force, physical and mental, and analogous subjects.

The work of which I now propose to give some account, is a favourable specimen of the class of essays alluded to, for although it does not seem to be in any degree founded on original research, its author has studied with great care, and has, in most cases, thoroughly understood, the best writers on the various subjects he treats of, and has brought to the task a considerable amount of original thought and ingenious criticism. He thus effectually raises the character of his book above that of a mere compilation, which, in less able hands, it might have assumed.

The introductory chapter treats of the characteristics of modern scientific thought, and endeavours to show, "that the chief and most distinctive intellectual characteristic of this age consists in the prominence given to historical and genetic methods of research, which have made history scientific, and science historical: whence has arisen the conviction that we cannot really understand anything unless we know its origin; and whence also we have learned a more appreciative style of criticism, a deeper distrust, dislike, and dread, of revolutionary methods, and a more intelligent and profound love of both mental and political freedom." The first six chapters are devoted to a careful sketch of the great motive powers of the universe, of the laws of motion, and of the conservation of energy. The author here suggests the introduction of a useful word, *radiance*, to express the light, radiant heat, and actinism of the sun, which are evidently modifications of the same form of energy,—and a more precise definition of the words *force* and *strength*, the former for forces which are capable of producing motion, the latter for mere resistances like cohesion.

He enumerates the primary forces of Nature as, gravity, capillary attraction, and chemical affinity, and notices as an important generalisation "that *all primary forces are attractive;* there is no such thing in Nature as a primary repulsive force" (p. 43). Now here there seem to be two errors. Cohesion, which is entirely unnoticed, is surely as much a primary force as capillary attraction, and, in fact, is probably the more general force, of which the other is only a particular case; and elasticity is the effect of a primary repulsive force. In fact, at p. 26, we find the author arguing that *all matter is perfectly elastic*, for, when two balls strike together, the lost energy due to imperfect elasticity of the mass is transferred to the molecules, and becomes heat. But this surely implies repulsion of the molecules; and Mr. Bayma has shown, in his "Molecular Mechanics," that repulsion is as necessary a property of matter as attraction.

The eighth chapter discusses the phenomena of crystallisation; and the next two, the chemistry and dynamics of life. The reality of a "vital principle" is maintained as "the unknown and undiscoverable something which the properties of mere matter will not account for, and which constitutes the differentia of living beings." Besides the formation of organic compounds, we have the functions of organisation, instinct, feeling, and thought, which could not conceivably be resultants from the ordinary properties of matter. At the same time it is admitted that conceivableness is not a test of truth, and that all questions concerning the origin of life are questions of fact, and must be solved, not by reasoning, but by observation and experiment; but it is maintained that the facts render it most probable that "life, like matter and energy, had its origin in no secondary cause, but in the direct action of creative power." Chapters X. to XIV. treat of organisation and development, and give a summary of the most recent views on these subjects, concluding with the following tabular statement of organic functions :—

Formative or Vegetative Functions, essentially consisting in the Transformation of Matter.

Chemical	Formation of organic compounds.
Structural.	Formation of tissue.
	Formation of organs.

Animal Functions, consisting essentially in the Transformation of Energy.

Motor.	Spontaneous.
	Reflex.
	Consensual.
	Voluntary.
Sensory.	Sensation.
	Mind.

In the fifteenth chapter we first come to one of the author's special subjects,—the Laws of Habit. He defines habit as follows : "The definition of habit and its primary law, is that all vital actions tend to repeat themselves ; or, if they are not such as can repeat themselves, they tend to become easier on repetition." All habits are more or less hereditary, are somewhat changeable by circumstances, and are subject to spontaneous variations. The *prominence* of a habit depends upon its having been recently exercised ; its *tenacity* on the length of time (millions of generations it may be) during which it has been exercised. The habits of the species or genus are most tenacious, those of the individual often the most prominent. The latter may be quickly lost, the former may appear to be lost, but are often latent, and are liable to reappear, as in cases of reversion. The fact that active habits are strengthened, while passive impressions are weakened, by repetition, is due in both cases to the law of habit; for, in the latter, the organism acquires the habit of not responding to the impression. As an example, two men hear the same loud bell in the morning ; it calls the one to work, as he is accustomed to listen to it, and so it always wakes him ; the other has to rise an hour later, he is accustomed to disregard it, and so it soon ceases to have any effect upon him. Habit has produced in these two cases exactly opposite results. Habits are capable of any amount of change, but only a slight change is possible in a short time ; and in close relation with this law are the following laws of variation.

Changes of external circumstances are beneficial to organisms if they are slight ; but injurious if they are great, unless made gradually.

Changes of external circumstances are agreeable when slight, but disagreeable when great.

Mixture of different races is beneficial to the vigour of the offspring if the races mixed are but slightly different ; while very different races will produce either weak offspring, or infertile offspring, or none at all. Even the great law of sexuality, requiring the union of slightly different individuals to continue the race, seems to stand in close connection with the preceding laws.

The next seven chapters treat of the laws of variation, distribution, morphology, embryology, and classification, as all pointing to the origin of species by development ; and we then come to the causes of development, in which the author explains his views as follows :—

> These two causes, self-adaptation and natural selection, are the only *purely physical* causes that have been assigned, or that appear assignable, for the origin of organic structure and form. But I believe they will account for only part of the facts, and that no solution of the questions of the origin of organization, and the origin of organic species, can be adequate, which does not recognise an Organising Intelligence, over and above the common laws of matter. . . . . But we must begin the inquiry by considering *how much* of the facts of organic structure and vital function may be accounted for by the two laws of self-adaptation and natural selection, before we assert that any of those facts can only be accounted for by supposing an Organising Intelligence.

Again :

> Life does not suspend the action of the ordinary forces of matter, but works through them. I believe that wherever there is life there is intelligence, and that intelligence is at work in every vital process whatever, but most discernibly in the highest. . . . Nutrition, circulation, and respiration are in a great degree to be explained as results of physical and chemical laws ;—but sensation, perception, and thought cannot be so explained. They belong exclusively to life ; and similarly the organs of those functions—the nerves, the brain, the eye, and the ear—can have originated, I believe, solely by the action of an Organising Intelligence.

Admitting Mr. Herbert Spencer's theory of the origin of the vascular system, and possibly of the muscular, by self-adaptation, he denies that any such merely physical theory will account for the origin of the special complexities of the visual apparatus :

> Neither the action of light on the eye, nor the actions of the eye itself, can have the slightest tendency to produce the wondrous complex histological structure of the retina ; nor to form the transparent humours of the eye into lenses ; nor to produce the deposit of black pigment that absorbs the stray rays that would otherwise hinder clear vision ; nor to produce the iris, and endow it with its power of closing under a strong light, so as to protect the retina, and expanding again when the light is withdrawn ; nor to give the iris its two nervous connections, one of which has its root in the sympathetic ganglia, and causes expansion, while the other has its root in the brain and causes contraction.

Nor will he allow that Natural Selection (which he admits may produce any simple organ, such as a bat's wing) is applicable to this case ; and he makes use of two arguments which have considerable weight. One is that of Mr. Herbert Spencer, who shows that in all the higher animals natural selection must be aided by self-adaptation, because an alteration in any part of a complex organ necessitates concomitant alterations in many other parts, and these cannot be supposed to occur by spontaneous variation. But in the case of the eye he shows that self-adaptation cannot occur, whence he conceives it may be proved to be almost an infinity of chances to one against the simultaneous variations necessary to produce an eye ever having occurred. The other argument is, that well-developed eyes occur in the higher orders of the three great groups, Annulosa, Mollusca, and Vertebrata, while the lower orders of each have rudimentary eyes or none ; so that the variations requisite to produce this wonderfully complicated organ must have occurred three times over independently of each other. In the first of these objections, he assumes that many variations must occur simultaneously, and on this assumption his whole argument rests. He notices Mr. Darwin's illustration of the greyhound having been brought to its present high state of perfection by breeders selecting for one point at a time, but does not think it possible "that any apparatus, consisting of lenses, can be improved by any method whatever, unless the alterations in the density and the curvature are perfectly simultaneous." This is an entire misconception. If a lens has too short or too long a focus, it may be amended *either* by an alteration of curvature, or an alteration of density; if the curvature be irregular, and the rays do not converge to a point, then any increased regularity of curvature will be an improvement. So the contraction of the iris and the muscular movements of the eye are neither of them essential to vision, but only improvements which might have been added and perfected at any stage of the construction of the instrument. Thus it does not seem at all impossible for spontaneous variations to have produced all the delicate adjustments of the eye, once given the rudiments of it, in nerves exquisitely sensitive to light and colour; but it does seem certain that it could only be effected with extreme slowness; and the fact that in all three of the primary groups, Mollusca, Annulosa, and Vertebrata, species with well-developed eyes occur so early as in the Silurian period, is certainly a difficulty in view of the strict limits physicists now place to the age of the solar system. A. R. WALLACE

THE PLANTS OF MIDDLESEX

Flora of Middlesex: a Topographical and Historical Account of the Plants found in the County; with Sketches of its Physical Geography and Climate, and of the Progress of Middlesex Botany during the last Three Centuries. By Henry Trimen, M.B., F.L.S., and W. T. Thiselton Dyer, B.A. Pp. xli., 428. (London: Hardwicke, 1869.)

THE first local Flora published in England gives a list of the plants of Hampstead Heath. It was prepared by Thomas Johnson, Apothecary on Snow Hill. Early on the morning of the 1st August, 1629, and accompanied by a few friends, he left London and proceeded on a simpling expedition to Hampstead, by way of Kentish Town and Highgate. A heavy shower arrested their progress for a little, but nothing daunted they made their way into the woods, and then on to the heath. The day's excursion was brought to a close in a country inn at Kentish Town, where the party dined together.

Johnson enumerated seventy-two plants as the result of the day's simpling. In subsequent expeditions he added sixty-nine others, so that in 1632 his *Enumeratio Plantarum in Ericeto Hampsted. cresc.* contained 141 species. This rare little volume, with its forgotten names—those of Gerarde and Lobel—is the earliest precursor of the Flora of Middlesex. Since its publication, the materials have been gradually accumulating for illustrating the Flora of the Metropolitan district, and one of the most valuable features in the work before us is, that its authors have, with great care and singular success, investigated and expounded all the ancient as well as the more recent plant-lore bearing on the subject.

The bi-nominal system of nomenclature and the Linnean classification introduced, somewhat more than a century ago, a new era into the science of Botany, and relegated to comparative obscurity the older authors. The difficulty of determining the value of their names, and the practice of neglecting all ante-Linnean synonymy, have caused their labours to be set aside. The authors of this volume have made the works of these earlier writers critically certain by the help of the Herbaria of Merrett, Petiver, Plukenet, Ray, and specially of Buddle, and of the manuscripts relating to them now preserved in the British Museum.

We have here given for the first time an authentic biography, so to speak, of the different plants so far as they are connected with Middlesex. The name of the observer who first recorded each plant, the date of the record, and the place where it was observed, are specified; while the chronologically-arranged localities where it has been at different times gathered, enable one frequently to trace its increasing rarity, and in not a few cases the biography terminates with the record of its complete extirpation. Thus Turner, the father of British Botany, first (1562) records Penny-royal (*Mentha Pulegium*, Linn.) from "beside Hundsley upon the Heth beside a watery place;" after him Gerarde (1597) tells us that it grew "on the common neere London called Miles ende, whence poore women bring plentie to sell in London Markets;" and then, through Blackstone, to our own time when it was found in plenty beside the Hampstead ponds, but finally disappeared from the county about twenty years ago. London Rocket, which Morison says might have been reaped like a crop of wheat on the ruins near St. Paul's after the Great Fire, was, up to the beginning of the present century, a common plant in Middlesex, but is now completely lost. The history of *Cucubalus*, from the Isle of Dogs, is much shorter. Known in England only in this locality, it flourished apparently in a wild state for twenty years, until building operations destroyed the habitat about twelve years ago.

Every page of the volume supplies similar interesting details in the history of Middlesex plants. This feature of the work is as novel as it is important. There is abundant evidence that the authors, in addition to their faithful and even loving exposition of the labours of their predecessors, possess a sound critical acquaintance with the species of British plants. Even in this aspect, the volume is not behind the best of our county Floras.

The influence of the geological condition of a district upon the organised bodies connected with it has lately been receiving the attention it deserves. Important conclusions have resulted from the Government inquiry into the relations subsisting between the diseases of man and the geological structure of the south-eastern corner of England. The connection between the indigenous vegetation and the geology of its habitat is not less interesting, and, when data have been sufficiently accumulated to warrant safe deductions, will yield valuable information. M. Thurmann, in an elaborate essay on the botany of the Jura, has shown that vegetation is influenced by the manner in which the particles of the rocks are combined, rather than by the nature of the materials of which they are composed. He has consequently classified rocks into two great groups, based on their mechanical constitution: the one he calls "Eugéogènes" (plentiful-detritus-yielding) and the other "Dysgéogènes" (sparing-detritus-yielding). The essential differences between the two groups are in respect to their hardness, their power of absorbing and retaining moisture in small masses, their permeability in extensive deposits, and the rate at which they form detritus resulting from the possession of these characteristics. Mr. Baker has applied the conclusions of the French botanist to Britain, in his Flora of North Yorkshire, and, more recently, in that of Northumberland and Durham. The limited extent of Middlesex, and the uniform character of its geology, give little scope for the application of these views to its Flora. The only Dysgeogenous rocks are the narrow outcrop of chalk in the north and north-west; the remainder of the county being composed of typical Eugeogenous strata. As far as it is possible, however, the authors have made good use of M. Thurmann's labours, and the limited application is to some extent compensated for by the accuracy of the details.

Appended to the volume is a valuable contribution to the history of British botany, covering to some extent the ground taken up by Pulteney in his "Sketches," and continuing it to the present day as far as the matter relates to Middlesex. Large additions are made to Pulteney's biographies of Turner, Johnson, Plukenet, Petiver, and Doody. New and interesting memoirs are given of Buddle, Blackstone, Curtis, and other less known investigators of Middlesex plants. It would be greatly to the advantage of science, if the authors, encouraged by the success which has attended their investigations into the progress of Middlesex botany, would continue their researches, and give us, not a new edition of Pulteney, but a new History of Botany in Britain.

W. CARRUTHERS

OUR BOOK SHELF

Van Heurck on the Microscope.—*Le Microscope, sa Construction, son Maniement, et son Application aux Etudes d'Anatomie végétale.* Henri van Heurck. 8vo. pp. 223, with Illustrations, price 3*s.* (Antwerp, 1869. London: Williams and Norgate.)

THE title-page of this little work, a mere fragment of which we have transcribed above, is perhaps its most objectionable feature. The ambitious superscription, however, need not affect its usefulness as an elementary descriptive treatise, and the English reader may add to his information by the perusal of a manual of microscopical manipulation written from a French or Belgian standpoint.

We have no manual in English of precisely similar scope and intention with which to compare M. van Heurck's; the one which it most resembles is, perhaps, Mr. Currey's translation of Dr. Schacht's excellent guide to the use of "the Microscope in Vegetable Physiology," the chief difference being in point of thoroughness: the former is a popular, the latter a scientific work.

M. van Heurck's book is divided into two portions, of about one hundred pages each: the first, on the construction and choice of a microscope; the second, on its application to vegetable anatomy. We may describe each section in a few words.

Naturally, the instruments of French makers have prominence assigned to them; and most of the well-known models manufactured by Hartnack, Chevalier, and Nachet are figured, together with one or two modifications we do not recollect having seen before. In too many of these, cheapness and simplicity go hand in hand with toy-like inefficiency. Some are of more interest, such as Chevalier's "Universal Microscope," and a "vertical," or rather "inverted," arrangement constructed by M. Nachet for photographic purposes. In the section devoted to manipulation, the subject of micro-photography is treated at greater length than has been customary in such works.

All notice of the microscopes of English makers appears to have been omitted in the first Edition of "Le Microscope," beyond a general intimation that their "price is exorbitant, and their complication excessive;" but, "at the request of subscribers," an appendix has been prepared to the present issue, containing a description of the instruments of Ross, R. and J. Beck, and Powell and Lealand. This seems to be written with only partial knowledge, and with very unequal justice.

The second portion of the book contains little of novelty in either fact, theory, or method. Beginners will find in it the sort of information they require to enable them to examine and mount vegetable tissues, and the numerous little woodcuts will enable them to understand the more important structures. There is also a section on the application of reagents, intended for those who have advanced a step farther in histological pursuits.

We may repeat that, though M. van Heurck's work will not bear comparison with several of our English manuals in completeness, the reader will scarcely rise from it without having gained a few useful hints.

H. B. BRADY

Bryologia Silesiaca. Von Dr. Julius Milde, Professor in Breslau. (Leipzig, 1869.)

THIS is a systematic description of the mosses, not only of Silesia, but also of Jutland, Holland, the Palatinate, Baden, Franconia, Bohemia, Moravia, and the neighbourhood of Munich. Special attention is, however, devoted to the Silesian flora. The work is prefaced by an account (for the use of beginners) of the most important organs of the musci in reference to the determination of species.

New Batrachians.—*Ueber neue und wenig bekannte Batrachier aus Australien und America.* Von W. Keferstein, Prof. in Göttingen. (Berlin, 1868.)

THE Göttingen Museum is rich in Australian frogs. Prof. Keferstein here describes, from the museum specimens, twenty-nine species. He also enumerates nineteen others, recorded as such in the literature of batrachiology, although their specific value appears, in many cases, to be doubtful. The frog-fauna of Australia, according to Prof. Keferstein, bears a great resemblance to that of South America. Some batrachians from Costa Rica are likewise described in this brochure. Five plates of figures are appended. It may be worth mentioning that the authorities of the museum will be glad to exchange some of their superfluous Australian species for other batrachians.

The Sandwich Islands.—*Ein Jahr auf den Sandwich-Inseln (Hawaiische-Inseln).* Von Dr. J. Bechtinger. (Wien, 1869.)

THE chief interest of this volume lies in its pictures of the social and moral condition of a primitive people in close contact with modern civilisation, and the subject for many years of unexampled missionary efforts. The author enters somewhat fully into the character of the climate, the nature of prevalent diseases, the physical and psychical characters of the people, and their probable ethnic affinities. Leprosy is a disease unfortunately very prevalent among the inhabitants, and their Government have hit upon a notable plan for putting the sufferers out of sight, and preventing the spread of the disease by contagion. In the island of Molokai there is a plain near the sea, and walled off from the rest of the island by mountains from two to four thousand feet high, and almost totally inaccessible. To this spot lepers are conveyed by a vessel which periodically leaves Honolulu for that purpose, and for the purpose of carrying food. Every other communication with the sufferers is strictly prohibited. Dr. Bechtinger had a very natural desire to visit this forbidden valley, and ascertain the condition of its inhabitants. Knowing, however, that great opposition would be made to his doing so, he resolved to go thither privately, and attempt to reach the valley over the mountain range at its back. Attended by a photographer, he succeeded in his project, and found the poor wretches (hundreds and hundreds of them) in a most horrible state, utterly neglected and almost entirely without the necessaries of life. It is satisfactory to know that the representations of the Italian doctor in the Honolulu newspaper procured for these outcasts some amelioration of their lot, although it procured for himself abuse and ill-will. As a frontispiece to the volume there is a woodcut, reproduced from a photograph, of the author surrounded by some of the lepers of Molokai. Other woodcuts are likewise given; but they are chiefly, if not solely, remarkable for their very primitive and inartistic character.

Chemical Lessons.—*Leçons de Chimie.* Deuxième edition. Par M. Alfred Riche. (Paris: Didot Frères, 1869.)

LIKE almost all French treatises on elementary science, M. Riche's book is clearly and concisely written, and the illustrations are perfect; but although introducing many of the newest discoveries in the science (perhaps somewhat too pointedly alluded to in the preface), M. Riche does not adopt the important new views lying at the basis of modern chemistry. He still adheres to the old equivalent notation, and therefore refuses to admit the cogency of the proofs which have carried conviction to the minds of almost all other chemists. The short historical introductions under Combustion, the Atmosphere, Dissociation, and the Atomic Theory are of interest to the student, especially an extract (p. 704) from a paper by Dumas on the history of chemical affinity since the time of Barckhausen, read before the Academy of Sciences last year.

H. E. R.

NOTES ON STALACTITES

THE mineralogist is acquainted with few objects of greater beauty than the stalactitic forms assumed by many minerals. So curious are these natural growths, that I venture to offer a few remarks upon their artificial production.

The dependent clusters which line limestone caverns are formed, as has often been explained, by the following process:—When water containing carbonate of lime oozes through a porous rock, each drop loses water and carbonic acid by evaporation. As water saturated with carbonic acid only retains 0·1 per cent. of carbonate of lime in solution, it follows that when the evaporation is continued beyond the point of saturation, carbonate of lime will be deposited. Globules of water on the roofs of limestone caverns are always covered with a thin film: this gradually thickens, and a tube is formed. This tube increases in size mainly by the deposition of carbonate of lime from water running over its surface. There are, however, many cavities containing tubes of arragonite in an horizontal position, and even of a curved form. Mr. Wallace has shown* that the growth of such stalactites has been from within outwards, the solution travelling along the self-constructed tube.

The following experiment affords a ready method of studying the somewhat rapid growth of similar forms:—Select a flat piece of porous sandstone, or, better, a slice of coke; saturate this with nitric acid. If a globule of mercury three or four millimetres in diameter be allowed to fall on the coke, the surface of the mass will be covered with minute beads of mercury. The nitric acid immediately attacks the under-surface of each sphere, producing an annular ring of nitrate of mercury. A short tube is thus formed, sustaining the metallic globule. As liquids rise in capillary tubes, but do not overflow the orifice, the periphery of the sphere is acted upon by the nitric acid, and lifted higher and higher by the deposited nitrate. The result is a tube of about twenty-five millimetres (one inch) in height, terminated by a minute sphere of mercury.

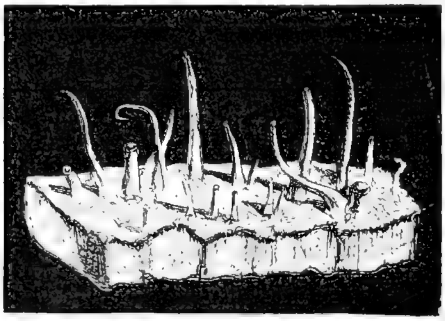
The cross-section of the stalactite is tubular; often, however, partially filled with interlacing crystalline planes. If nitrate of mercury is deposited more rapidly on one side, a twist is given, and a spiral tube is formed. Often a thin wall on one side predisposes the direction, and a curved stalactite is produced.

* Proc. Geo. Soc. 1865, 413.

It is well to consider briefly the stalactites that appear to have been formed mainly by deposition from water running over their surface. Of this class the siliceous stalactites well repay examination. Silica occurs in stalactite tubes of crystalline silicic anhydride, as in the specimens from Malwa, in Central India.

The chalcedonic form, however, is far more common, and the specimens from Trevascus Mine afford beautiful examples. The tubes are generally about two to three millimetres in diameter, and if a section through the length of the tube be made, the following structure will be easily made out by a hand lens or one inch objective. Firstly, we observe a slender opaque thread with a tube running down its entire length; over this opaque thread there is a covering of chalcedony. Frequently, but not invariably, the junction is marked by a vesicular structure.

To understand this it is necessary to turn to the artificial production of an aqueous solution of silica. By



NITRATE OF MERCURY STALACTITES

bringing together 112 grammes of silicate of soda, 67·2 grammes of dry hydrochloric acid, and 1 litre of water, and dialysing for four days, a solution containing 4·9 per cent. of silicic anhydride remains upon the dialyser; the chloride of sodium and excess of hydrochloric acid having diffused away. This solution becomes pectous somewhat rapidly, forming a solid jelly which dries in air into a glassy, lustrous hydrate. A solution containing 0·5 per cent. of silicic anhydride remains permanently limpid.

The minutest trace of a soluble carbonate, or a bubble of carbonic acid, causes a solution of silica to gelatinise rapidly. Professor Church has shown the importance of this fact in the formation of siliceous pseudomorphs of corals. By passing water containing 0·15 per cent. of silica, dissolved carbonic acid, and air, over the coral, he replaced the carbonate of lime by hydrated silica.

In the Trevascus stalactite under consideration, probably the opaque thread was originally carbonate of lime. The carbonate would have arrested and gelatinised the silica, the covering thus produced affording a colloid septum for the diffusing away of crystalloid salts.

This view is supported by the vesicular junction with the chalcedonic layer, as the escape of carbonic acid would probably have produced bubbles in the yielding jelly. Whether this be so or not, it is easy to convert stalactites of arragonite into siliceous pseudomorphs that present a close resemblance to the natural mineral.

W. CHANDLER ROBERTS

THE SHARPEY PHYSIOLOGICAL SCHOLARSHIP

WE are most pleased to report that the movement for the establishment of a "Sharpey Physiological Scholarship" at University College, in honour of Prof. Sharpey, is meeting with all the success that it deserves. Already, by the more or less private efforts of the secretaries and other members of the committee, a sum of £1,500 has been subscribed: much more, however, will be required in order to carry out the wishes of the promoters of the "Sharpey Memorial" scheme.

Having held his present professorship since 1836, Dr. Sharpey is well known to, and as thoroughly esteemed by, a very large number of old students, who have not only experienced the benefit of his clear, logical, and thorough method of teaching, but have felt the genial influence of his kindly sympathy, and the value of that breadth and soundness of judgment for which he is so remarkable. The large majority of his old and present students will now doubtless be delighted to take part in a movement destined to do honour to their favourite professor; and we believe that many of those who have been associated with Dr. Sharpey in his various official capacities in connection with science and education will also gladly avail themselves of this opportunity of testifying to their high appreciation of the valuable services which he has performed in both these capacities, and also of bearing witness to the strong feelings of personal regard with which he has inspired them.

The proposed memorial is of a nature likely to be peculiarly gratifying to Dr. Sharpey. The future "Sharpey Physiological Scholar" is destined to work in the Physiological Laboratory of the College, in the practical departments of the science; and successive students who may obtain this honourable distinction will, it is hoped, come for some time under the immediate supervision of Dr. Sharpey himself. The Professor has most liberally offered to present to the College his anatomical and physiological library, consisting of the best works of the older anatomists, a useful series of foreign scientific periodicals, and a large number of monographs by some of the most active and learned observers of modern times. It is proposed to place these books in a new class-room for practical physiology, which is about to be fitted up under the name of the "Sharpey Physiological Laboratory and Library;" and which, as part of the memorial, is to be adorned by a portrait of the man to whom the subscribers wish to do honour now, and whose memory they desire to perpetuate in the future. If the amount of the "Memorial Fund" is sufficient, it is also proposed that a bust of Dr. Sharpey should be executed for presentation to the College. The plan seems an excellent one, combining as it does the feature of being a thorough personal tribute of the most gratifying nature to Dr. Sharpey, destined to convey to successive generations of students a notion of the high estimation in which his services in the cause of science and education were regarded by his contemporaries, whilst it is also a movement likely to result in the further extension of that branch of science to which he has himself principally contributed. It is hoped that the study of practical physiology will thus be helped on more than it has hitherto been in this country, and that in time a school of practical physiology—the precursor of many others—may be established, equal to any of the now celebrated continental schools. It is expected that many of the fellows of the Royal Society and of other scientific bodies will gladly take this opportunity of doing honour to a man whom they all esteem so highly, and for whom so many entertain warm feelings of personal regard. We are glad to find that several of the foremost amongst them have already given evidences of substantial co-operation, and we trust that many others will follow their example.

THE ISTHMIAN WAY TO INDIA

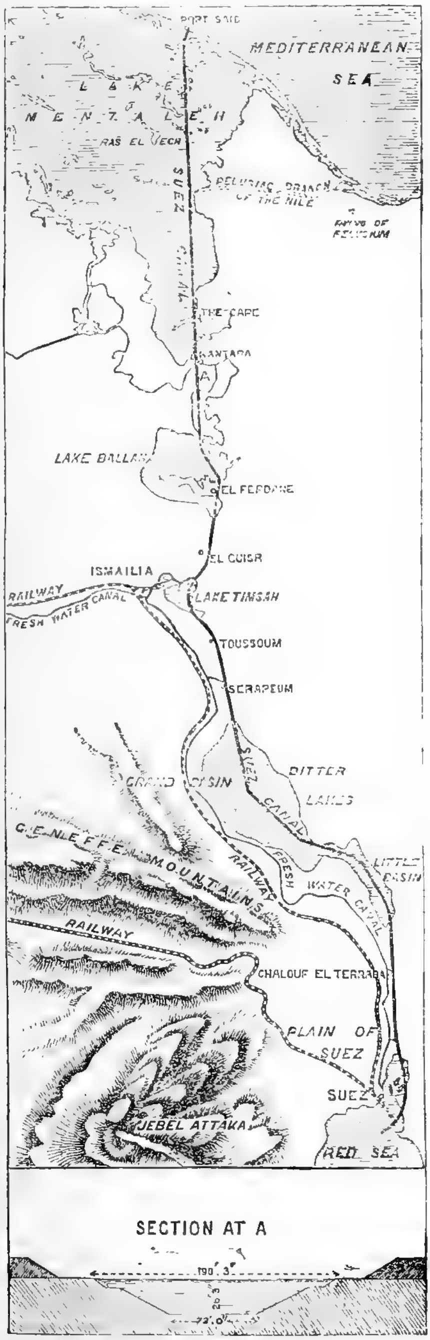
THE Canal has been opened. The flotilla, with its noble, royal, imperial, and scientific freight, has progressed along the new-made way from sea to sea. From Port Saïd, that new town between the sea and the wilderness, with its ten thousand inhabitants, and acres of workshops and building-yards, and busy steam-engines, the naval train floated through sandy wastes, across lakes of sludge and lakes of water filled from the Salt Sea; past levels where a few palm-trees adorn the scorched landscape; past hill-slopes on which the tamarisk waves its thready arms; past swamps where flocks of flamingoes, pelicans, and spoonbills, disturbed by the unwonted spectacle, sent up discordant cries; through deep excavations of hard sand or rock; across the low flat of the Suez lagoons, where Biblical topographers have searched for the track of the children of Israel; and so to the "red" waters of the great Gulf of Arabia. The flotilla has done its work: the Canal has been opened; and the distance by water to India is now 8,000 miles, instead of the 15,000 miles by the old route round the Cape of Good Hope.

It is a great achievement. So great, that we need not wonder that the capital of 8,000,000*l.* sterling with which it was commenced in 1859 was all expended, and as much more required, before the work was half accomplished. And perhaps we ought not to be too much overcome with pity for the 20,000 unlucky Egyptians—natives of the house of bondage—pressed every month up to the year 1863 by their paternal Government to labour, wherever required, along the line of excavations. How persistent are Oriental customs! Here we have in modern days—the days of power-looms, of steam printing-presses, and under-sea telegraphs—a touch of the old tyranny, the taskmasters and the groanings, associated in our memories with the very earliest of Egyptian history.

The length of the Canal is one hundred miles, and the depth, as the French engineers inform us, is to be everywhere twenty-eight feet, so as to admit of the passage of large vessels. It must not be supposed that an excavation of the depth above mentioned has been dug all across the Isthmus, for the level of the country is, for the most part, below that of the Mediterranean; consequently, miles of banks have been thrown up across the lowest tracts to form a channel for the water. In looking at a section of the whole route from Saïd to Suez—seventy-five miles in a direct line from sea to sea—the great extent of depression is well seen. In Lake Timsah it is about eighteen feet; in the Bitter Lakes, which stretch to a length of twenty-five miles, it is in places twenty-six feet. On the other hand, the elevations, though comparatively few, are somewhat formidable of aspect, particularly at El Guier and at Chalouf. The more this section is studied, the more forcible becomes the impression on the mind that a strait thickly studded with islands, as Behring's Strait, once separated Asia and Africa, and that by the drift from the Nile and the desert the sea has been filled up around the islands, with the exception of the lake depressions, until the present Isthmus was formed. Hence the difference of soil. The islands rising boldly up: El Guier, ten miles long, layers of sand and hard clay; Serapeum, three miles long, a kind of shelly limestone; and Chalouf, six miles long, composed of hard clay, sandstone rock, and conglomerate, the severest part of the excavation. Geologists have remarked upon the fact that the fossils found in the Chalouf ridge are identical with those of the London basin and the hill of Montmartre, whereby we learn that parts of Egypt, France, and England are of the same age.

The mountains of Abyssinia are every year diminished in size and height by the enormous periodical rains which wash down millions of cubic feet of mud and clay into the Nile. Vast clouds of sand are blown into the great river in its long course through the deserts; and these transported matters, caught by the strong current setting in from the Straits of Gibraltar, have been drifted to the eastward during immemorial ages, with consequences which are well known to those who have studied the geography and geology of the Isthmus. Such a transformation will be recognised as one of the ordinary operations of nature, when we remember that in 4,150 years the valley of the Nile has been raised eleven feet by deposits from the periodical floods, and that the land of Egypt is supposed to have been at one time a gulf stretching from the Mediterranean towards the Mountains of the Moon, but which became silted up by slow accumulations.

We may now form a clear notion of the region through



MAP AND SECTION OF THE SUEZ CANAL

which the Canal has been cut. A low, sandy shore is generally washed by a shallow sea. At Southend the pier extends for a mile and a quarter into the sea before meeting depth enough for an ordinary steamer; and the long piers at Lowestoft and other places on our eastern coast present themselves as illustrations in point. So shallow is the sea off Port Saïd, that the mouth of the harbour had to be commenced two miles from the shore, for there only did the required depth of twenty-six feet of water begin. Less than this will keep out vessels of the largest class. The western pier, the one against which the whole weight of the powerful current falls, projects more than two miles into the sea; the one to the east is half a mile shorter. These breakwaters have been built up of concrete blocks weighing twenty tons each, made on the spot from the sand dredged out of the harbour mixed with hydraulic lime brought from Marseilles. Spaces were left between the blocks to be filled up by the seadrift; but though there have been great deposits of sand and mud outside the breakwater, the filling up of the gaps has not been so speedy as was anticipated, and heaps of sand which drifted through have had to be dredged out again. Of course, while money for payment is forthcoming, any number of dredging-machines may be employed; but can that process be depended on when enthusiasm shall have evaporated, and there is nothing but the prosaic work of letting ships in or out to animate the promoters? Will it always be possible to prevent the formation of such soft banks as that on which the "Prince Consort" and the "Royal Oak" grounded on their arrival to take part in the opening of the Canal?

There is something instructive in the operations which have so diligently been carried on at the mouth of the Tyne, where a passage through the bar is essential. To maintain this passage, eighteen feet deep only, more than four million tons of sand must be dredged out every year. This has been going on for ten years or more, and the channel is not yet secure.

Not only the harbour of Port Saïd, but the greater part of the Canal itself, has been formed by dredging; and this, in soft ground or through the sludge of Lake Menzaleh, was comparatively easy work. The mud raised from the bottom was spread along each margin of the newly-scooped-out channel; but it would not stay there, and for a time the prospect of maintaining an open channel seemed as hopeless as George Stephenson's first attempt to carry the Liverpool and Manchester railway across Chat Moss. No sooner was the Menzaleh mud deposited in its new position, than it either slipped back into its former bed, or squeezed the soft soil on which it lay into the channel. The dredgers were in despair over a task in which no progress could be made, until one day one of the labourers showed that if, instead of great heaps, a thin layer of the mud were spread and left to harden in the sun, it would not slip back. So layer by layer the mud was spread, the banks were built up, and a way for the Canal was opened through such slime as was used in ancient days for the making of bricks.

In the hard ground the "bondagers" dug with pick and spade, and carried away the loosened soil in baskets. But when they were supplemented by European labourers, powerful excavating machinery was employed, and the line of works presented as busy a spectacle as an English railway in course of construction, or the main drainage works in their progress towards Barking Creek across the Essex marshes. The slopes of the cuttings were alive with labourers and machines, by which the excavated earth was lifted and run off to a distance. The power of the digging-machines may be judged of from the fact that some of them could dig out 80,000 cubic metres of soil every month, and that on one occasion the quantity was 120,000. A dozen or two of machines working at this rate would soon make a big gap through the high grounds before them.

The lakes of water on the Isthmus may be regarded as Nature's contribution towards the success of the Canal; for in them the only labour required is to dredge a channel which will give a depth of twenty-eight feet. Moreover, they may be used as ports. This is especially the case with Lake Timsah, on the shore of which stands the newly-built town of Ismaïlia, the half-way stopping place for travellers on the Canal. Here anchored the flotilla during the progress of the opening, and the dark-skinned children of the Prophet were seen mingled with throngs of fair-complexioned Giaours in friendly rejoicings.

Ismaïlia is an important place, for it is the pumping-station of the fresh-water canal which was first made in order to supply the thousands of labourers with drink, and water for their works. On this pumping-station all the country between Lake Timsah and Port Saïd depends for its supplies of the precious element.

The hollow of the Bitter Lakes, six miles wide in the widest part, is believed to have been at one time connected with the Red Sea. The level of the water in these lakes has been brought up to that of the sea by a re-opening of the connection. In March of the present year, all preparations being complete, the water was admitted, and a great stream, pouring in from the Mediterranean and from the Red Sea, gradually rose upon the arid saline slopes of the deep and desolate basin. For some weeks the flow went on, until, as was estimated, two thousand million cubic metres of water had flowed in, and the level was established. The area of the lakes will be largely increased by this contribution from the two seas; and it will be interesting to watch whether in connection with the two canals—the salt-water and fresh-water—any modification of the climate of the Isthmus may be produced. Much has been said, too, about the loss that will take place by evaporation under the sun of Egypt: the amount is so great as to be almost incredible. This loss will have to be provided for; as also the effect of blowing sands, which will accelerate the tendency of the bottom to grow towards the surface, always observable in canals.

Up to the last moment predictions from various quarters have been heard that no big ships would ever effect the passage of the canal. But while we write these lines, telegrams from the East inform us that *L'Aigle*, the French yacht, with her Majesty the Empress on board, had got through, and was anchored in the Red Sea. From the same source we learn that the Peninsular and Oriental steamer *Delta*, drawing 15½ feet of water, had arrived at Ismaïlia from Port Saïd, but had touched ground a few times on the way. The Egyptian vessel *Lattif* attempted the passage, but for want of sufficient depth had to return; difficulties occurred with other vessels, and the banks of the Canal were much damaged.

But the Khédive has invested M. de Lesseps with the Grand Cross of the Order of the Osmanli, and the Emperor Napoleon has appointed him to the rank of Grand Cross of the Legion of Honour. We may therefore hope for the best in all that appertains to the Suez Canal, and that foreigners will believe that Englishmen are too ready to admire good work to feel jealous of the energetic hearts by whom it has been accomplished.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents.*]

The Meteor of November 6th

METEORS being in season just now, all facts respecting them will, I presume, be acceptable. The public have lately been treated to a great number of letters in newspapers descriptive of the remarkable meteor of Saturday, November 6th—perhaps I should rather say *a* instead of *the* remarkable meteor, because, from the discrepancies as to the time of the appearance and the differences in the description, I am inclined to believe that more than one meteor of unusual splendour was seen on that evening. I need hardly say how important it is to have observations of the visual direction of these bodies as viewed from stations widely separated from each other, because it is only observations of this kind which can afford data for judging of the distance of a meteor. In the hope of contributing information which may assist in clearing up this interesting question, I venture to add another letter to the many which have already appeared.

At five minutes before seven on Saturday evening, November 6th, while walking with my back towards the south, near the village of Rothbury in Northumberland, I was startled by a brilliant light behind me, and on turning I saw a magnificent meteor descending from the eastward at an angle of about 45° to the southern horizon. Its colour was a bluish-white, and it left a train which looked exactly like that of a large rocket, but which did not remain visible to my view for more than about fifteen seconds. The meteor did not appear to me to burst, although pieces seemed to separate from it before it expired. At the moment of extinction it was about 12° or 14° above the horizon, and its direction was then S.S.W. I am quite sure as to the time of the occurrence to within a minute, because, although I could not see to read my watch at the moment—a chronometer on which I can depend, and which I know was right—I hastened to the nearest light, about four hundred yards distant, where I ascertained that the time was one minute to seven, which, allowing about four minutes for walking the four hundred yards, would make the time of the appearance five minutes to seven. So far as I have seen, there is but one describer of this meteor whose record of the time exactly agrees with mine, and as it is incredible that two such unusual meteors should occur in the same minute, it is almost absolutely certain that he and I saw the same. My co-observer was the writer of a letter in the *Times*, signed J. A. Cayley, dated from the neighbourhood of Bristol, where he witnessed the phenomenon at a distance of two hundred and sixty miles from where I saw it in Northumberland. As viewed by him, it appeared to descend from the zenith to about 20° above the *western* horizon, while I, as already stated, saw it in the *south*. His description of the meteor differs from mine only in regard to the train, which is described as continuing visible to him for fifteen minutes, a difference which may be attributed to its being nearer and more overhead to him than to me.

I will not hazard even an approximate calculation of distance from the data I have given, but I confess my inability to reconcile the different angles under which this object was seen at opposite ends of a base-line having Bristol at one end and Rothbury at the other, with the supposition that its height did not exceed that which is ordinarily assigned to the atmosphere. At all events, if the atmosphere exists at the height of this meteor, it will be more attenuated than in the exhausted receiver of the most perfect air-pump, and it is difficult to conceive how air so rarefied can so oppose the flight of a solid body as to produce the intense ignition exhibited in a meteor. Yet it seems impossible to attribute the incandescence of these bodies to any other cause than the resistance opposed by the atmosphere to their prodigious velocity.

W. G. ARMSTRONG

Newcastle-on-Tyne, Nov. 22, 1869

Lectures to Ladies

No one can appreciate more heartily than I do the excellent article on "Lectures to Ladies" which appeared in NATURE No. II.; but I feel far from sanguine of success attending the efforts there referred to. If we put aside the impulse of dilettantism and the spirit of rivalry as against men, there will, let us hope, be left a very fair residue in the shape of love of learning, for learning's sake, as a reason for attendance; and it is only this pure love of learning which can make such lectures in the long run successful. It cannot, however, be such a love which brings to the lectures of the University College Professors, Lady Barbara, who sneers aloud when the lecturer wisely lays a sure foundation of elementary facts and ideas; or which carries to South Kensington the Hon. Miss Henrietta, who tosses her head when she finds the great Mr. Huxley paddling about in that common river the Thames, and treating his audience as if they were little girls at the Finsbury Institution.

I very much fear that the Lady Barbaras of the present generation are beyond redemption, and that many earnest men are wasting their strength in trying to win the minds of intellectual coquettes.

There is an order of women, however, having in their number, as I know full well, some of the brightest and best of the women of England, to whom such lectures would be as manna in the wilderness. To women struggling, as many of us are, to get their daily bread by the hard task of teaching, and in the struggle getting glimpses of the sweetness and the light of real knowledge, the chance of listening to real teachers would be an inestimable boon. These are the women to whom, it must be remembered, the early training of many children is entrusted; and if our children are to be properly trained, the teachers must first of all be faithfully taught.

Nearly all these women are practically shut out from the lectures both at South Kensington and University College, because none of the lectures are given in the evening.

At University College they don't pretend to care for such an audience. At South Kensington something is said about those engaged in teaching: a mere mockery; for how can any one who is hard at work all day go to a lecture in the forenoon? I trust, Sir, you will use your already powerful voice in urging, especially on our scientific teachers, the—to me it seems—great duty before them to help those who need and cry for help the most.

M.

NOTES

The three annual medals of the Royal Society have been awarded thus: The Copley Medal goes to M. Regnault, one of the first among the many living French physicists and chemists: one of the Royal Medals has been conferred on Dr. Matthiessen, distinguished for his chemical and physical researches; while Sir Thomas Maclear, the Cape astronomer, with whose valuable contributions to science all are doubtless familiar, carries off the other. The medals will be presented on the 30th instant, at the annual meeting of the Society.

We hear that Dr. Balfour Stewart, F.R.S., so well known for his many scientific researches, has resigned the appointment which he held under the Meteorological Committee. As the arrangements between the Meteorological and the Kew Committees are not well understood, we may mention that the exact appointment resigned is that of Secretary to the Committee, and Director of their Central Observatory.

All anxiety regarding the fate of Dr. Livingstone is, we are rejoiced to say, at an end. From a recent telegram we learn that in May last he was at Ujiji, on the east coast of Lake Tanganyika, in lat. 5° S. To this place his supplies had been sent. Burton gives the distance from the coast as 540 geographical miles, increased by the winding route pursued to 950 miles, occupying 150 days' march. It is the great mart for slaves and ivory and palm oil, and the most fertile place in that portion of Africa. The fair season lasts from May to September. While on this subject we would mention that the map which appeared in our last issue was drawn by the author of the paper, and did not emanate officially, as our expression might seem to indicate, from the Royal Geographical Society.

The following is an extract from a letter addressed by Mr. Lyon Playfair, M.P., to the honorary secretary of the City of London Middle-class School:—"As part of your freehold I observed some inferior houses the site of which would be admirable for chemical laboratories and scientific museums in relation to commerce. I should like to see built upon this site a building suited for these purposes, open to the school during the day, and to the working classes in the evening. No boy with such advantages need leave the upper classes of the school without being able to examine the various kinds of merchandise which he will meet with in his occupations, so far, at least, as would enable him to test chemically their relative excellences, or detect their adulterations. No boy need then leave the school without having had his physical and political geography copiously illustrated by objects of natural history, in their relation to the imports and exports, upon which the prosperity of the country so largely depends. The cost and maintenance of such a building as that indicated may be estimated at a sum of from 12,000*l.* to 15,000*l.* But what would this sum be to the great London corporations, which, by their recent public meeting, have shown their anxiety to co-operate in the advancement of technical education? Abroad we see much larger sums spent in the erection of mere chemical laboratories to advance the industrial education of the people. Berlin and Bonn have recently erected them at the expense of 50,000*l.* each, and Leipsic, I understand, at a cost of about 30,000*l.* The much smaller sum that I have indicated as sufficient for your wants might be subscribed in a single day by such wealthy corporations as the Goldsmiths', Grocers', Mercers', Haberdashers', Fishmongers', Drapers', Skinners', Merchant Taylors', Clothworkers', and Salters' Companies, and others with which you must be more familiar than myself. They have expressed themselves zealous and willing, and I am sure could not engage in a more profitable expenditure." Here is a fair challenge, which we hope will be fairly met. The benefit which would result from adopting Mr. Playfair's suggestion is simply incalculable.

At the Meeting of the French Academy of Sciences on the 15th inst., M. des Cloiseaux was elected a member of the Section of Mineralogy and Geology, in the place of the Vicomte d'Archiac.

The volume of the Memoirs of the Royal Astronomical Society about to be issued will consist of Lieut.-Col. Tennant's Report on the Total Eclipse of the Sun of August 17-18, 1868. It will be copiously illustrated with engravings of the various phases of the Eclipse. The volume owes much to the scrupulous care with which Mr. Warren de la Rue, in the author's absence, has superintended its printing and the enlargement of the photographs.

The American Government evince a great liberality in the encouragement they afford to scientific publications. It was thus that Dr. George Engelmann was enabled to produce the 72 exquisite plates which illustrate his paper on "The Cactaceæ of the Mexican Boundary Survey," a district which contains at least one-tenth of all the known species of cactus. There is another recent instance. Until 1867, the physical geography of the Californian peninsula may be said to have been unknown. In that year Mr. J. Ross Browne, Mr. W. M. Gabb, of the Geological Survey, and Dr. Von Lohr, of the School of Mines, Freiburg, made a scientific *reconnaissance*, with a corps of assistants, throughout the whole length of the peninsula. The account of their researches forms a valuable contribution to geographical knowledge, and will be found in Mr. Ross Browne's "Official Report on the Mineral Resources of the United States for 1868." The first correct map of the district, almost the whole of which was purchased cheap from Juarez by an American venture, the Californian Land Company, at a time when it was probable that Maximilian would be successful, was compiled from the labours of this party.

The first meeting of the Oxford Ashmolean Society for the present Term will be held on Monday next, when a communication will be made to the society by Professor Lawson, "On the Nature of Chlorophyll, and the changes it undergoes." Mr. Heathcote Wyndham will explain also a modification of Galton's Altazimuth for Geological Surveying. Certain specimens recently added to the University collections will be exhibited at the meeting.

We extract the following from the letter of a correspondent in Algeria:—"I was on the point of starting for Grand Kabylie, with the view of searching for ferns, &c., when one of those horrid tempests came on for which the N.W. point of the compass here is celebrated. It did great damage, and its effects at Oran were most disastrous. The magnificent new harbour recently finished there has been swept away as completely as a child's castle of cards, and, like the Temple of Jerusalem, not one stone stands on another. Great efforts were made to preserve it; the General Commanding the Provinces went down and sat before the waves in a chair, like Canute, with all the material of the engineer department, in the way of chains and tackle, around him. *Sa Grandeur* the Bishop came next, with bell, book, and candle, and blessed the sea; next came the Mahomedan Mufti with his Koran; but the waves laughed at them all, and toppled over the immense masses of concrete of which the breakwater was formed, like ninepins."

We have received the following from our Dublin Correspondent:—The newly-appointed Professor of Geology at Trinity College, Dublin—Dr. Macalister—commenced a course of lectures on the Invertebrates last week. Referring in his introductory lecture to the researches of Pouchet, Pasteur, Massalongo, and others, on spontaneous generation, he seemed to regard the proofs of its existence as now fully established. The examination for the Natural and Experimental Moderatorship has just been concluded: the gold medals were awarded to Lloyd, West, and Wilson, and the silver medals to Colles, Tweedy, Hart, Rainsford, Abridge, and MacIvor. The subjects selected by the first gold medallist were chemistry, botany, zoology, and palæontology. The librarianship vacant by the death of the Rev. Dr. Todd has not yet been filled. The candidates are the Rev. Dr. Dickson, F.T.C.D., and the Rev. Dr. Reeves. The former is perhaps the more popular candidate, as, in spite of the high position held by Dr. Reeves as an archæologist, it is felt desirable that the librarian of so important a library should take as great if not a greater interest in modern than in ancient books. The University of Dublin has established Examinations for Women. Two examinations will be held annually, one for senior, the other for junior candidates. The examination for junior candidates will be open to all who are above 15 and under 18 years of age; the examination for senior candidates to all who are above 18 years of age. A committee, nominated by the board of Trinity College, will appoint examiners, determine the times, places, and subjects of examination, and make an annual report to the board. The senior lecturer of Trinity College will exercise a general supervision over the conduct of all the examinations. Examinations will be held at any place where a ladies' superintending committee shall be constituted, and at least twenty candidates guaranteed to present themselves. An examiner will be sent to each place, who, in conjunction with the Ladies' Committee, will arrange the details of the examination. Every candidate presenting herself for examination will be required to pay a fee of twenty shillings, together with the local fee, the amount of which is to be determined by the local committee. No class lists will be published; but, after each examination, notice of the result will be sent to the home of each candidate. Special excellence in any subject will be notified on the certificate. For a certificate of honour, superior answering in the compulsory and two optional subjects will be required. The first examination will be held at some time between the 25th of March and the 15th of April, 1870. Further information can be obtained by application to the senior lecturer, Trinity College, or to the secretaries of the ladies' local committees. No head of any educational establishment is to be a member of a Ladies' Committee.

The Academy of Natural Sciences at Philadelphia have sent out the third part of Vol. VI. of their "Journal," a handsome imperial quarto which affords dimensions for ample illustrations. The part contains two papers—on the Distribution of Freshwater Fishes in the Alleghany Region of South Western Virginia, by Mr. E. D. Cope; and on shells, Unionidæ, Melindæ, &c., by the veteran Isaac Lea. The plates, numerous and well-executed, particularly the coloured representations of the fishes, exemplify at once the interest taken by the Academy in Natural History, and the painstaking of American artists. This large book is accompanied by the volume of "Proceedings" for 1868, in which we find papers and notices on more than fifty different subjects; and we gather from the annual report at the end of the volume, that the citizens of Philadelphia as well as the naturalists appreciate natural history, for during the year they visited the Academy's Museum to the number of 65,769 persons, and they have contributed 100,000 dollars towards the cost of a new building for the accommodation of the Academy and their collections. The library contains nearly 22,000 volumes, and, in common with the natural history collections, is continually increased by donations. Among those recently acquired were the large collections made by the Orton expedition to Equador and the Upper Amazon. We may fitly close this paragraph with a notice published by the Academy, that "the children of the late Augustus E. Jessup, wishing to carry out the intention of their father, pay to the Academy the sum of 480 dollars per annum, to be used for the support of one or more deserving poor young man or men, who may desire to devote the whole of his or their time and energies to the study of any of the Natural Sciences."

M. Elie de Beaumont has been elected vice-president of the Collége Français for the year 1869–70. M. Bastien has been appointed assistant naturalist to the chair of Pharmacy in the same institution in place of M. Pouchet.

The chair of Geology and Mineralogy of the Faculty of Sciences at Lyons is vacant; also that of Chemical Toxicology at the École Supérieure of Paris.

Our American friends intend holding an International Exhibition at New York in 1871.

Another edition of Hirt's Atlas of the three kingdoms of nature has been issued in commemoration of the Humboldt centenary.

Baron Claus von der Decken's Travels in East Africa has reached the third volume. The entire work, most exhaustive as it is in every particular, is expected to be complete in a year.

We are promised shortly "the Scientific Results of a Journey in Brazil," which contain Professor L. Agassiz's observations on the natural history, and an account of Mr. F. Hart's examinations of the physical geography and geology, of the region traversed by the well-known recent exploring expedition.

A geographical congress is to be held at Anvers, in August, 1870.

We believe that Mr. Charles Hamilton, well-known as the author of a work on Hunting in Southern Africa, and by his travels in Brazil, is about to undertake a scientific exploration of the Red River, and some of the Hudson Bay settlements, with a view to promote our knowledge of the zoology of the district.

We have received from Mr. Browning four stereograms of the planet Mars; a chart of Mars on Mercator's projection; and descriptive remarks on the stereograms by Mr. Proctor—and very interesting they all are. We are glad that Mr. Proctor, who seems determined to become the chartographer of astronomy, has taken Mars under his wing, and with Mr. Browning's aid, has brought a discussion of all the observations of modern astronomers—the lamented Dawes being first and foremost among them—to such a beautiful and practical ending.

The third fasciculus of the second volume of the "Archives du Musée Teyler" has just been published at Haarlem, in the same handsome style as the former parts. It contains papers, all by Dr. Van der Willigen, on subjects of much importance at present in optical and chemical science, as may be seen in the following list:—Sur la réfraction du quartz et du spath d'Islande; Sur la réfraction et la dispersion du flint-glass et du crown-glass; Les indices de réfraction des mélanges d'alcool et d'eau, et des mélanges de glycérine et d'eau; Les indices de réfraction de la benzine; Les indices de réfraction des dissolutions des chlorures de calcium, de sodium, d'ammonium, et de zinc, &c. Many of the results are given in a tabulated form which facilitates reference.

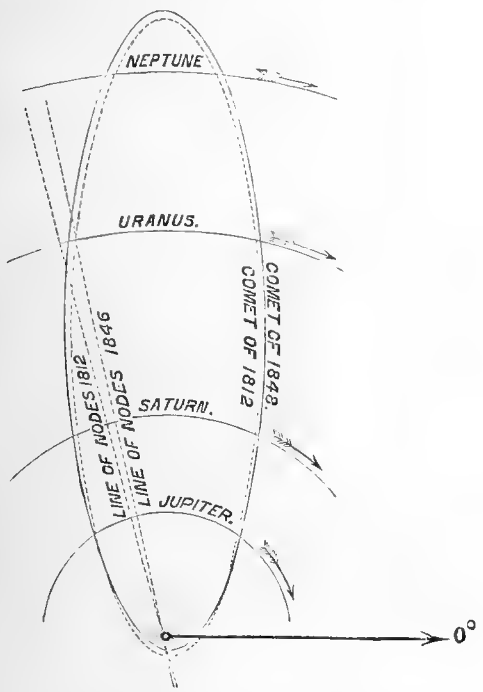
We understand that Mr. B. Loewy, well known from his connection with the Kew sun-observations, is engaged in publishing a collection of problems in physical science, with their solutions, which will embrace all branches generally required for the various public examinations of our Universities.

ASTRONOMY

Kirkwood on the Origin of Comets

THE recent important investigations of Hoek on the origin of comets may be said to have opened out quite a new field of astronomical research of the highest importance. We are glad, therefore, to lay before our readers an abstract of a continuation of the work which we owe to Professor Kirkwood, who has communicated it to *Sillimans' Journal.* Professor Kirkwood has dealt with the comets 1812, i. and 1846, iv.

The wonderful similarity of the elements of these, except in the longitude of the ascending node, is very remarkable. It is also noticeable that the longitude of the *descending* node of the latter is very nearly coincident with that of the *ascending* node of the former. These remarkable coincidences are presented to the eye in the following diagram, where the dotted ellipse represents the orbit of the comet of 1812, and the continuous curve, that of the comet of 1846.



Dr. Kirkwood remarks :—

"It is infinitely improbable that these coincidences should be accidental : they point, undoubtedly, to a common origin of the two bodies." And adds :—

"The theory of comets now generally accepted is that they enter the solar system *ab extra*, move in parabolas or hyperbolas around the sun, and, if undisturbed by the planets, pass off beyond the limits of our system to be seen no more. If in their motion, however, they approach very near any of the larger planets, their direction is changed by planetary perturbations; their orbits being sometimes transformed into ellipses. The new orbits of such bodies would pass very nearly through the points at which their greatest perturbation occurred : and accordingly we find that the aphelia of a large proportion of the periodic comets are near the orbits of the major planets. 'I admit,' says M. Hoek, 'that the orbits of comets are by nature parabolas or hyperbolas, and that in the cases when elliptical orbits are met with, these are occasioned by planetary attractions, or derive their character from the uncertainty of our observations. To allow the contrary would be to admit some comets as permanent members of our planetary system, to which they ought to have belonged since its origin, and so to assert the simultaneous birth of that system and of these comets. As for me, I attribute to these a primitive wandering character. Travelling through space they move from one star to another in order to leave it again, provided they do not meet any obstacle that may force them to remain in its vicinity. Such an obstacle was *Jupiter*, in the neighbourhood of our sun, for the comets of Lexell and Brorsen, and probably for the greater part of periodical comets; the other part of which may be indebted for their elliptical orbits to the attractions of *Saturn* and the remaining planets.

"'Generally, then, comets come to us from some star or other. The attraction of our sun modifies their orbit, as had been done already by each star through whose sphere of attraction they had passed. We can put the question if they come as single bodies or united in systems. This is the point I have undertaken to investigate. Since some time already I had felt the truth of the following thesis :—

"'*There are systems of comets in space that are broken up by the attraction of our sun, and whose members attain, as isolated bodies, the vicinity of the Earth during a course of several years.*'

"In the researches here referred to it has been shown by M. Hoek that the comets of 1860 iii., 1863 i., and 1863 vi., formed a group in space previous to their entrance into our system. The same fact has also been demonstrated in regard to other comets which need not here be specified. Now, the comets of 1812 and 1846, iv. have their aphelions very near the orbit of Neptune, and hence the original parabolas in which they moved were probably transformed into ellipses by the perturbations of that planet. Before entering the solar domain they were doubtless members of a cometary system. Passing Neptune near the same time, and at some distance from each other, their different relative positions with regard to the disturbing body may account for the slight differences in the elements of their orbits.

"*At what epoch did they enter the solar system?* The mean between the longitudes of the aphelia of the two comets is 271° 41′. Neptune had this longitude in 1775; the comet of 1812, in 1777; and that of 1846, in 1809. Now, with the known period of Neptune and the periods of the comets as determined by Encke and Peirce, we find (neglecting perturbations) that—

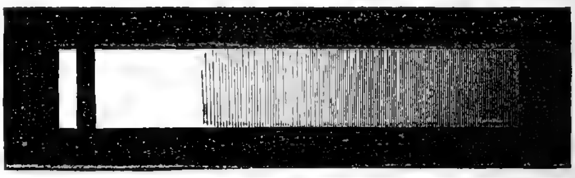
Neptune was in longitude 271° 41′ in the year 694 B.C.
The Comet of 1812 ,, ,, ,, 696 ,,
,, 1846, iv. ,, ,, ,, 696 ,,

It seems, therefore, that the three bodies were very nearly together about 695 years before the Christian era. It is consequently not improbable that the elliptical form of the two cometary orbits dates from this epoch."

BOTANY

Spectroscopic Examination of Diatoms

THE vegetable nature of the Diatomaceæ is now generally admitted, but if any further proof were needed we have it in marked results from the application of the spectroscope. Mr. H. L. Smith has been enabled to prove the absolute identity of *chlorophyll*, or the green endochrome of plants, with *diatomin*, or the olive yellow endochrome of the Diatomaceæ. The spectrum-microscope used was made by Browning, of London. Mr. Smith states that it is not at all difficult to obtain a characteristic spectrum from a living diatom, and to compare it directly with that of a desmid, or other plant. From about fifty comparisons of spectra, he concludes that the spectrum of chlorophyll is identical with that of diatomin. The spectrum in question is a characteristic one, and is figured below.



A very black, narrowish band in the extreme red, reading at the lower edge, which appears to be constant, about $\frac{7}{8}$ of Mr. Sorby's scale, is too characteristic to be mistaken. There are two other very faint bands, not easily seen, and somewhat more variable in position. The black band in the red is always present, and is remarkably constant in the position of its lower edge. In making comparisons of spectra it is of the utmost importance that the slit of the spectroscope should be absolutely in the focus of the achromatic eye lens. If this be not attended to there will be a slight parallax; and bands really identical in position, e.g., those of blood (scarlet cruorine), will not absolutely correspond when two spectra are formed, one from blood on the stage of the microscope, and the other from the same on the stage of the eyepiece.

The dark band of the chlorophyll spectrum is slightly variable in width—and the action of acids and alkalies sometimes causes a slight displacement, the former raising (moving toward the blue end) and the latter depressing. The endochrome of a diatom after treatment with acid is green, and the acid, in this case, produces scarcely any displacement of the band, which may be observed even in the dark reddish mass of the dead Diatomaceæ, almost identical in colour with the ferrous carbonate so often found in bogs where the larger diatoms are abundant; and what is more remarkable is, that the carbonate gives no absorption bands at all. As a general rule, alcoholic solutions of chlorophyll and diatomin have the band slightly depressed, reading 1 to $1\frac{1}{2}$ on the interference scale.—[Amer. Jour. Sci. and Arts.]

CHEMISTRY

Thallium Salts.—I.

MM. LAMY AND DES CLOISEAUX have resumed the study of the principal thallium salts, with the view of ascertaining their chemical composition, optical properties, and crystalline form (Annales de Chimie et de Physique, xvii. 310). The method of obtaining crystals was that which M. Deville has for a considerable time been in the habit of employing in his laboratory. A given substance is placed in contact with water, or some other solvent, either in a closed or lightly covered vessel, and exposed to the usual conditions of temperature of an inhabited apartment; if these do not suffice, the liquid is heated every day for an hour to a certain extent. In course of time, even the most microscopic crystals, if submitted to this process, become large, well-formed, and transparent.

The thallium in these salts was determined as iodide; a compound which from its sparing solubility (especially in water containing a little potassic iodide), as well as on account of its great specific gravity and crystalline character, is very well adapted to the purpose. The density of thallous *sulphate*, $Tl2SO_4$, is 6·603,* and its form a right rhomboidal prism, geometrically and optically isomorphous with ammonic sulphate. The crystals often appear unsymmetrical, on account of the unequal development of the different faces. The optic axes are wide apart; and the dispersion of the axes, as observed in oil, is feeble, with $\rho < \nu$. To the already known thallium *alums* may be added a mixed series, having the general formula:

$$(Al_2O_3 . Fe_2O_3)3SO_3 + (K_2O . Tl_2O)SO_3 + 24Aq.$$

Special attention is directed to one of these, which was obtained accidentally in the course of a lixiviation, and had the formula:

$$[(Al_2O_3)^{\frac{2}{3}}(Fe_2O_3)^{\frac{1}{3}}]3SO_3 + [(K_2O)^{\frac{3}{4}}(Tl_2O)^{\frac{1}{4}}]SO_3 + 24Aq.$$

Its colour is slightly yellow, and in solubility it much resembles potassic alum. After several solutions and recrystallisations, the whole of the iron is removed, and the following alum appears:

$$Al_2O_3 . 3SO_3 + [(K_2O)^{\frac{3}{4}}(TlO)^{\frac{1}{4}}]SO_3 + 24Aq.$$

Zinco-thallous sulphate—

$$Tl_2SO_4 + ZnSO_4 + 6H_2O,$$

which had already been described by Willm and Werther, belongs to the oblique rhomboidal prismatic system, and is geometrically isomorphous with ammonio-ferrous sulphate, potassic magnesio-sulphate &c. (as, indeed, Werther has shown); but it is optically different from these salts, both in orientation and in the sign of its acute bisectrix (negative).

Plane angle of the base	107° 5′ 14″
Plane angle of the lateral faces	99° 31′ 24″
Obliquity of the primitive prisms . .	106° 10′ 00″

The optic axes lie in the plane of symmetry. There is a strong proper dispersion with $\rho < \nu$. The *inclined* dispersion is weak, and only brought out by a difference in the brightness of the colours lying at the edges of the hyperbolæ of the two systems of rings. Thallous *nitrate*, $TlNO_3$, has the specific gravity 5·550, and occurs in right rhomboidal prisms of 125° 52′ (the corresponding angle for nitre is 118° 50′). The plane of the optic axes is perpendicular to the corresponding plane in potassic nitrate. The acute bisectrix is negative, and the dispersion of the axes considerable, with $\rho < \nu$. This salt had been already examined optically by Miller. In order to prepare thallous *carbonate*, (Tl_2CO_3), a saturated solution of thallous oxide in alcohol was exposed to air, in contact with a lamina of thallium. At the end of six months, very large crystals were obtained. These have an adamantine lustre, and a specific gravity 7·164; they belong to the clino-rhombic system, thus agreeing neither with plumbic, potassic, nor ammonic carbonate. Macles by hemitropy round one particular axis, are frequently observed. The plane of the optic axes is normal to the plane of symmetry, and almost exactly perpendicular to the base. The acute bisectrix is negative, and normal to the horizontal diagonal of the base; the double refraction energetic. The dispersion of the optic axes is well marked, with $\rho < \nu$; while the *horizontal* dispersion is, on the contrary, inappreciable. An attempt to prepare other thallous carbonates did not succeed.

Di-thallous *phosphate*—

$$2[Tl_2HPO_4] . H_2O,$$

is a very soluble salt, anhydrous at 200°, and crystallises in the rhombic system. Lustre vitreous. The dispersion of the optic axes is strong, with $\rho > \nu$. *Mono*-thallous *phosphate*—

$$TlH_2PO_4,$$

is very soluble in water, and readily crystallises in long voluminous needles which were submitted to the growing process already described. Density 4·723. The crystals may be referred to a clino-rhombic prism of 34° 59′, having a base only slightly sloping towards the lateral faces. Macles by hemitropy are common, giving rise to a re-entering angle of 176° 32′. The plane of the optic axes is parallel to the horizontal diagonal of the base. Acute bisectrix negative; horizontal dispersion indistinct; proper axial dispersion considerable. The *pyrophosphate*— $Tl_4P_2O_7$, crystallises in magnificent transparent prisms, soluble in water with partial decomposition, softened by a heat of 120°, and having the density 6·786. Its form is an oblique rhomboidal prism. The crystals are fragile, and have a somewhat adamantine lustre. The plane of the optic axes is normal to that of symmetry, and almost parallel to the base. While the horizontal dispersion is but slight, the proper dispersion of the axes is the greatest hitherto observed, as shown by the following means of measurements taken in oil and air, determining the apparent separation of the axes in air at 24°:

$$2E = 125° 48′ \text{ (red rays)}; 112° 30′ \text{ (yellow)};$$
$$2E = 89° 47′ \text{ (green rays)}; 52° 34′ \text{ (blue)}.$$

The *hydrous pyrophosphate*—

$$Tl_4P_2O_7 + 2H_2O,$$

separates from the mother-liquid of its predecessor. It is soluble in water with but little decomposition; but it is less stable at a high temperature than the anhydrous salt, which, on the other hand, it exceeds in the intensity of its vitreous lustre, its hardness and cohesion. The plane of the optic axes is normal to the plane of symmetry: the acute bisectrix negative and perpendicular to the horizontal diagonal of the base. Horizontal dispersion feeble; proper dispersion of the axes considerable, with $\rho < \nu$. The *ammoniacal thallous phosphate*—

$$3NH_3 . H_3PO_4 + 2NH_3 . H_2TlPO_4$$

is obtained by adding ammonia to the common phosphate, filtering to remove tri-thallous phosphate, and evaporating the mother-liquid. The crystals are very soluble in water, and completely isomorphous with ammonic phosphate. Their figure is that of a right prism with square base, elongated in the direction of the vertical axis, and terminated by an octohedron of 119° 50′. The double refraction is on a negative axis.

E. J. M.

* The temperature in this and following determinations is not given in the memoir.

PHYSICS

Pfaundler on the Regelation of Ice

THE fact observed by Faraday that two pieces of ice freeze together when brought into contact has met with various explanations. Helmholtz, for example, assumes that pressure is always at work in regelation; hence depression of the fusion point of the ice, and a cold sufficient to freeze a small portion of water in another part of the mass. Tyndall, on the other hand, admits the hypothesis of pressure only where it is actually observable; but, in other cases, explains the phenomena by a difference between the fusion-point inside and at the surface of the ice. Schultz has actually verified Tyndall's theory with water from which the air had been expelled.

Pfaundler has recently reconsidered this subject, and states the question as follows :—" Can a piece of ice, surrounded by water at 0°, preserve its shape if the water undergo no disturbance?" So far as we know at present, both weight and figure remain unchanged. Either, then, a part of the ice must melt, or a part of the water freeze, or both of these phenomena happen together. Such alterations involve certain mutations of the amount of heat contained in the surrounding water, or, at least, of the equilibrium of temperature in different parts of the liquid. Now, Clausius's researches into the constitution of liquids show that, in the case of individual molecules, such an equilibrium does not exist. Moreover, the conditions of molecular movement at the free surface of the ice are evidently different from those that are within. Hence, the piece of ice must grow, in certain places and in certain directions, at the expense of other of its parts; the increment at one spot corresponding to the decrement at a different one. Two pieces of ice in contact, or even in close proximity, are therefore likely to freeze together.

By freezing water in a flask under a pressure of a decimetre of mercury, solidification was invariably promoted; and it not unfrequently took place in a direction which was definitely related to what may be called a great circle of the flask.

Pressure, however, is not the only source of regelation. According to the author's theory, the phenomenon may result from any *molecular* disturbance.

PHYSIOLOGY

Coagulation of Blood

PROF. MANTEGAZZA cuts the Gordian knot of the cause of the coagulation of the blood, by attributing it to an action of the white corpuscles of the blood. Admitting Schmidt's theory of fibrin being the product of fibrinoplastin and fibrinogen, he puts forward the idea that normal plasma of the blood contains fibrinogen only, but that the white corpuscles have the power, when irritated, of emitting, or we might almost say secreting, fibrinoplastin, and thus of causing coagulation. The shedding of blood, any contact with foreign substances, are causes of irritation to the white blood corpuscles, and hence these things become in turn causes of coagulation. In support of this theory he insists on the complete coincidence of the power of coagulation with the presence of white blood (or lymph) corpuscles; and on the fibrinoplastic properties of tissues, such as cornea, &c., which abound in cells similar at least in nature to white blood corpuscles.—(Ann. di Chim., July 1869.)

THE *Journal of Anatomy and Physiology*, No. 5, November 1869, contains many valuable papers, *e. g.* on the Muscles of the Limbs of the Anteater, &c., by Professor Humphry; on the Movements of the Chest, by Dr. Arthur Ransome; on the Chemical Composition of the Nuclei of Blood Corpuscles, by Dr. Brunton; an abstract of Mr. E. Ray Lankester's Report on the Spectroscopic Examination of Animal Substances; and a long paper by Dr. T. A. Carter, on the Distal Communication of the Blood-vessels with the Lymphatics. The abstracts of Anatomy and Physiology are still continued with the completeness, accuracy, and critical intelligence which render them the best things of the kind to be found anywhere. Dr. Moore, the indefatigable translator from Dutch and other unusual tongues, supplies a translation of a very interesting paper by Engelmann, on the Periodical Development of Gas in the Protoplasm of Living Arcellæ. We may congratulate ourselves on the fact that the journal is able to make its way, in spite of the difficulties with which in this country Anatomy and Physiology have to contend.

SOCIETIES AND ACADEMIES

LONDON

Royal Geographical Society, November 22.—Sir Roderick Murchison in the chair. A paper was read detailing the results of an exploration of the new course of the Hoang-Ho, or Yellow River, made in 1868, by Mr. Elias, a young merchant of Shanghai, illustrated by a map, the positions in which had been carefully laid down from observations taken by that gentleman. The Chinese records, which are very copious in relation to this turbulent river, mention nine changes of its course, dating from 602 B.C. to the last in 1853, during which its outlet has shifted from 34° to 40° north latitude, the present being the former mouth of the river Tsa-Tsing, in the Gulf of Pecheli. The gradual elevation of the bed of the river caused the waters to press against the upper portion of the embankments, and as neither the dykes were raised, nor the bed deepened, the waters effected a breach in 1851, which was enlarged in the following year, till in 1853 the whole stream flowed through the mile-wide breach, in a north and east direction, leaving the old course dry. From this breach at Lung-Menkau, the river flowed in an ancient bed for 52 miles, but from that point a tract 96 miles long was inundated to a width of 15 miles. Ruined houses, broken bridges in the midst of the waters, and the remains of the banks of two canals forming the northern and southern channels, and here and there vast stretches of mud—were all that told of a once fertile and populous district. The deserted houses were in many cases silted up to the eaves by the alluvial deposit. In the dry season fifteen inches of water were scarcely found in some places. At Yushan the waters converged into the bed of the former river, Tsa-Tsing, now usurped by the Yellow River. The Grand Canal crossed this flooded district, but its banks have been carried away and its communication to the north destroyed. Proceeding down, a broken bridge of seventy arches obstructed the stream it could not span. For 150 miles a fertile and garden-like country was passed through, to which succeeded a barren treeless waste, except for the belt adjoining the river, which was fertile and cultivated; the ground, however, even with the growing crops, and in one place the town wall, was undermined and carried away piecemeal by the encroaching river. A barren, marshy tract of reeds, tenanted by wildfowl, extended for about twenty miles from the sea. This change of course, has, it is said, cost the Chinese Empire fifty to sixty millions of its population, the country lying on the old course having been ruined by the drying up of the river, and that in the new by the floods. The new course is unfit for navigation. Vessels drawing six feet of water might cross the bar, and proceed with difficulty to Yushan, but none beyond.—Captain Sherard Osborn remarked that in 1818 the Chinese Censors had called the Imperial attention to the impossibility of effectually controlling the Yellow River; although the expense of the maintenance of the dykes had been quintupled. The maladministration which had resulted in this calamitous change could not, therefore, be chargeable to British interference with China. British engineers, if employed, would soon restrain the Hoang-Ho within due bounds, and utilise its waters for navigation and irrigation. The Chinese water-systems were beginning to be better known, and he hoped that the Upper Yangtse would soon be opened to our steamers, for every forward footstep of Englishmen would, he believed, be a blessing to China.—Mr. Wylie, the first Englishman who saw the results of the diversion of the river from its course, gave an account of his crossing the river bed, then become a sandy highroad covered with passengers, and some particulars of a journey made by him to the sources of the Han River, in which he identified the pass described by Marco Polo as the White Horse Pass.

Royal Asiatic Society, November 15.—This was the first meeting of the Society after the recess. Mr. W. E. Frere occupied the chair. A paper was read containing an Account of the Bheel Tribes of the Vindhya and Satpura Ranges, by Lieut. J. Waterhouse. The writer starts from a popular tradition among those tribes, according to which the originator of the Bheel race is said to have been a vicious and deformed son of Mahadeva, who, on account of his having killed his father's favourite bull, was sent off to the jungle and uninhabited wastes, and told to cultivate where he chose. From this tradition, combined with the well-known legend of the Mahabharata and Shrî Bhagavata, by which the Nishadas are said to have descended from the Rajput king Vena, Mr. Waterhouse concludes that the Bheels had originally been settled in Judhpur and Marvar, but being driven thence by Rajputs, they emigrated southwards and established themselves in the mountains of Malwa and Candeish, in the Vindhya and Satpura ranges, and on the rugged banks of the Nerbudda and Tapti, where, protected by the natural conditions of the country, they had since dwelt, subsisting partly on their own industry, but mainly by inroads into the surrounding plains. Moreover, it was stated in the history of the princes of Judhpur and Oodeypur, that the Rajputs originally conquered their country from the Bheels. These are then divided by the writer into three classes—the Village, the Cultivating, and the Mountain Bheels. The first are said to consist of a few only, who, being scattered over the villages on the plains, were generally considered as honest and trustworthy, and often employed as the watchmen of their villages. The Cultivating Bheels continued to live peacefully in hamlets under the rule of their Turwees, though still preserving traces of a ruder and wilder state, such as was prevalent among the Mountain Bheels, who, owing to the difficult nature of the places inhabited by them, had never been altogether subdued, and subsisted only by plunder. Notwithstanding these distinctions the Bheels were one people, and their different tribes intermarried, though with certain restrictions. Polygamy was the rule with them, and it was by no means uncommon to find men with four or five wives. Many children were born, but a large portion died young, owing perhaps, in a great measure, to the malaria in the jungles, where fever and diseases of the spleen were common. The writer then proceeds to give a brief description of their dress and arms, their language and some of their customs. The Bheels are said to be very vindictive and to keep up feuds for many years, sometimes for generations. "Blood for blood" is their general maxim. The life of a man can, however, be made good to his relatives by payment in kind or money of 120 rupees, or of a woman of 60 rupees. In each community the head Bheel is called Turwee. His office is hereditary, and the police arrangements of the village are carried out by him. On the succession of any of the Rajput chiefs it is considered essential the head Bheel Turwee should make a mark with his blood on the forehead of the chief, without which ceremony no succession is considered complete. By the Rajputs intermarrying with the Bheel women, a race results called Bheelalahs, to which most of the chiefs of the Vindhya Bheels belong. In consequence of their descent from the Rajput conquerors they obtain superior rank and authority among the Bheels, though, as is generally the result of a blending of different races, they seem to combine the viciousness and roguery of the subdued Bheels with the arrogance and haughty bearing of the conquering Rajput. The reading of Mr. Waterhouse's paper was followed by a lively discussion, in which several of the members present took part, who, from a residence in the places occupied by the tribes in question, were able to supply some new and interesting particulars with regard to their dialect and manners. It was then announced by the chairman that the next meeting would be held on Monday the 29th inst.

Royal Horticultural Society. *Scientific Committee*, Nov. 16.—Mr. W. W. Saunders, F.R.S., in the chair. The Rev. M. J. Berkeley exhibited some walnuts, in which the outer rind was completely blackened and shrivelled by frost, the nut in the interior being unaffected. Mr. Glaisher remarked that during winter the temperature of the atmosphere was usually considerably warmer at a level of 20—50ft. above the surface than at a lower altitude. He expressed his opinion that the peculiar appearances presented by the walnuts were due rather to dryness of the atmosphere than to actual frost. Prof. Ansted called attention to the effect of wind in blackening the leaves on one side of a tree, while on the unexposed side they retained their green colour. The chairman stated that an illustration of this fact might recently have been seen in Somersetshire, where the trees for a distance of thirty miles or more were thus affected. Mr. A. Murray then alluded to a peculiar beetle preying on the foliage of orchids introduced from widely diverse countries, and pointed out many interesting facts. Dr. Masters, who spoke on the part of the sub-committee appointed to watch the progress of the plants in the experimental ground at Chiswick, exhibited a series of diagrams, showing in a graphic form the relative degrees of vigour exhibited by the plants at the various dates of observation, and the fluctuations in the intervals between them. Similar tables had been prepared, showing the amount of heat and rainfall during the entire period of observation, and the fluctuations in the intervals between each separate observation. The most striking results shown in the diagrams were as follows:—In almost every case the plants in the unmanured boxes were the least vigorous. The application of purely mineral manures was productive of little or no result in the case of the grasses, but was much more effective in promoting vigour in the case of the clovers. A striking contrast was exhibited in the case of almost all the twelve separate kinds of plants treated with ammonia salts, or with nitrate of soda respectively. It was shown in Dr. Masters' tables that almost invariably when the plants treated with ammonia salts manifested an increased degree of vigour, those treated with nitrate of soda showed a corresponding decrease. These contrasted fluctuations occurred at a time when the weather tables showed a high rainfall and a decreased temperature. Similar antagonistic results, but manifesting themselves at a later period, when the temperature was higher and the rainfall less, prevailed to a less extent in the boxes manured with a combination of mineral manures and nitrate of soda, and of mineral manures and ammonia respectively. Dr. Gilbert remarked that the experiments, as conducted this year, were serviceable rather as indications of what to avoid in the coming year, than for any immediate use at present. The soil made use of was too fertile, and in consequence the plants made undue growth. The contrasting conditions alluded to by Dr. Masters probably depended on variations in the relative power of diffusion of the several salts, and the range of the roots. Nitrate of soda was distributed with great rapidity. The ammonia salts were converted into nitrates before absorption by the plant, and were thus distributed at a lower depth. Dr. Voelcker corroborated Dr. Gilbert as to the necessity of caution in drawing general inferences from this season's experiments, and advised that in future the plants should be grown in pots, so as to be more under control, and less subject to disturbing influences. Mr. Glaisher alluded to the effects produced by the roots of plants in increasing the temperature of the soil, and suggested that a thermometer should be inserted into each of the seventy-two boxes. These thermometers, moreover, should be made with great care, and the mercury in all should be derived from the same source, so as to secure uniformity of expansion.—A report from Mr. Barron, on various experiments that have been carried on as to grafting on various stocks, was then read. The results had been very varied, and were of a very interesting character. In those cases where failure had resulted, the want of success was attributed to one or more of the following causes:—Imperfection in the mode of operating; the too advanced condition of the stocks or of the buds before the operation; the want of correspondence in point of time between the growth of stock and scion, &c. This report will be published *in extenso*.—A communication from Mr. Barber, forwarded by Dr. Hooker, relating to the culture of Aloes, was then read. The Chairman remarked that the rocky nature of the country in which Aloes grew was serviceable in preventing excessive or long-continued moisture. He had ascertained from Mr. Cooper that many of the Haworthias grew naturally closely environed by herbage, and that when this was eaten by the sheep the plants became unduly exposed to the sun, and died in consequence; hence the sheep were only indirectly injurious (not directly, as Mr. Barber had stated) by removing the herbage. Mr. Saunders in practice substituted a fold of thin paper or muslin for the grass, and thus tempered the light, to the great advantage of the plants.—A report from Mr. Moore on the experiments carried out at Chiswick with various chemical manures on variegated zonal and other *Pelargoniums*, with a view to ascertain the effect of the manures on the colouration of the leaves and the production of flowers, was then read.—A lengthy communication on the cultivation of Tea, by Mr. McPherson, was laid on the table, on which the secretary was instructed to report to a future meeting.—Dr. Masters exhibited, on the part of Mr. D. T. Fish, a sample of soil in which there was a thin layer of lime about six inches below the surface. This had evidently been put on as a top-dressing. Mr. Fish attributed the position of the lime beneath the surface to an annual superposition of a layer of carbonaceous matter on the surface, and to the decomposition of the roots. He advanced this view in opposition to that of Mr. Darwin, who attributes similar effects to the agency of worms. Dr. Voelcker remarked that lime so applied was always washed down gradually in the manner described.

Ethnological Society, Nov. 23.—Prof. Huxley, F.R.S., President, in the chair.—Dr. G. W. Leitner gave an account of his visit in 1866 to Ladak, Little Tibet, Kashmere, and the unvisited country of Ghilghit. He succeeded, by a new route crossing the Shingun and Maraug, in reaching Ladak six weeks before the usual passes were open. The Abbot of Pugdal—the Buddhist monastery where Csoma de Körös spent five years—agreed with him to secure the safe passage of any English or Hungarian traveller to Lassa; offering to give a near relative of his own as hostage for the safety of the visitor. The Punjab Government having commissioned him to obtain information respecting the Chilasi people, with a view of tracing a connection between them and the Darada, and the Hindu Olympus, the Kaylas, he crossed the frontier and penetrated into Ghilghit, four marches beyond any previous European travellers. Out of fifty, only two of his followers accompanied him to the country of the dreaded Dards. Dr. Leitner gave an account of the legends of this people, whom he judges to be a remnant of the most ancient Aryan stock, speaking a highly inflexional and perfect, though unwritten language, and preserving ancient mythologies and traditions of their origin. A singular exception to the Dard dialects is found in the Khajuna spoken by the Hunza people—the robbers of Kunjut—and Nagyr, which is like no other known language. Dr. Leitner has brought a large collection of Thibetan and Dard curiosities, and an intelligent Yarkandi, who as soldier and trader has traversed nearly all Eastern Turkistan: it is to be hoped that he may be given, during his stay in England, opportunities of learning something of our manufactures and commerce, so that he may carry back to Yarkand a good report of English power, and, we will add, of English hospitality and friendship, which will assuredly bear good fruit in the future conduct of the Yarkandis, who are already well disposed to receive and trade with our countrymen.

Entomological Society, November 15.—Mr. H. W. Bates, President, in the chair. The following gentlemen were elected: Messrs. French and Websdale as members; and Messrs. Barnes, Brown, E. M. Janson, O. E. Janson, Pearson, and Robinson, as subscribers. Exhibitions of insects were made by Messrs. F. Smith, Pascoe, Briggs, Davis, and Salvin; and the discussion which ensued thereon was participated in by the President, Messrs. Westwood, Wallace, Müller, Weir, Janson, McLachlan, Eaton, Wormald, Horne, Verrall, and Dunning. The following papers were read:—"New Genera and Species of *Coleoptera* from Chontales, Nicaragua," by the President. "Description of New Genera and Species of *Hispidæ;* with notes on some previously-described species," by Mr. J. S. Baly. "A Synopsis of the Genus *Clothilda,*" by Mr. Osbert Salvin.

Statistical Society, November 16. — A large body of Fellows assembled to hear the President, Mr. W. Newmarch, F.R.S., deliver his inaugural address, in which he reviewed the progress that had been made in statistical science since the foundation of the Society in 1834. He pointed out that at that time, with perhaps two or three partial exceptions, foreign Governments and Legislatures had not arrived at even the faintest notion of the desirableness of systematic statistical evidence, but that during the last twenty-five years this state of things had almost disappeared, and in several foreign states there were now in full activity statistical departments, and a vigour of statistical research by independent persons, that almost reduced the United Kingdom to a second place. Having enumerated the branches of inquiry in which this country had made most decisive and gratifying progress during the last thirty-five years, he stated that the following fields of statistical research seemed to him to require early attention:—1. The annual consumption per head among different classes, and by the nation as a whole, of the chief articles of food—corn, butchers' meat, tea, coffee, sugar, tobacco, wine, spirits, and beer. 2. The annual production in agriculture, minerals, metals, ships, and manufactures. 3. The comparative wages, house-rent, and cost of living in different parts of the country. 4. The total annual income and earnings and the total annual accumulations of different classes, and of the country as a whole. 5. The relative taxation of different classes in this country, as compared with the same classes in those foreign countries, the competition of which England has to understand and meet—carefully attending in the inquiry to the comparative merits of direct and indirect taxation. 6. The financial and economical cost and burdens entailed by extensive warlike armaments. 7. Periodical statistics of public hospitals in the metropolis and larger towns, with a view to the comparison of the efficiency and cost of the relief afforded in each. 8. Periodical returns of the income and operations of charitable trusts and endowments, for relief and education. 9. A statistical ascertainment of the numerical strength of the different religious churches and sects. 10. Statistical evidence of the cost to the community in sickness, excessive mortality, and poor-rate expenditure of defective dwellings, and sanitary regulations. 11. Statistical evidence of the gain to the community of instruction in popular schools in the rudiments of political economy, in the commoner industrial arts, and in military exercises. 12. Statistical evidence of the consequences in this country of the emigration from it. 13. Investigations relative to the advantages and cost to this country of the occupation of India. 14. An investigation on grounds of fact of the effect of commercial treaties, especially of the French Treaty of 1860. 15. A similar investigation of the consequences produced in the United States by the rigid system of protective tariffs. 16. And by the protracted suspension of specie payments. 17. Statistical inquiries relative to the effects produced in Europe on commerce, accumulation, invention, prices, and the rate of interest, by the gold discoveries in California and Australia. 18. Investigations of the mathematics and logic of statistical evidence; that is to say, the true construction and use of averages, the deduction of probabilities, the exclusion of superfluous integers, and the discovery of the laws of such social phenomena as can only be exhibited by a numerical notation.

DUBLIN

Royal Dublin Society, November 15.—The first meeting of the 139th session. Mr. W. Andrews read a paper on Deep-Sea Soundings. The author stated that he did not mean to refer to the deep-sea dredgings of the *Lightning* and *Porcupine,* but to some soundings of his own, extending to the moderate depths of eighty fathoms off the Blasquet Islands, on the west coast of Ireland, which were chiefly undertaken in connection with the subject of Irish fisheries. There was a rock near Dingle harbour known as the Barrack Rock to the fishermen, the position and bearings of which had never been determined, no notice of it appearing in the corrected charts of 1860. In July of the present year he had succeeded in taking its bearings and soundings; at low water and at extreme springs there are barely three fathoms covering the rock, and yet in the charts the soundings over it were marked at from 38 to 40 fathoms. The author then proceeded to notice some of the more interesting animals taken by him off the west coast of Ireland during this and other soundings; such as, *Paracyathus taxilianus* and *P. thulensis,* the animals of which he had examined [these two species were first described by Gosse, from single Scotch specimens, and the animals belonging to them were up to the present unknown]; *Eschara foliacea,* which he inclines to think is very different from the true *Millepora cervicornis,* which latter coral he took living in 39 fathoms off the little Skellig Island. [*E. foliacea* is not uncommon off the west coast of Ireland; but we suspect some strange mistake here, as *Eschara* is a well-known genus of the Polyzoa, whereas *Millepora* is almost without doubt a *Hydrozoön,* and has never yet been met with, we believe, north of a mean winter temperature of the sea of 66° F.]

Mr. W. F. Kirby read an account of a natural history excursion made to the continent of Europe in the spring of the present year, detailing his captures at Hilden, Basle, the Righi, St. Gothard, and the Val da Foin.—Mr. A. G. More read an account of an excursion, zoological and botanical, to Connemara, county Galway.—Mr. H. Grubb gave an account of a remarkable meteor seen in the heavens over Dublin between 6 and 7 o'clock, P.M., on the 6th inst.

Royal Irish Academy, November 8.—The first meeting of the present session. The council announced that Lord Talbot de Malahide had, owing to his intended sojourn abroad for the winter and spring months, sent in his resignation of the office of President; this resignation was, with regret, accepted. Of the names of those mentioned as likely to succeed to the post, that of the Earl of Dunraven would appear to be the most popular. A paper was read by Mr. G. H. Kinahan on the ruins of Ardillaun, county Galway.

The following numbers of the Transactions have been published since the session closed in July.—Mr. W. Andrews on *Ziphius Sowerbyi.* [Trans. vol. xxiv. Science, part X.]—Prof. W. King on the Histology of the Test of the class Palliobranchiata. [Trans. vol. xxiv. Science, part XI.]—John Casey, A.B., on Bicircular Quartics. [Trans. vol. xxiv. Science, part XII.]—Professor E. Perceval Wright, contributions toward a knowledge of the Flora of the Seychelles, with four plates. [Trans. vol. xxiv. Science, part XIII.]

MANCHESTER

Literary and Philosophical Society, November 2.—J. P. Joule, LL.D., F.R.S., &c., President, in the chair. William Boyd Dawkins, M.A., F.R.S., and Thomas Edward Thorpe, Ph.D., were elected ordinary members of the Society. Professor H. E. Roscoe, Ph.D., F.R.S., presented a paper on a new Chromium Oxychloride, by T. E. Thorpe, Ph.D., assistant in the laboratory of Owen's College. When chromyl dichloride, CrO_2Cl_2, prepared by heating a mixture of potassium dichromate, sodium chloride, and sulphuric acid, is maintained at a temperature of 180°—190° C. in a sealed tube for three or four hours, it is almost completely converted into a black solid substance, and on opening the tube when cold a considerable quantity of free chlorine escapes. By exhausting the tubes containing the liquid chloride before subjecting them to heat, the author ascertained that chlorine was the only gaseous product of thi decomposition. The black compound invariably contained mor or less of the liquid chloride which had escaped decomposit on; the greater part of this was easily expelled on gently heatin the mass after opening the tube. In order to free it completely from the latter body the black substance was transferred to a clean tube, and heated to 120° C. (*i.e.* about 2° above the boiling point of chromyl dichloride) in a current of dry carbonic acid gas until its weight appeared constant. A determination of the amount of chlorine contained in the volatile portion showed that it was simply chromyl dichloride which remained undecomposed. The solid substance, dried in the manner above described, appeared as a black uncrystalline powder, which, when exposed to the air, rapidly deliquesced to a dark reddish brown syrupy liquid, smelling of free chlorine. When thrown into water it quickly dissolved, forming a dark brown solution, which, on standing, also evolved chlorine. In nitric acid solution hypochlorous acid appeared to be produced. In strong hydrochloric acid the substance dissolved with a dark brown colouration, and on boiling the solution chlorine was evolved, the liquid became greenish yellow, and ultimately changed to the dark green colour, peculiar to a solution of chromium sesquioxide in hydrochloric acid. When thrown into dilute ammonia, chromic acid was dissolved, together with all the chlorine, and a precipitate was formed, possessing the properties of the chromate of chrome sesquioxide ($Cr_2O_3CrO_3$) described by Storer and Eliot. Upon this decomposition is based the method which the author employed for the estimation of the amount of chlorine contained in this body. The weighed quantity of the substance was treated with very dilute ammonia, the solution boiled for a few minutes, filtered, the precipitate well washed by hot water, an excess of nitric acid added to the filtrate, and the chlorine precipitated by the addition of silver nitrate. Two determinations of chlorine, carried out in this manner on preparations made at different times, gave 21·06 per cent. of chlorine as the mean. In order to determine the amount of chromium, a weighed portion of the substance was repeatedly heated with strong hydrochloric acid on a water-bath until the evolution of chlorine entirely ceased; the solution was then diluted with water, heated to boiling, ammonia added in slight excess, and again boiled until the supernatant liquid appeared perfectly colourless. The precipitated chrome sesquioxide was then filtered, dried, and weighed. The mean of two determinations indicated 48·91 per cent. of chromium. These results come very near to the percentage composition calculated for the empirical formula $Cr_3O_6Cl_2$. In conformity with the analytical results, the new oxychloride may be regarded as a compound of chromous chloride with two equivalents of chromium trioxide, and represented by the formula $CrCl_2 2CrO_3$, analogous to the formulæ assigned by Péligot to a series of chlorochromates. Experiment, however, led the author to believe that the constitution of his chromium chlorochromate, and of the salts described by Péligot, is not correctly represented by such formulæ, and in his paper he gives elaborate structural formulæ, which seem to him to agree better with experimental facts, and to show the relation of these compounds to chromyl dichloride.

PARIS.

Academy of Sciences, November 15.—M. E. Becquerel communicated the fifth memoir of his researches upon the luminous effects resulting from the action of light upon bodies, containing his investigation of the influence of the waves of light of different refrangibilities. His paper, which is of the greatest interest and importance to physicists, describes his experiments upon the behaviour of a number of phosphorescent bodies in various parts of the spectrum. No idea of its contents could be given in a short abstract, but we shall probably revert to it on another occasion.—In a note on "The Explosions of Bolides and the Falls of Aerolites which accompany them," M. Delaunay suggested that the explosion of a bolide is caused by the pressure of the atmosphere in front of it taking advantage of any irregularities in the structure of the body, the latter being probably, in many cases, caused or increased by the influence of the great superficial heat. The same atmospheric pressure, in M. Delaunay's opinion, stops the onward motion of the detached fragments, which then fall to the ground. The black crust of the surface of aerolites was ascribed by the author to the passage of the fragments at the moment of their being detached through the compressed and heated air. General Morin remarked upon the compression of the air in front of projectiles and below falling bodies.—M. Chapelas presented a note on the meteors of November 1869, in which he stated that on the 12th and 13th of this month the number of meteors observed was—on the 12th, 6·8, and on the 13th 24·8, per hour. The maximum occurred in the early part of the night.—A notice of the partial explosion of a bolide by M. J. Silbermann was communicated. This meteor was observed on the 11th November, at 10·55 p.m., in the constellation of Ursa Major. It descended obliquely towards the horizon N.N.E. of Paris, and passed through a space of about 34°. Its trajectory, at first nearly straight, soon became undulated between the stars ψ and ω, *Ursæ Majoris;* its rapidity of movement diminished considerably, and a violent explosion took place, the apparent volume and brilliancy of the body having previously increased greatly. After the explosion it continued in a straight course for some distance. The explosion was very brilliant, and sparks were scattered in all directions. The author concluded that this explosion was only partial. M. H. Lartigues, who also observed this meteor, spoke of it as having disappeared after dividing into fifteen or twenty fragments. He described some of these as coloured, which was denied by M. Silbermann; and the latter gives the meteor a duration of at most $1\frac{3}{4}$ seconds, whilst according to M. Lartigues it was visible for four seconds.—M. H. Sainte-Claire Deville presented the correction of an error in the formulæ for calculating the co-efficients of dilatation in some of his memoirs.—M. E. J. Maumené communicated some facts observed with regard to inverted sugar. The author stated that inverted sugar consists not of equal quantities of glucose and levulose, as supposed by Dubrunfaut, but of 12·14 of the former and 87·86 of the latter. Crystals of glucosate of sodium-chloride obtained from inverted sugar, presented the same composition and primitive crystalline form as crystals obtained from diabetic sugar, but their solution effected what M. Maumené calls the *deversion* of the rotatory power in an hour and three-quarters, whilst the solution of the same compound prepared from diabetic sugar requires seven hours to produce the same effect. The author also remarked upon some other points connected with inverted sugar and the glucosate of sodium chloride.—Of two geological papers presented to the meeting, the first was by Mr. Gaston Planté on "The Lower Lignites of the Plastic Clay of the Paris Basin." The author described a section near Meudon, where the lower lignite beds had been exposed. It showed in descending order—(1) the lower beds of the *Calcaire grossier;* (2) a bed of plastic clay with a black lignitiferous vein (the upper lignite bed); (3) a red marbled clay bed; (4) a dark clay bed containing lignites (the lower lignite bed); and (5) conglomerate. The lower lignite beds furnished parts of the lower jaw of *Crocodilus depressifrons* (Blaino), and a femur belonging to the same species; two vertebræ, probably of *Coryphodon;* and the lower extremity of a bone, probably the humerus of a mammal, having the whole of the osseous tissue converted into gypsum in small crystals. The bed contained numerous coprolites of crocodiles. The subjacent conglomerate furnished numerous fossils, including teeth and fragments of crocodiles and mammals, portions of tortoises, and scales of *Lepidosteus.* The teeth of mammalia appear to indicate the genera *Coryphodon, Palæonictis,* and *Pachynolopyus.*—The second geological paper was by M. E. Guignet, and treated of the chemical composition and formation of the beds of the great oolite and forest marble of the Haute Marne. The author discussed the distribution of these formations and the influence exerted by their presence upon agriculture.—M. Croullerois presented a note on a "Theorem of Electro-Dynamics and the Explanation of an Electrical Phenomenon;" and M. Milne Edwards four notes on some zoological observations made in his laboratory at the Museum.—In the first of these, M. Jobert described the structure and anatomical relations of the nasal glands in birds; the second, by M. Oustalet, contained a minute description of the respiratory organs in the pupæ of dragon-flies; the third consisted of observations on the salivary glands of *Myrmecophaga tamandu,* by M. J. Chatin; and the fourth was an anatomical and zoological investigation of the species of the genus *Equus* allied to the *Hemione,* by M. George.—A letter from Mr. A. Mayer, accompanying his photographs of the late total eclipse of the sun, was communicated by M. Delaunay.—M. E. Mathieu presented a memoir on the equation with partial differences of the fourth order $\Delta \Delta u = 0$, and on the equilibrium of elasticity of a solid body.—A portion of a letter from M. E. Duclaux was read, in which he announced that by exposing the eggs of silkworms to cold in August, he had caused an early development of the embryos, which were hatched in November.

—M. E. Prillieux described some experiments by which he has demonstrated that etiolated plants acquire their healthy green colour more rapidly when shaded than when exposed to the direct rays of the sun.—M. L. Colin communicated a note on the etiology of intermittent fevers, or "telluric intoxication," in which he ascribed them entirely to the toxical action of the soil, and declared that residence in large cities has a remarkable prophylactic effect.—Several other notes, of which only the titles are given, were read.

VIENNA

Imperial Academy of Sciences, October 21.—A memoir was communicated from Dr. W. F. Gintl on Ratanhine and its Compounds.—Dr. F. Steindachner presented a report on a collection of fishes made by Baron Ransonnet, at Singapore. The collection contained 60 species, some of them of particular interest, as having been previously obtained only from Japan or Eastern Africa. Four species were described as new, belonging to the genera *Platyglossus* (2), *Pseudochromis*, and *Gerres*.—A memoir, on the origin of the fatty oil in the olive, by M. C. O. Harz, was presented, in which the author states that at first this secretion does not possess the properties of a fatty oil, but its constituents are surrounded by a membrane, and therefore represent true secretion-cells, until the approach of maturity. These secretion-cells are not simple vesicles, but contain numerous daughter-cells, which, with the membrane of the mother-cell, all finally become converted into oil. The presence of the membrane is best demonstrated by treatment with Miller's Salt solution of aniline and chloriodide of zinc successively; the membrane acquires a fine dark-blue colour.—The table of meteorological and magnetical observations at the Central Observatory for the month of September was presented.

November 4.—M. F. Maly communicated a memoir entitled Theorems upon Straight Lines in Space.—Dr. Fitzinger presented the concluding part of his memoir on the cynopterine family of bats; and Dr. A. Boué made some remarks on the geography of the basins of the Drin and Vardar in North Albania and Macedonia.

November 11.—Prof. Lang communicated a memoir describing an experimental investigation of the velocity of light in quartz. Quartz, unlike other uniaxial crystals, possesses a doubly refractive power in the direction of its longitudinal axis. The author has already stated theoretically that in quartz there is no ordinary undulation, and even the extraordinary undulation changes according to a different law from that prevailing in the ordinary uniaxial crystals. His present paper contains the observational proof of this theoretical result. Dr. C. Jelineck reported upon a self-registering thermometer, constructed by M. Hipp, of Neuchâtel. Dr. F. Steindachner presented the first part of his ichthyological report upon a journey to Senegambia. It referred to the brackish-water fishes of the Senegal, and contained descriptions of 21 species, most of which are among the greatest rarities in European museums, and several of them are only known from the Guinea coast. The species belong to the families *Percidæ*, *Pristipomatidæ*, and *Carangidæ*. The author stated that *Otolithus senegalensis* is identical with *Pseudolithus typus* (Bleek.), *Pristipoma macrophthalmum* (Bleek.) with *Larimus auritus* (Cuv. and Val.), *Trachynotus myrias* and *maxillosus* with *T. goreensis* (Cuv. and Val.), and *Trachynotus goreensis* (Bleek.) with *T. ovatus* (Lin.), and that *Pristipoma Rangii* (Cuv. and Val.) is only a young form of *P. suillum* of the same authors.—Prof. Ditscheiner communicated a note upon the dispersion of the optic axes in rhombic crystals, in which he showed that both the true and the apparent angle of the optic axes may be represented by Cauchy's dispersion formula:—

$$\frac{\phi}{2} = A + B\frac{1}{\lambda^2}$$

as a function of the wave-length λ. The table of observations for the month of October, at the Imperial Central Institution for meteorology and terrestrial magnetism, was communicated.

BERLIN

German Chemical Society, November 8.—The following papers were read.—Schultsen and Nenky on the formation of Urea in the Body.—Liebreich on an Antidote against Strychnia.—Oppenheim on Iodo-bromide of Mercury.—Baeyer: Remarks on Thomsen's Criticism of Hermann's Calculation of the Heat of Combustion.—Hoffmann on some Derivatives of Sulphuretted Ureas.—Von Somaruga on Cresylopurpuric Acid.—Weidel on Sandal-wood.—Weselsky on Double Cyanides.—Thomsen (1) on the Preparation of the Hydrate of Chloral; (2) on Selenious and Selenic Acids.—Henry on Ethylated Derivatives of Alcohols and of Polyatomic Acids.—Henry on the Preparation of Pure Iodine from Iodide of Mercury.—Henry and Radzicewsky: Correction of a Former Note on Paratoluidine.—Friedel: Scientific Correspondence from Paris.—Merz and Weith on a new method of forming Triphenylated Guanidine.

PHILADELPHIA

Academy of Natural Sciences, May 4.—A paper entitled "A Review of the Species of Plethodontidæ and Desmognathidæ," by E. D. Cope, was presented for publication.—Mr. J. H. Redfield stated that on the 22nd of April, in company with Mr. C. F. Parker, he had visited Cedar Bridge, Ocean County, New Jersey, in search of *Corema Conradii*. This plant occurs in Newfoundland, on islands near Bath, Maine, at Plymouth, Cape Cod, and near Islip, Long Island, and was first discovered at Cedar Bridge by Prof. S. W. Conrad. This locality was visited by Dr. Long about 1835, and carefully indicated by him in Ann. N. Y. Lyc. Nat. Hist. iv., 83, so that there was no difficulty in finding the precise points mentioned; but Mr. Redfield was sorry that no trace of the plant could be found there; and it has doubtless been eradicated by animals or by unscrupulous collectors, or has been otherwise unable to maintain its foothold in "the struggle for existence." The vicinity also was carefully examined, but without success. The plant is said to have once existed near Pemberton Mills, New Jersey; but as that neighbourhood is now entirely under cultivation, there is no evidence that the *Corema Conradii* now exists south of Long Island. If it is again to be discovered in New Jersey, it will probably be in the wide sandy waste a few miles west of Cedar Bridge, near the boundary between Burlington and Ocean counties, where a succession of elevated ancient ocean beaches offer conditions similar to those of Cape Cod.—Prof. Cope exhibited bones and teeth of a large extinct Chinchilla of the island of Anguilla, West Indies, *Amblyrhiza inundata;* and with them teeth of a second and new species, which he called *Loxomylus longidens.* It was also allied to the Chinchillas, and of large size. They were accompanied by a shell implement of human manufacture, which was (so far as discovery in earthy matrix, the colour, &c., were evidence) of the same age as the Rodent.

May 11 and 18.—The following papers were presented for publication:—"Further notes on Microscopic Crystals"; by Isaac Lea, LL.D.—"Sexual Law in the Conifera"; by Thomas Meehan.—"An attempt to ascertain the average weight of the brain in the different races of mankind"; by Joseph Barnard Davis.

June 1.—Prof. Cope exhibited some interesting specimens of extinct reptiles; one of these was the cranium, minus a portion of the muzzle of a gavial, from the New Jersey Greensand, previously described under the name of *Thoracosaurus brinispinus*, but which this specimen demonstrated to belong to another genus, since it did not present the lachrymal foramina of the former. He applied the name *Holops* to it, and stated that he had evidence that *Crocodilus tenebrosus* Leidy, and probably *C. obscurus* L. also belonged to it. He also exhibited drawings, with measurements of portions of the limbs, of a very large Dinosaur, in the collection of Dr. Samuel Lockwood, of Keyport, Monmouth county, New Jersey. It was discovered by this gentleman in the lower cretaceous clays on the shores of Rassitan Bay. It consisted of the extremity of the tibia, with astragalus and fibula. He said it indicated the second genus of his suborder Symphypoda, and was thus allied to Compsognathus, differing in the remaining indication of suture between astragalus and tibia, which disappeared in Compsognathus. The astragalus thus entirely anchylosed was also confluent with the calcaneum, forming a continuous condyloid surface for the tibia. In an anterior projection externally, the extremity of the fibula reposed by a condyloid extremity, the shaft lapping over the outline of the tibia. This demonstrated what he had already stated, that the fibulæ of Iguanodon and Hadrasaurus had been reversed. The length of the fragment was sixteen inches, the fractured section was a transverse oval, the medullary cavity nearly filled with cancellous tissue. The transverse width of the extremity 12 in.; oblique diameter 14 in. This form he called *Ornithotarsus immanis*, and placed it between Hadrasaurus and Compsognathus. It indicated one of the most gigantic of the Dinosaurs yet discovered. He made some observations on a fine fragment of the muzzle of a large Mosasauroid, which pertained to a cranium of near five feet in length. The pterygoid bones were separated from each other, and support nine teeth. A peculiarity of physiognomy was produced by the cylindric prolongation of the premaxillary bone beyond the teeth, and a similar flat prolongation of the extremity of the dentary. He referred the species to *Macrasaurus* Owen, under the name of *M. pririger*. The specimen he stated belonged to Prof. Agassiz, who obtained it from Western Kansas, probably from the No. 3 of the Upper Cretaceous of Hayden. The following paper was presented for publication:—"Description of new Carboniferous Fossils from the United States"; by F. B. Meek and A. H. Worthen.

June 8.—The following paper was presented for publication: "On the production of Bractæ in *Larix*"; by Thos. Meehan.

June 22.—The following paper was presented for publication: "Notice of certain obscurely known species of American Birds, based on specimens in the museum of the Smithsonian Institution"; by Robert Ridgway.

June 29.—The report of the Biological and Miscroscopical Section was presented, and referred to the Publication Committee. On permission being granted, Mr. Warner spoke upon the mathematical representation of organic forms. Such limitations, he said, might seem to narrow the field of research into the physical causes of organic forms, and perhaps furnish the suggestion of a rational theory of these causes. If no other advantage were desirable from investigations of this kind, they might, he thought, be useful for description and classification. He exhibited a representation of the longitudinal section of an egg by a curve which he called the hyper-ellipse, and of the section of an embryo by another curve, which he termed a deformed lemniscate. Of the egg curve he said that it very closely resembled an ideal section of an egg, taken from a standard modern work. Of the curve representing the embryo he said that it not improbably marked the boundary of matter lying within it in a different state of temperature, density, or tension from the matter lying without. These representations were verified by the members present. The speaker expressed the intention of making these representations the subject of a future paper, in which he would give drawings and formulæ.

July 18.—Mr. Thos. Meehan presented leaves of the peach and cherry, and said it had fallen to him to point out that the leaf-blades of plants were developed in proportion as vigorous vitality was released, and that they were adherent or decurrent in proportion as vigorous vitality was thoroughly developed in the central axis or stem. By following out the same line of observation he had discovered the law which governed the production of sexes in plants, and he now wished to call attention to the operation of the same cause in the production of glands on the leaf-stalks of the peach and cherry. A careful examination of the gland-bearing variety of either of these would show that these glands were simply germs of the cellular matter which formed the leaf-blade. They might be seen in every stage of development, from dense full globes on the petioles to very small dots on the apex of the tolerably well-expanded matter, and it would be further seen that in proportion as vitality was weak were these germs and glands developed. Leaves from the shaded centre of the tree, or from shoots weak or enfeebled from any other cause, produced glandless leaves, while the stronger the shoot the stronger and more numerous were the glands or undeveloped parts. Remembering that these glands were but undeveloped leaf-blades, and that it had been previously proved by the author that plants developed these less freely in proportion to a vigorous axial or stem growth, it should necessarily follow that a weakened vitality would be indicated by an absence of glands. That this was so in the cases referred to, the weak and glandless leaves showed. The author had had a very remarkable confirmation of these recent physiological discoveries. Many varieties of peaches have no glands, and these had been found by the growers of southern Illinois, as he was informed by Dr. Hull, of Alton, in all cases to be the first to succumb to diseases or unfavourable circumstances. It was very seldom that the developments of science and untutored observations went along together, and so thoroughly accorded. To the author it was one of the most interesting facts he had met with in support of his theory, that the degree of separation of the leaf-blade from the main stems was wholly a question of vitality.—Mr. Meehan exhibited some fibre obtained from Mr. Roezel, of Vera Cruz, which was finer and stronger than that furnished by the "Ramie." Mr. Roezel obtained it from a plant which he had found in the Alleghanies, and which he believed to be a new species of Boehmeria. Mr. Meehan had, however, since found it abundantly along the Missouri River, and it proves to be only *Urtica purpurascens*, Nuttall.

EDW. D. COPE, *Corresponding Secretary.*

DIARY

THURSDAY, NOVEMBER 25.

ROYAL SOCIETY, at 8.30.—Preliminary Report of the Scientific Exploration of the Deep Sea in H.M. surveying vessel *Porcupine*, during the summer of 1869, conducted by Dr. Carpenter, V.P.R.S., Mr. J. Gwyn Jeffreys, F.R.S., and Prof. Wyville Thompson, LL.D., F.R.S. (conclusion). Spectroscopic Observations of the Sun; No. 5: J. N. Lockyer, F.R.S. Researches on Gaseous Spectra in Relation to the Physical Constitution of the Sun, Stars, and Nebulæ. Note 3: Dr. Frankland, F.R.S., and J. N. Lockyer, F.R.S. And other papers.

SOCIETY OF ANTIQUARIES, at 8.30.—Ancient British Barrows of Wiltshire and the adjacent counties: J. Thurnam, M.D., F.S.A

ZOOLOGICAL SOCIETY, at 8.30—Notes on some Spiders and Scorpions from St. Helena, with descriptions of new Species: Rev. O. P. Cambridge. On a small collection of Birds from the Tonga Islands: Dr. O. Finsch and Dr. G. Hartlaub.

MATHEMATICAL SOCIETY, at 8.

LONDON INSTITUTION, at 7.30.—Architecture: Prof. R. Kerr.

PHILOSOPHICAL CLUB, at 6.

FRIDAY, NOVEMBER 26.

QUEKETT MICROSCOPICAL CLUB, at 8.

SATURDAY, NOVEMBER 27.

ROYAL BOTANIC SOCIETY, at 3.45.

MONDAY, NOVEMBER 29.

INSTITUTE OF BRITISH ARCHITECTS, at 8.

INSTITUTE OF ACTUARIES, at 7.—Translation by Mr. Bumsted of "Suggestions for a Law to regulate the Calculation and Investment of the Reserve in Life Assurance Companies:" Herr Hopf.

MEDICAL SOCIETY, at 8.

ROYAL ASIATIC SOCIETY, at 3.

LONDON INSTITUTION, at 4.—Elementary Physics: Prof. Guthrie.

TUESDAY, NOVEMBER 30.

ROYAL SOCIETY, at 4.—Anniversary.

INSTITUTE OF CIVIL ENGINEERS, at 8.—Renewed Discussion upon Mr. Gandard's paper on the Strength and Resistance of Materials. On the Public Works of the Province of Canterbury, New Zealand: Mr. Edwd. Dobson, Assoc. Inst. C.E.

ANTHROPOLOGICAL SOCIETY, at 8.—The Shina People (described for the first time): Dr. G. W. Leitner.

WEDNESDAY, DECEMBER 1.

PHARMACEUTICAL SOCIETY, at 8.

OBSTETRICAL SOCIETY, at 8.

THURSDAY, DECEMBER 2.

LINNEAN SOCIETY, at 8.30.

CHEMICAL SOCIETY, at 8.30.

BOOKS RECEIVED

ENGLISH.—Dictionary of Scientific Terms: Dr. Nuttall (Strahan and Co.) Dr. Buckland's Bridgwater Treatise: Geology and Mineralogy as exhibiting the Power, Wisdom, and Goodness of God, fourth edition, edited by Francis T. Buckland (Bell and Daldy).—The Development of the Idea of Chemical Composition: Prof. A. Crum Brown (Edinburgh: Edmonston and Douglas). —Country Walks of a Naturalist with his Children: Rev. W. Haughton (Groombridge and Sons).—Hereditary Genius; and Inquiry into its Laws and Consequences: Francis Galton, F.R.S. (Macmillan).—The Origin of the Seasons considered from a Geological Point of View: Samuel Mossman (Blackwood and Sons).—As regards Protoplasm in relation to Prof. Huxley's Essay on the Physical Basis of Life: James Hutchinson Stirling (Blackwood and Sons).

FOREIGN.—Manuel de Chimie Médicale et Pharmaceutique: Alfred Riche. —Des Bases Organiques, naturelles et artificielles, au point de vue chimique, physiologique et médicale: Dr. A. Lacote.—Ein Jahr auf den Sandwich-Inseln: Dr. J. Bechtinger.—Bryologia Silesiaca: Dr. Julius Milde.—Lehrbuch der Chemie: A. Geuther.—Leçons de Chimie: A. Riche.—Neue Probleme der vergleichenden Erdkunde als versuch einer Morphologie der Erdoberfläche: Oscar Peschél.—Etude sur la Physique du Globe: R. Bruck. —Die Abhängigkeit der Pflanzengestalt von Klima und Boden. (Through Williams and Norgate.)

CONTENTS

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH

No. 5] THURSDAY, DECEMBER 2, 1869

Registered for Transmission Abroad.]

THURSDAY, DECEMBER 2, 1869

SCIENCE REFORM

A MOVEMENT has been for some time on foot, of a character so important to the Science of England, that we can no longer delay consideration of its object and prospects. It is proposed to submit to a Royal Commission the entire question of the relation of Science to the State; both what now is, and what should be, that relation.

In order to centre the attention of the scientific world on the leading features of the proposed inquiry, we will confine this present opening of the subject, as much as possible, to a narrative of the events which have brought the movement to its present stage.

At the meeting of the British Association at Norwich in 1868, a paper was read by Lieut.-Colonel Strange, in the Mathematical and Physical Section, entitled, "*On the Necessity for State Intervention to Secure the Progress of Physical Science;*" an abstract of which was published in the Report of the Association of that year. Colonel Strange stated verbally that he desired to be considered as merely putting into language the thoughts which had long occupied the minds of many eminent men of science. No one who mixes much in the scientific circles, indeed, can fail to recognise in his paper ideas which, in one form or other, have for some years been gathering strength. Discussion followed the paper, but, as might be expected, it branched off into many of the innumerable details which are involved in so large a question. A practical result, however, was arrived at by the Section, namely, that a committee should investigate the whole matter during the recess, and report to the Association at its next meeting.

This committee accordingly presented its report to the Association this year, at its late meeting at Exeter; and, since the future steps that may be taken must be based, more or less, on this document, we cannot do better than here print it *in extenso*.

The Recommendation adopted by the General Committee at the Norwich Meeting was, that Lieut-Col. Strange, F.R.S., Professor Sir W. Thomson, F.R.S., Professor Tyndall, F.R.S., Professor Frankland, F.R.S., Dr. Stenhouse, F.R.S., Dr. Mann, F.R.A.S., Mr. Huggins, F.R.S., Mr. Glaisher, F.R.S., Professor Williamson, F.R.S., Professor Stokes, F.R.S., Professor Fleeming Jenkin, F.R.S., Professor Hirst, F.R.S., Professor Huxley, F.R.S., and Dr. Balfour Stewart, F.R.S., be a Committee* for the purpose of inquiring into, and of reporting to the British Association the opinion at which they may arrive concerning the following questions:—

I. Does there exist in the United Kingdom of Great Britain and Ireland sufficient provision for the vigorous prosecution of Physical Research?

II. If not, what further provision is needed? and what measures should be taken to secure it?

and that Dr. Robert James Mann be the Secretary.

The Report was as follows:—

Your Committee, having sought the counsel of many of the most eminent men of science of the United Kingdom upon these questions, so far as it was found practicable to do so, and having carefully deliberated thereon, have arrived at the following conclusions:—

I. That the provision now existing in the United Kingdom of Great Britain and Ireland is far from sufficient for the vigorous prosecution of Physical Research.

II. It is universally admitted that scientific investigation is productive of enormous advantages to the community at large; but these advantages cannot be duly reaped without largely extending and systematising Physical Research. Though of opinion that greatly increased facilities are undoubtedly required, your Committee do not consider it expedient that they should attempt to define categorically how these facilities should be provided, for the following reason:—

Any scheme of scientific extension should be based on a full and accurate knowledge of the amount of aid now given to science, of the sources from which that aid is derived, and of the functions performed by individuals and institutions receiving such aid. Your Committee have found it impossible, with the means and powers at their command, to acquire this knowledge. A formal inquiry, including the inspection of records to which your Committee have not access, and the examination of witnesses whom they are not empowered to summon, alone can elicit the information that is required; and, as the whole question of the relation of the State to Science, at present in a very unsettled and unsatisfactory position, is involved, they urge that a Royal Commission alone is competent to deal with the subject.

Your Committee hold that this inquiry is of a character sufficiently important to the nation, and sufficiently wide in its scope, to demand the most ample and most powerful machinery that can be brought to bear upon it.

Your Committee therefore submit, as the substance of their Report, the recommendation that the full influence of the British Association for the advancement of Science should at once be exerted to obtain the appointment of a Royal Commission, to consider:—

1. The character and value of existing institutions and facilities for scientific investigation, and the amount of time and money devoted to such purposes.
2. What modifications or augmentations of the means and facilities that are at present available for the maintenance and extension of science are requisite; and,
3. In what manner these can be best supplied.

To proceed with our historical narrative. The report passed through the ordeal to which all such matters are subjected according to the rules of the British Association; namely, First, the consideration of the committee of the Section in which it originated (Section A); Secondly, that of the Committee of Recommendations; Thirdly, that of the General Committee. By this last it was submitted to the Council of the Association, "*for consideration and action if it seems desirable*," and the report was considered by a sub-committee of the Council on Saturday last.

As the matter now stands, it is for the Council of the British Association to determine whether science in this country stands, or does not stand, on a settled, satisfactory foundation; and if not, then the further question, whether anything short of an inquiry conducted by the State will suffice to redress existing evils and to initiate desirable reforms.

If we refer to the list of names of the Norwich Committee, given above, we find that it includes men of the highest eminence in almost every branch of scientific inquiry,—men whose whole lives are, and have long been, devoted to actual scientific work—professors, investigators, and writers, members of many learned societies, and of universities, leaders of philosophical thought, and persons possessing every available means of insight into all that passes in the scientific world,—and what do they tell us? Why, virtually this, that the provision for extending science in England is derived from so many sources, is subject to so many authorities, is so entirely without consistency and system, that even their joint knowledge fails to grasp and arrange the heterogeneous mass of confusion; they say, however, with an absence of circumlocution that bears the stamp of well-founded conviction, that this

* The following names have since been added to the Committee:—Alfred Tennyson, F.R.S.; Lyon Playfair, F.R.S., M.P.; J. Norman Lockyer, F.R.S.

provision, such as it is, not merely fails as to system and quality, but that, as to extent and quantity, "*it is far from sufficient for the vigorous prosecution of Physical Research.*"

Now, the opinions of men like these, so clearly and strongly expressed, must have carried great weight, whatever recommendations they might have founded on them; but when we consider their recommendation our faith in the soundness of their advice receives a strong accession. They do not say, as they might have done,—Establish such institutions, abolish others, alter the constitution of some, create great scientific offices, elevate the condition of scientific men, form us into a body for setting everything to rights, ourselves included. No; with an impartiality that does them honour, they say,—Place this matter before the highest tribunal known to our constitution for the deciding of such questions—before men selected for their high station and unquestionable independence; let all branches of science come in succession under their scrutiny; let the truth appear openly before the world without a possibility that an imputation of partiality and favouritism, which might attach to *our* decision, should cast a shade over their proceedings and their judgment and so damage the cause.

If we next consider the composition of the Council of the British Association, we shall feel the most positive assurance that a Report coming to them from so strong a Committee will be considered with the utmost care. For our own part we cannot feel doubtful of the result. But the question whether or not the Government shall be asked for a Royal Commission on Science is at this moment in their hands, and having said this we have brought down the history of the movement to the present moment.

A few words in conclusion. This is precisely one of those subjects which is liable to be dealt with in detail by minds before which it is definitely presented for the first time. Let us, therefore, indicate briefly the main questions, the discussion of which is, in the present stage of the matter, desirable. These are: First, does scientific investigation labour in England under disabilities and disadvantanges for want of the necessary funds and material appliances? Secondly, on what principles should the State assist scientific exertion; are these principles settled and acknowledged; and are they acted on? Thirdly, if the answers to these questions be, as we may almost assume they will be, unfavourable, is there any chance that piecemeal rectification will suffice to correct existing evils, or must we go to the root of the matter with the help of a Royal Commission?

When these questions are settled, it will be time to go more into details—but not before.

PHYSICAL METEOROLOGY

II.—SUGGESTIONS

AT the end of a previous article, I ventured to say I should make some suggestions touching a method by which I think meteorology might perhaps be made a branch of physical inquiry. In doing so, I will borrow the thought, and very many of the words which were brought before the Exeter meeting of the British Association. And furthermore, no allusion will be made in the present article to the elements of pressure and temperature.

With respect to the motion of our atmosphere, it cannot be anticipated that we shall ever possess the same complete knowledge which astronomy gives us of the motion of the heavenly bodies; for in the latter case the identity of the object is not lost sight of, while in the former case it is clearly impossible to ascertain the motions of individual particles of air. Our inquiries into the distribution and motion of the elements of our atmosphere must, therefore, be pursued by that method which enables us to ascertain the distribution and motion of any other substance or product with the individual components of which we find it impracticable to deal.

Suppose, for instance, we wish to ascertain the wealth of our country in grain or in spirits, and the distribution of this commodity over the earth's surface. We should first of all begin by taking the stock of the commodity corresponding to a given date; we should next keep a strict account of all the imports and exports of the material, as well as of its home production and home consumption.

Now, if we have taken stock properly at first, and if our account of the imports, the exports, the production, and the consumption of our material is accurate and properly kept, it will obviously be unnecessary to take stock a second time. But if these accounts are not kept with sufficient accuracy, or if we suspect that our material leaves us by some secret channel which we wish to trace, it will clearly be necessary to take stock frequently; and thus a comparison of our various accounts may enable us to detect the place and circumstances of that secret transit which has hitherto escaped our observation.

Applying these principles to the vapour of our atmosphere, what we wish to know is the amount of this material present at any one station at any moment, and also the laws of its motion. It would appear that the best way of measuring the amount present at any moment is by ascertaining the *mass* of vapour present in a *cubic foot* of air, mass and volume being fundamental physical conceptions.

Next, with regard to the motion of the atmosphere, including its vaporous constituent, the method of co-ordinates suggested by Dr. Robinson would appear to be the natural way of arriving at this. Let us set up at a station two imaginary apertures (strictly imaginary, of course), one facing north and south and the other east and west, and gauge the mass of dry air and the mass of moisture that passes each of these openings in one hour; we shall by this means get the nearest attainable approach to the elements of motion of the atmospheric constituents from hour to hour. We shall not, however, obtain by this means a complete account of this motion, for we have at present no means of measuring its vertical component. This vertical component corresponds in fact to the secret channel in the illustration given above, which we must endeavour to detect by some indirect method. Another thing that ought to be determined is the production or consumption of the vaporous element of our atmosphere as it passes from place to place. This might be done could we keep an accurate account of the evaporation and the precipitation, the two processes by which this element is recruited and consumed. This would, however, be a very difficult observation.

Let us now recapitulate what information regarding moisture we can obtain from such complete meteorological observations as are at present made. We have to begin with, as I have shown—

(1) The mass of vapour actually present at a station from hour to hour.

(2) The mass that passes a station in one hour, going east and west.

(3) The mass that passes a station in one hour, going north and south.

There is wanting—

(4) The vertical component of the motion of vapour.

(5) Its production or consumption as it passes from place to place.

These deficiencies may, however, be to some extent overcome by the following considerations:—

First, the atmosphere moves as a whole when it moves, the dry and moist air moving together; *secondly*, dry air is neither capable of production nor of consumption, but always remains constant in amount.

To illustrate this part of the subject, let it be supposed that we wish to investigate the vertical motion of the atmosphere at a certain station. Make this station the imaginary centre of a circle, the circumference of which may be supposed to be studded with other stations at sufficiently frequent intervals, so that we can tell, hour by hour, how much dry air passes in towards the centre of the circle through its circumference, and also how much passes out.

Let us suppose that more is passing in than is passing out, or that the imports into the area of the circle are greater than the exports out of it. Now, the dry air that passes in is incapable of production or of consumption, and hence the stock of the material at the central station, and in the area generally, ought to be on the increase, since we have imagined the imports to be greater than the exports. If, however, we ascertain from actual observation that the stock of dry air is diminishing instead of increasing, we may be sure that some is carried off by an upward current, which of course carries the moisture with the dry air.

The establishment of accurate observations is so recent that I cannot at this moment produce any definite example in illustration of this mode of analysis. We may, however, take a cyclone. As I have said, there are two hypotheses with regard to the motion of air in this phenomenon: one set of philosophers advocating a strictly rotatory motion, and the other set an indraught of air from the circumference towards the centre; and yet frequently we have a falling barometer in the centre. Now, what can carry off the air, if there be not an ascending current at the very heart of the cyclone? This is, however, I may remark, merely put forward in illustration of the method.

So much for the vertical component; and now, in the next place, with regard to the production or consumption of aqueous vapour as it passes from place to place. Our consideration has hitherto been confined to *quantity*; let me now define what is meant by the *hygrometric quality* of the air. It may be represented by the following quotient:—

$$\frac{\text{mass of vapour in a cubic foot}}{\text{mass of dry air in a cubic foot}}.$$

Now, this quotient can only alter by evaporation, by precipitation, or by mixture. This hygrometric quality of the air may perhaps be considered a quality sufficiently constant to aid us in tracing the actual motion of air, just as we may make use of the element of saltness to trace the actual path of an oceanic current. It gives us, in fact, a chemical analysis of the air, and one, moreover, which is independent of pressure, so that we can tell by its means the various qualities of air which we meet with in a balloon or mountain ascent. But besides this aid, we may make use of it to enable us to tell the precipitation or evaporation. For instance, a very damp air, in passing over a very dry country, may be supposed to emerge less damp, having its hygrometric quality changed; or a very dry air, in passing over a very damp country, may be supposed to emerge less dry, having its quality changed in the opposite direction. Thus, by actual observation of the quality of the air at the time of its reaching some particular tract of land or ocean, and at the time of its leaving it, we may possibly get much better observations of what goes on in the country, as far as this particular research is concerned, than if it were studded with gauges.

I would therefore suggest that meteorological observations should, by a system of reduction, be made to show—

(1) The mass of dry air and of moisture in one cubic foot actually present at each station from hour to hour.

(2) The mass of dry air and of moisture that passes each station, hour by hour, in two lines of direction at right angles to each other, namely, north and south and east and west.

When these hourly elements are obtained, they might for seasonal changes be reduced after the method of five-day means; or for the investigation of changes of weather, they might be utilised in some other way, as, for instance, in that lately suggested by the Astronomer Royal.

I ought to remark of this method of *gauging*, that all I claim to have done is to have put it in a somewhat new form; for it has been acted on by Maury and others before now, and has, in fact, given us one proof of the anti-trades. For we know that there is a constant indraught of air from the tropics to the equator on both sides; and as it does not accumulate there it must be carried off somehow, that is to say, it must return by the upper regions.

Before concluding,—one word of recapitulation as to the present stage of development of meteorology. We have seen that, judging by astronomy, there ought to be three stages: the object of the first being to ascertain the actual motions of the air, the second the causes of those motions, while we prophesy in the third. We have also seen how little progress we have made in the very first of these; and we may naturally conjecture that the third or prophetical stage is so very far in advance of us that we may not reach it for a long time. Nevertheless there is one crumb of comfort for weather prognosticators; for just as astronomers predicted certain phenomena in a rough way before the law of gravitation was established, so here also we may make certain rough and ready predictions of much practical utility before the advent of the Newton of meteorology.

BALFOUR STEWART

SERMONS IN STONES

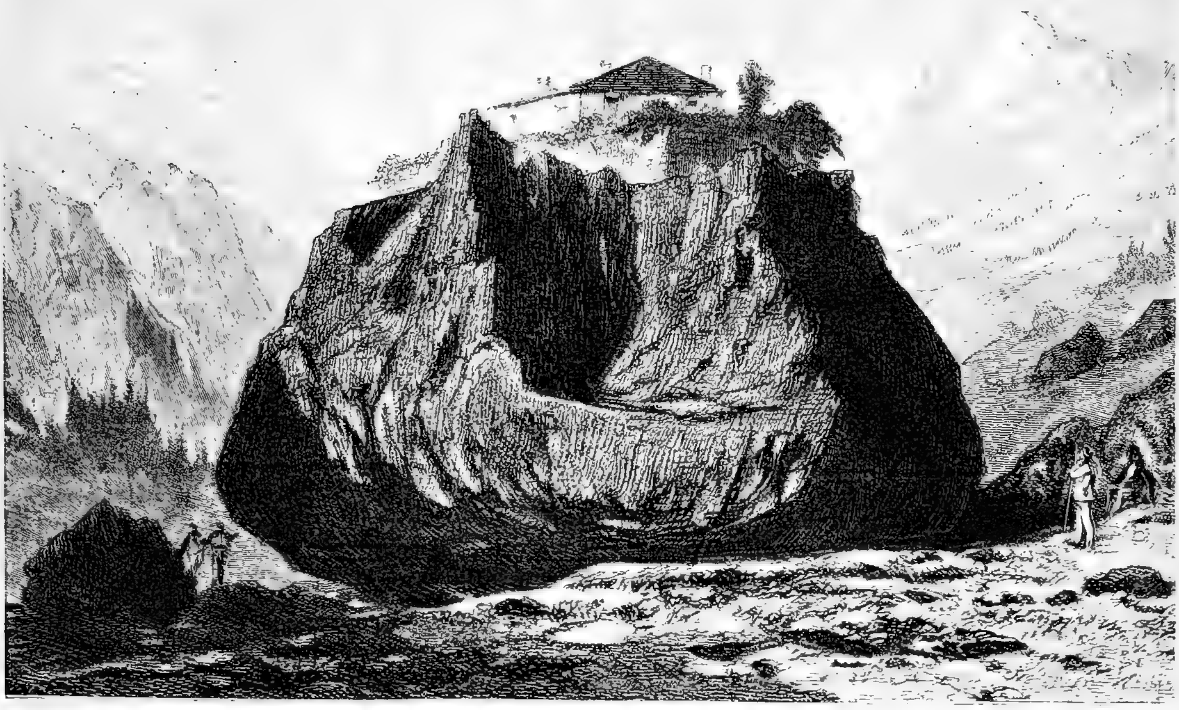
Les Pierres, Esquisses Minéralogiques. Par L. Simonin. Pp. 516, with 91 woodcuts, and 21 chromo-lithographs for coloured plates. (Paris, 1869. Hatchette et Cie.)

THIS volume is another of the recent works on popular science which, like "La Vie Souterraine" of the same author, "Les Volcans" of Boscowitz, and others of a similar character, the publishers of Paris seem of late to compete with one another in bringing out, and of which it may be said that they are peculiarly French, for neither here, elsewhere on the Continent, nor in England do we find their exact representatives.

Copiously illustrated by chromo-lithographs, coloured plates, and woodcuts of a most spirited, and occasionally what may be termed a somewhat sensational, character, these works apparently seek to impart scientific information mainly by appealing to the eye of the reader, and it must be admitted that in this they are sometimes very successful, the illustrations often conveying at a glance impressions which it would be tedious, or at times even difficult, to communicate in words. As an example of this, and also at the same time of the style of the woodcuts themselves, which are so abundant in the volume now under consideration, we reproduce two of them in our pages. The first of these is a most successful attempt to depict the general features of one of those polar glaciers which in prehistoric times have played so important a part in the earth's geological history, by the transporting of vast accumulations of rocks and their *débris* to other parts of the globe far distant from their original sites. This woodcut may be said to be, as it were, supplemented by the second, representing a Swiss landscape, showing in the foreground one of the great erratic blocks, or boulders, carried far from the glaciers themselves, and deposited in its present situation upon the melting of the icy raft which had floated it southwards. It may fairly be asked whether any description would be likely to produce on the mind of the geologically-inclined reader the effect which the mere sight of this woodcut must do? Does not the appearance of this gigantic pebble, with the dwelling-house perched upon its summit, instantly convey the most vivid impression of the more than grand scale of those glacial phenomena which at one period of the earth's history exhibited themselves in full activity?

POLAR GLACIERS

Bearing in mind that the word "stone" is throughout this work employed in an altogether popular sense—*i.e.* used promiscuously to designate any fossil, loose stone, rock, or mineral species whatsoever—the book itself is divided into two parts, treating respectively—(1) of stones, as a group or family, and (2) of the history of certain stones. Under the former of these heads, after a somewhat vague introduction to mineralogy proper, and a more detailed description of the somewhat complicated and cumbrous equipment considered by the author as necessary for the travelling mineralogist, or rather geologist, we find, in the second chapter, what might be called the condensed essence of geological science. Starting with cosmogony, we have laid before us, in turn, the nebular hypothesis of the origin of the earth; its subsequent condition of igneous fluidity, and consolidation upon cooling; the appearance of life upon its surface; and the various subsequent changes which it experienced through successive geological ages down to the present day,—the text being but a sort of running commentary upon the numerous and often admirably-executed illustrations which occur in its pages.



PIERRE DES MARMETTES, AT MONTHEY (VALAIS)

From this we are, in the third chapter, carried to the consideration of what are termed the stones of France; under which head we find a hurried but interesting account of the coal and iron mines of France, and of the utilisation of their products in the metallurgical industries of the country, interspersed with sketches of their history, statistics, &c., of the mining and manufacturing population; concluding with a still shorter account of the other more strictly denominated metallic mines of France.

A fourth chapter completes this first division of the work by a description of what are termed "Les Pierres du Globe," arranged under the heads of—(1) Carbon, (2) Metallic substances, (3) Building stones, (4) Gems, (5) Earths and salts, (6) Petroleum and subterranean water; all of which are treated of in a very interesting, but necessarily, from want of space, equally superficial manner.

The second part of the work, or what is termed the "Histoire de quelques Pierres," is subdivided into four chapters, each of which is in itself a somewhat more detailed account of the mining industry carried on in certain districts more specially noted for their mineral productions. These are as follows:—(1) The gold and silver deposits of the Rocky Mountains; (2) The marble quarries of Italy; (3) The iron mines of Elba; and (4) The coal mines of the centre of France. The descriptions of these are given in a very characteristic and instructive manner, and here again we may remark that they are profusely illustrated.

In reviewing this book, it must be remembered that Simonin's "Les Pierres" is not to be regarded in the light of a strictly scientific work, nor is it put forward with any pretensions to such a character. Although treating of subjects within the domain of their respective sciences, it is evidently, and admittedly, *not* written for the use of either mineralogist, geologist, or metallurgist; it claims but to provide those readers who are not at home in mineralogical or geological science, with information, arranged in a popular, or, to them, readable form, concerning such mineral substances as are likely to come under their attention either at home or in the course of their travels, and as such we cannot but recommend it.

The worthlessness of coloured illustrations of minerals has frequently been descanted upon, and it is perfectly true that they can be of no utility whatsoever to the student in mineralogy; in the present instance, however, they may be looked upon as but so many ornaments contributing to the general attractiveness of the volume as a whole. We are inclined to the belief that publications of this character, without being profound, or even free from some not inconsiderable defects, may still do good service to the cause of science, by attracting the attention of readers who, misled by vulgar report, eschew, without trial, what is commonly called the usual dry scientific literature; and that in some instances at least it may induce them to follow up their introduction by the study of more substantial scientific pabulum.

DAVID FORBES

THE ORIGIN OF SPECIES CONTROVERSY

Habit and Intelligence, in their Connection with the Laws of Matter and Force. A Series of Scientific Essays. By Joseph John Murphy. (Macmillan and Co., 1869.)

II.

IN his chapter on "The Rate of Variation," Mr. Murphy adopts the view (rejected after careful examination by Darwin) that in many cases species have been formed at once by considerable variations, sometimes amounting to the formation of distinct genera and he brings forward the cases of the Ancon sheep, and of remarkable forms of poppy and of *Datura tatula* appearing suddenly, and being readily propagated. He thinks this view necessary to get over the difficulty of the slow rate of change by natural selection among minute spontaneous variations; by which process such an enormous time would be required for the development of all the forms of life, as is inconsistent with the period during which the earth can have been habitable. But to get over a difficulty it will not do to introduce an untenable hypothesis; and this one of the rapid formation of species by single variations can be shown to be untenable, by arguments which Mr. Murphy will admit to be valid. The first is, that none of these considerable variations can possibly survive in nature, and so form new species, unless they are *useful* to the species. Now, such large variations are admittedly very rare compared with ordinary spontaneous variability, and as they have usually a character of "monstrosity" about them, the chances are very great against any particular variation being useful. Another consideration pointing in the same direction is, that as a species only exists in virtue of its being tolerably well adapted to its environment, and as that environment only changes *slowly*, small rather than large changes are what are required to keep up the adaptation. But even if great changes of conditions may sometimes occur rapidly, as by the irruption of some new enemy, or by a few feet of subsidence causing a low plain to become flooded, what are the chances that among the many thousands of *possible* large variations the one exactly adapted to meet the changed conditions should occur at the right time? To meet a change of conditions this year, the right large variation *might* possibly occur a thousand years hence.

The second argument is a still stronger one. Mr. Murphy fully adopts Mr. Herbert Spencer's view, that a variation, however slight, absolutely requires, to ensure its permanence, a number of concomitant variations, which can only be produced by the slow process of self-adaptation; and he uses this argument as conclusive against the formation of complex organs by natural selection in all cases where there is no tendency for action to produce self-adaptation; *à fortiori*, therefore, must a sudden large variation in any one part require numerous concomitant variations; it is still more improbable that they can accidentally occur together; it is impossible that the slow process of self-adaptation can produce them in time to be of any use; so that we are driven to the conclusion, that any large single variation, unsupported as it must be by the necessary concomitant variations, can hardly be other than hurtful to the individuals in which it occurs, and thus lead in a state of nature to its almost immediate extinction. The question, therefore, is not, as Mr. Murphy seems to think, whether such large variations occur in a state of nature, but whether, having occurred, they could possibly maintain themselves and increase. A calculation is made by which the more rapid mode of variation is shown to be necessary. It is supposed that the greyhound has been changed from its wolf-like ancestor in 500 years; but it is argued that variation is much slower under nature than under domestication, so that with wild animals it would take ten times as long for the same amount of variation to occur. It is also said that there is ten times less chance of favourable variations being preserved, owing to the free intermixture that takes place in a wild state; so that for nature to produce a greyhound from a wolf would have required 50,000 years. Sir W. Thomson calculates that life on the earth must be limited to some such period as one hundred million years, so that only two thousand times the time required to produce a well-marked specific change has, on this theory, produced all the change from the protozoon to the elephant and man.

Although many of the data used in the above calculation are quite incorrect, the result is probably not far from the truth; for it is curious that the most recent geological researches point to a somewhat similar period as that required to change the specific form of mammalia. The question of geological time is, however, so large and important that we must leave it for a separate article.

The second volume of Mr. Murphy's work is almost wholly psychological, and can be but briefly noticed. It consists to a great extent of a summary of the teachings of Bain, Mill, Spencer, and Carpenter, combined with much freshness of thought and often submitted to acute criticism. The special novelty in the work is the theory as to the "intelligence" manifested in organisation and mental phenomena, and this is so difficult a conception that it must be presented in the author's own words :—

"I believe the unconscious intelligence that directs the formation of the bodily structures is the same intelligence that becomes conscious in the mind. The two are generally believed to be fundamentally distinct: conscious mental intelligence is believed to be human, and formative intelligence is believed to be Divine. This view, making the two to be totally unlike, leaves no room for the middle region of instinct; and hence the marvellous character with which instinct is generally invested. But if we admit that all the intelligence manifested in the organic creation is fundamentally the same, it will appear natural, and what might be expected, that there should be such a gradation as we actually find, from perfectly unconscious to perfectly conscious intelligence; the intermediate region being occupied by intelligent though unconscious motor actions—in a word, by instinct. . . . . The intelligence which forms the lenses of the eye is the same intelligence which in the mind of man understands the theory of the lens; the intelligence that hollows out the bones and the wing-feathers of the bird, in order to combine lightness with strength, and places the feathery fringes where they are needed, is the same intelligence which in the mind of the engineer has devised the construction of iron pillars hollowed out like those bones and feathers. . . . . It will probably be said that this identification of formative, instinctive, and mental intelligence is Pantheistic. . . . . I am not a Pantheist: on the contrary, I believe in a Divine Power and Wisdom, infinitely transcending all manifestations of power and intelligence that are or can be known to us in our present state of being. . . . . Energy or force is an effect of Divine power; but there is not a fresh exercise of Divine power whenever a stone falls or a fire burns. So with intelligence. All intelligence is a result of Divine Wisdom, but there is not a fresh determination of Divine thought needed for every new adaptation in organic structure, or for every new thought in the brain of man. Every Theist will admit that there is not a fresh act of creation when a new living individual is born. I go a little further, and say that I do not believe in a fresh act of creation for a new species. I believe that the Creator has not separately organised every structure, but has endowed vitalised matter with intelligence, under the guidance of which it organised itself; and I think there is no more Pantheism in this than in believing that the Creator does not separately cause every stone to fall and every fire to burn, but has endowed matter with energy, and has given energy the power of transposing itself."

I am not myself able to conceive this impersonal and unconscious intelligence coming in exactly when required to direct the forces of matter to special ends, and it is certainly quite incapable of demonstration. On the other hand, the theory that there are various grades of conscious and personal intelligences at work in nature, guiding the forces of matter and mind for their purposes as man guides them for his, is both easily conceivable and is not necessarily incapable of proof. If therefore there are in nature phenomena which, as Mr. Murphy believes, the laws of matter and of life will not suffice to explain, would it not be better to adopt the simpler and more conceivable solution, till further evidence can be obtained?

The only other portion of the work on which my space will allow me to touch, is the chapter on the Classification of the Sciences, in which a scheme is propounded of great simplicity and merit. Mr. Murphy does not appear to be acquainted with Mr. Herbert Spencer's essay on this subject, and it is somewhat remarkable that he has arrived at so very similar a result, although less ideal and less exhaustively worked out. In one point his plan seems an improvement on all preceding ones. He arranges the sciences in two series, which we may term primary and secondary. A primary science is one which treats of a definite group of *natural laws*, and these are capable of being arranged (as Comte proposed) in a regular series, each one being more or less dependent on those which precede it, while it is altogether independent of those which follow it. A secondary science, on the other hand, is one which treats of a group of *natural phenomena*, and makes use of the primary sciences to explain those phenomena; and these can also be arranged in a series of decreasing generality and independence of those which follow them, although the series is less complete and symmetrical than in the case of the primary sciences. The two series somewhat condensed are :—

Primary Series.	Secondary Series.
1. Logic.	1. Astronomy.
2. Mathematics.	2. Terrestial Magnetism.
3. Dynamics.	3. Meteorology.
4. Sound, Heat, Electricity, &c.	4. Geography.
5. Chemistry.	5. Geology.
6. Physiology.	6. Mineralogy.
7. Psychology.	7. Palæontology.
8. Sociology.	8. Descriptive Biology.

Taking the first in the list of secondary or compound sciences, Astronomy, we may define it as the application of the first five primary sciences to acquiring a knowledge of the heavenly bodies, and we can hardly say that any one of these sciences is more essential to it than any other. We are, perhaps, too apt to consider, as Comte did, that the application of the higher mathematics through the law of gravitation to the calculation of the planetary motions, is so much the essential feature of modern astronomy as to render every other part of it comparatively insignificant. It will be well, therefore, to consider for a moment what would be the position of the science at this day had the law of gravitation remained still undiscovered. Our vastly multiplied observations and delicate instruments would have enabled us to determine so many empirical laws of planetary motion and their secular variations, that the positions of all the planets and their satellites would have been calculable for a moderate period in advance, and with very considerable accuracy. All the great facts of size and distance in planetary and stellar astronomy, would be determined with great precision. All the knowledge derived from our modern telescopes, and from spectrum analysis, would be just as complete as it is now. Neptune, it is true, would not have been discovered except by chance; the nautical almanack would not be published four years in advance ; longitude would not be determined by lunar distances, and we should not have that sense of mental power which we derive from the knowledge of Newton's grand law ;—but all the marvels of the nebulæ, of solar, lunar, and planetary structure, of the results of spectrum analysis, of the velocity of light, and of the vast dimensions of planetary and stellar spaces, would be as completely known to us as they now are, and would form a science of astronomy hardly inferior in dignity, grandeur, and intense interest, to that which we now possess.

Mr. Murphy guards us against supposing that the series of sciences he has sketched out includes all that is capable of being known by man. He professes to have kept himself in this work to what may be called positive science, but he believes equally in metaphysics and in theology, and proposes to treat of their relation to positive science in a separate work, which from the author's great originality and thoughtfulness will no doubt be well worthy of perusal.

ALFRED R. WALLACE

OUR BOOK SHELF

Nature contemplated Philosophically.—*Die Natur im Lichte philosophischer Anschauung.* By Maximilian Perth. (Leipzig and Heidelberg, 1869.) Large 8vo. pp. viii. and 805.

THE modern developments of the study of natural science have led to the separate and too exclusive consideration of branches of knowledge. This result necessarily follows from the defects inherent in our methods of investigation; but everyone will admit the importance and advantage of contemplating Nature as a whole, instead of attending to a fragment of her works. Hence she must be contemplated philosophically; for it is the business of philosophy alone to work out the greater problems which are common to, and underlie, the great problems of the sciences.

Such are the views which led Prof. Perth to write this book, a task for which he had fitted himself by many-sided study from boyhood, and the accomplishment of which has exacted the labour of several years. It is a purely philosophic work, belonging to a class of which there are few specimens, and cannot be easily read except by those who have some technical acquaintance with philosophic terms. The following are titles of a few of the topics treated in the volume:—"Matter, Organism, Spirit;" "The Relation of Nature to the Moral Idea;" "The Chemical Process;" "Species;" "The Chronological Perfection of Organic Nature;" "The Geographical Distribution of Plants;" "The Spiritual Life."

The author does not attach himself to any particular school of thought; but Kant, Hegel, and Spinosa have, perhaps, a predominance. His information is universal; but the erudition displayed is accompanied, as generally happens, by a want of point, precision, and climax. Here and there, a somewhat sad and sombre eloquence relieves and ornaments the picture. E. J. M.

An Introduction to the Science of Heat.—By Temple Augustus Orme. (London: Groombridge & Sons.)

IT is not many years since the appearance of the first thoroughly scientific treatise on heat in the English language, and now we hail the advent of a well-written introduction to more advanced works: a book intended for the beginner who is supposed to possess nothing but a fair knowledge of arithmetic and an average amount of intelligence. This book is full of excellent examples of the various laws of heat, in which the author makes use of the metrical system of measurements, and the centigrade scale of temperature; and the student who has worked through these questions cannot fail to have acquired a good practical knowledge of the subject of heat, as well as an appreciation of the advantage of the metrical system. Nor are theoretical views left out, and although the treatise only professes to be an introductory one, we have a good elementary account of the dynamical theory of heat, including the grand laws of the conservation and dissipation of energy. The author is undoubtedly right in accustoming the student at an early age to think of, and if possible apprehend, this great generalisation, for in truth it forms the appropriate supplement to and completion of the ordinary laws of motion, and should be studied along with these; otherwise the student may be led to conceive that when two equally massive inelastic balls strike one another with equal and opposite velocities, the result is *nil*, and to entertain many similar absurdities. And inasmuch as the laws of motion find their way into introductory treatises on natural philosophy, so should the laws of energy find a place in these. In the study of such laws, the student cannot too soon become accustomed to those technical terms which are necessary to give accurate expression to his conception; and we are glad the author has introduced the terms *kinetic* and *potential*, although we think that on one or two occasions he has used the word *force* where *energy* would have been preferable.

B. S.

Sicilian Fungi.—*Funghi Siciliani.* Per Guiseppe Inzenga. Centuria Prima. 4to. pp. 95, with 8 coloured plates, price 10*s*. (Palermo, 1869. London: Williams and Norgate.)

A WORK which will be very welcome to English fungologists, and especially to those who are interested in fungophagy. We have here descriptions of 100 of the more conspicuous Fungi of Sicily, with coloured plates of some of the more important or newly-described species, an account of their localities, and of the uses to which they are applied; and, what is of no small importance in a work on Fungi, a list of the synonyms belonging to each species. Sig. Inzenga has paid special attention to the economic properties of the Sicilian Fungi; among this first century he enumerates 30 species, which he can vouch for as being perfectly wholesome, more or less delicate in flavour, and easily distinguished from any noxious species, many of them being largely used as articles of food by the Sicilian peasantry, and sold in the markets of Palermo and Messina; while only eight are named as being absolutely poisonous, or so suspicious as to be prudently rejected. Our common mushroom, which is forbidden to be sold in the markets of Rome, is freely eaten in Sicily, though not so much esteemed as several other species.

A. W. B.

The Microscope and its Applications.—*Das Mikroskop und seine Anwendung.* Von Dr. L. Dippel. Zweiter Theil. Anwendung des Mikroskopes auf die Histiologie der Gewächse. 8vo. pp. 328, with 188 woodcuts, and 6 lithographic plates, price 12*s*. (Brunswick, 1869. London: Williams and Norgate).

THE first part of Dr. Dippel's treatise on the microscope was devoted to a description of its different forms, with practical directions for its use and for the preparation of specimens; in the present volume we have an account of its application to the observation of the minute parts of plants. It is divided into four sections. The first consists of investigations of cells as distinct organisms, including the cell-membrane, the cell-nucleus, the cell-fluid, protoplasm, and salts; the formation of cells; and their transformation into tubes and vessels. The second part relates to the more complicated tissues of the higher cryptogamia and of the phanerogamia. The third records the results of investigations on the elementary organs and tissues in polarised light. The fourth part is occupied by an account of the anatomical structure or comparative anatomy of the different compound organs, the stem, root, leaves, and organs of reproduction. With this volume the work closes for the present, but an additional one is promised at some future time on animal histiology. It contains a clear record of the present state of microscopical science as applied to the minute structures of the vegetable kingdom, free from those abstruse speculations which often fill so large a portion of continental works of this description. The illustrations, both wood-cuts and lithographs, are of the excellence to which we are accustomed in German scientific works, and to each section is appended a list of all the important works and papers already published on the subject. A. W. B.

The Physical Phenomena of Life.—*Les Phénomènes Physiques de la Vie.* Par J. Gavairet, &c. (Paris: Masson et Fils. London: Williams and Norgate.)

WE do not quite see why this little book should have been written. It is too technical to be useful as a popular volume; it is too diffuse, and yet too incomplete, to be a text-book; and it has neither the critical grasp nor the originality of an independent essay. There is a grand opening for some one to gather up all the recent advances in physiological physics, and weld them up together into a single book. When we took this volume in hand, we hoped to find something of the kind; but it really consists of little more than a straggling discourse on animal heat, and another on muscular contraction. M. F.

THE DEEP-SEA DREDGING EXPEDITION IN H.M.S. "PORCUPINE"

I.—NATURAL HISTORY

My part of the expedition in H. M. S. *Porcupine* commenced on the 18th of May, and ended on the 13th of July last. It comprised the Atlantic coast of Ireland, from the Skelligs to Rockall (a distance of about 6½ degrees, or 400 miles), Loughs Swilly and Foyle on the north coast, and the North Channel on the way to Belfast. I took with me as assistant Mr. B. S. Dodd (who had accompanied me in former dredging expeditions); and as dredger Mr. W. Laughrin, of Polperro, an old coast-guardman, and an Associate of the Linnean Society. Both did their share of the work carefully and zealously.

The first dredging was on the 24th of May, about 40 miles off Valentia, in 110 fathoms; bottom sandy with a little mud. The fauna was mostly northern, and the following are the more remarkable species there procured: Mollusca—*Ostrea cochlear*, *Neæra rostrata*, *Verticordia abyssicola*, *Dentalium abyssorum*, *Aporrhaïs Serresianus*, *Buccinum Humphreysianum*, *Murex imbricatus*, *Pleurotoma carinata*, and *Cavolina trispinosa;* Echinodermata —*Echinus elegans*, *Cidaris papillata*, and *Spatangus Raschi;* Actinozoa—*Caryophyllia Smithii*, var. *borealis*. Of these, *Ostrea cochlear*, *Aporrhaïs Serresianus*, and *Murex imbricatus* are Mediterranean species; and *Trochus granulatus* also imparted somewhat of a southern character, although that species was afterwards found living in the Shetland district. *Ostrea cochlear* is a small Mediterranean species of oyster; and it is one of the shells which Milne-Edwards noticed as adhering to the telegraph-cable between Sardinia and Algiers from a depth of about 1,100 fathoms. Although considered peculiar to deep water, I found it attached to the columns of the temple of Jupiter Serapis at Pozzuoli, which are reputed not to have been submerged to any depth. The above-mentioned results of this dredging will give a fair idea of the fauna inhabiting the 100-fathom line on the west of Ireland.

After coaling at Galway we steamed south; and (the weather being very coarse and unpromising) we dredged in Dingle Bay, at a depth of from 30 to 40 fathoms; bottom rocky and muddy. As before, in comparatively shallow water, we had two dredges out, one at the bow, and the other at the stern; this was what I always did in my own yacht, when dredging in from 20 to 200 fathoms. In Dingle Bay the dredges several times caught in rocks or large stones, but were saved by the usual yarn-stops, and by the extraordinary strength of the two-inch Chatham rope which was used. On one occasion, when the dredge was fast, the steamer, which was nearly of 400 tons burden, was pulled round, and swung by the rope as firmly as if she were at anchor and moored by a chain cable. Here, again, the Mollusca were mostly northern. *Siphonodentalium Lofotense*, *Chiton Hanleyi*, *Tectura fulva*, *Odostomia clavula*, *Trophon truncatus*, and *Cylichna nitidula* fall within this category; and *Eulima subulata*, *Trophon muricatus*, *Pleurotoma attenuata*, and *Philine catena* may be reckoned southern species. But the most remarkable shell obtained in this dredging was *Montacuta Dawsoni*, which I had described and figured from specimens found by Mr. Robert Dawson in the Moray firth. I subsequently detected in the Royal Museum at Copenhagen specimens of the same species in the collection of Greenland shells, made by the late Dr. H. P. C. Möller. The species was briefly described or noticed by him in the addenda to his 'Index Molluscorum Groenlandiæ,' as "*Testa bivalvis*"*;* but he did not give it any other name. The size of the Greenland specimens is considerably greater than that of British specimens, thus adding another to the numerous cases of a similar kind which I have from time to time adduced in illustration of the fact, that with regard to those species of Mollusca which are common to northern and southern latitudes, and which inhabit the same bathymetrical zone, northern are usually larger than southern specimens. It may, perhaps, be a not unfair inference, that the origin of such species is northern, and that they dwindle or become depauperated, in proportion to the distance to which they have migrated, or been transported from their ancestral homes.

The following week was occupied in sounding and dredging off Valentia, and on the way to Galway, at depths varying from 85 to 808 fathoms. The fauna throughout was northern. Several interesting acquisitions were made in all departments of the Invertebrata. Among the Mollusca I may mention—*Nucula pumila* (Norway), *Leda frigida* (Spitzbergen and Finmark), *Verticordia abyssicola* (Finmark), *Siphonodentalium quinquangulare* (Norway and Mediterranean), and an undescribed species of *Fusus* allied to *F. Sabini;* Echinodermata—*Brisinga endecacnemos;* Actinozoa—*Ulocyathus* (or *Phyllodesmia*) *arcticus*. That fine sponge *Phakellia ventilabrum* was also met with so far south, in 90 fathoms. The 808 fathoms' dredging was then a novelty, being the greatest depth ever explored in that way. The length of rope paid out was 1,100 fathoms, and the time occupied in hauling in was 55 minutes. The same proportional time was observed in other dredgings during my part of the expedition, viz. 5 minutes for every 100 fathoms of rope. The dredge contained about 2 cwt. of soft and sticky mud, in appearance resembling "China clay." The animals brought up on this occasion were quite lively; and I examined more than one specimen of a small Gastropod (described and figured by me as *Lacuna tenella*), which had very conspicuous eyes: there was also an active little stalk-eyed crab.

The next cruise was for ten days, and comprised the examination of the sea-bed between Galway and the Porcupine Bank, as well as beyond the Bank, at depths varying from 85 to 1,230 fathoms. All the Mollusca were northern, except *Aporrhaïs Serresianus;* and even that I am now inclined to consider identical with *A. Macandreæ*, which inhabits the coasts of Norway and Shetland; the latter appears to be a dwarf variety or form. The more remarkable species were, *Limopsis aurita* (a well-known tertiary fossil), *Arca glacialis*, *Verticordia abyssicola*, *Dentalium abyssorum*, *Trochus cinereus*, *Fusus despectus*, *F. Islandicus*, *F. fenestratus*, and *Columbella haliæeti*, (a tertiary fossil), among the Mollusca; *Cidaris papillata* and *Echinus Norvegicus* among the Echinoderms, and the beautiful branching coral, *Lophohelia prolifera*. In the deepest dredging made in this cruise (1,230 fathoms), occurred several new species and two new genera of the *Arca* family, *Trochus minutissimus* of Mighels (a North American species) having two conspicuous eyes, a species of *Ampelisca* (Crustacea) with the usual number of four eyes, comparatively gigantic Foraminifera, and other animals belonging to undescribed species and genera. An enormous fish (*Mola nasus*), which is not uncommon on the coasts of upper Norway, was slowly swimming or floating on the surface of the sea; but we did not succeed in capturing it for want of a harpoon.

We then put into Killybegs, county Donegal, and coaled there for our Rockall cruise. In anticipation of this cruise taking a clear fortnight, coals were stacked on the deck, in addition to the usual stowage in the bunkers, so as to provide a sufficient supply. Some delay was caused by the non-arrival of a proper galvanometer to work Siemens' electro-thermometrical apparatus, which we were anxious again to try. We left Donegal Bay on the 27th of June, and returned to the mainland on the 9th of July, after experiencing severe weather. The vessel sustained some injury from the heavy cross seas which struck her on her homeward passage. During this cruise we dredged seven days at depths exceeding 1,200 fathoms, and on four other days at less depths; the greatest depth was 1,476 fathoms. In this last-mentioned dredging we got several living Mollusca and other animals, a stalk-eyed crustacean with two prominent and unusually large eyes, and an Echinoderm of the Holothuria family, of a blue colour. The bottom, at the greatest depths, consisted of a fine clayey mud, which varied in colour (in some dredgings being brownish, in others yellow, creamcolour, or drab, and occasionally greyish), and invariably having a greater or less admixture of pebbles, gravel, and sand. The upper layer formed a flocculent mass, which appeared to be animal matter in a state of partial decomposition. This was in all probability derived from the countless multitude of *Salpæ*, oceanic *Hydrozoa*, Pteropods, and other gelatinous animals, which literally covered the surface of the sea, and filled our towing net directly it was dipped overboard. Their remains must fall to the bottom after death. Such organisms doubtless afford a vast store of nutriment to the inhabitants of the deep. It must be borne in mind that it is extremely difficult to dredge in very deep water. The dredge must be unusually heavy to counterbalance the tendency of the necessary bulk of rope to buoy it up under the descending pressure; and when it reaches the bottom, it sinks by its own weight, like an anchor, into the mud. This would give only the same result as the cuplead or any sounding machine, but on a larger scale; and it would tell us very little about the fauna. Further, if by the drift-way of the vessel, or by a few turns of the engine now and then, we are enabled to scrape the surface of the sea-bed, the dredge gets choked up with the flocculent mass above described. The fertile ingenuity of our experienced and excellent commander devised a method which was a great improvement in deep-sea dredging, and which enabled us to obtain at least a sample of the substratum. This was to attach two iron weights, each of 100 lbs., to the rope, at a distance of 300 or 400 fathoms from the dredge (when the depth exceeded 1,200 fathoms), so as to dredge from the weights instead of from the ship, the angle thus made causing the blade of the dredge to lie in its proper position: in fact it reduced the depth by the distance of these weights from the vessel to the easy and manageable limit of 300 or 400 fathoms. Another method was to fasten the bag to the dredge in such a way that, when it was hauled in it could be unlaced, emptied, and afterwards washed quite clean. I was thus assured that the specimens really came from the place where each dredging was made, and the risk of intermixture with previous dredgings was avoided. My sieves were also framed with a similar object, every sieve having a beading round the inside rim, to prevent specimens remaining inside the edges when the sieves were washed after every dredging. Two other kinds of sieve I also found useful. One was spherical, with its lid fastened inside by bolts; its frame consisted of a strong network of copper ribs, which was lined with very fine gauze-wire of the same metal; and it had a ring through which a rope would pass. Its use was to sift and wash away in the sea the impalpable mud got in such quantities at great depths, so as to leave only for examination all organisms exceeding in size $\frac{1}{32}$ of an inch, this being the greatest diameter of the wire-mesh in the lining. Some of the residuum or strained mud was likewise preserved after sifting the material in the usual way. This apparatus, which we called the "globe-sieve," saved a great deal of the time and useless labour required for washing that sort of dredged material through the ordinary sieves in a tub of sea-water, which would immediately become so turbid that, unless the tub were continually emptied and refilled, it was extremely difficult (if not impossible) to detect any specimens. Another kind of sieve had a similar framework; but the body was semi-globose, with a funnel-shaped neck. It was fastened to a long pole, and served for catching Pteropods, *Salpæ*, and other animals on the surface of the sea. This went among us by the name of the "vase-sieve." We tried on this and other occasions a contrivance of Mr. Easton, the celebrated engineer, consisting of gutta percha valves, which closed inwards in a wedge-like form, and were fitted to the mouth of the dredge. The object was to retain the contents of the dredge while it was being hauled in, as I had found by frequent and disappointing experience that a large portion of the contents generally escaped through the mouth during this part of the operation. The contrivance, although admirable in a theoretical point of view, was found impracticable; perhaps it may yet succeed after more trials, and with some alterations. In their present form the valves close the mouth of the dredge, so that it has no contents to be retained. The deep-sea dredgings in this cruise yielded no end of novelties and interesting results in every department of the Invertebrata. They were enough to take one's breath away. Among the Mollusca were valves of an imperforate Brachiopod with a septum in the lower valve, which I propose to name *Cryptopora gnomon*. Some shells were of a tolerable size; and the fry of *Isocardia cor* (*Kelliella abyssicola* of Sars) were not uncommon. Many Crustacea (Amphipoda) were scarlet, and others bright red with feathered processes of a golden colour at the tail. A magnificent Annelid was pinkish, with purplish-brown spots on the line of segmentation. A *Holothuria*, from 1,443 fathoms, was 5 inches long and 2¼ in circumference. None of the animals, especially the Mollusca, were living when they were brought on board and examined; this was perhaps owing to the great change of temperature (sometimes as much as 20°) between that of the sea-bed and that of the atmosphere.

But to return from the bottom to the surface. At a distance of from 130 to 140 miles from the nearest part of the Irish coast I observed quantities of floating seaweed (mostly *Fucus serratus*) and feathers of sea-fowl, covered with *Lepas fascicularis*, and occasionally *L. sulcata;* and on the seaweed were also two kinds of sessile-eyed Crustacea. The wind having been previously easterly, it is difficult to say what share the wind or tide had in the drift; but it did not appear to have been caused by any circulation from the equator. The fauna nowhere showed the least trace of that wonderful and apparently restricted current known as the Gulf Stream. The beautiful Pteropod, *Clio pyramidata*, flitted about in considerable numbers; a delicate cuttle-fish (*Leachia ellipsoptera*), which is supposed to prey on *Salpæ*, was caught in the vase-sieve, as well as several specimens of a small and very slender pipe-fish or *Syngnathus*. One peculiar feature of this cruise was Rockall, an isolated and conical excrescence of the Atlantic, 70 feet high, and situate at least 200 miles from the nearest land. We lay to within a quarter of a mile of it on the evening of Saturday the 3rd of July, when fishing parties were formed, and continued their sport till midnight. The supply of fresh fish thus procured was very acceptable. The rock was inhabited by a multitude of sea-fowl; and a huge gannet perched on the highest pinnacle, looking like a sentinel, or the president of the feathered republic. On our return to Ireland, we dredged in Lough Swilly, Lough Foyle, and the North Channel, on the way to Belfast, where we arrived on the 13th of July. Here I parted with my shipmates and excellent companions, and enjoyed the hospitality and sympathy of my friends Professor Wyville Thomson and Mr. Waller.

After my part of the expedition was concluded, I went for the second time to Scandinavia, and compared notes with Dr. Koren at Bergen, Prof. Sars (now, alas! no more) at Christiania, Prof. Lovén at Stockholm, Prof. Lilljeborg at Upsala, Prof. Torell at Lund, Prof. Steenstrup and Dr. Mörch at Copenhagen, and with Prof. Möbius and Dr. Meyer at Kiel. All these zoologists had investigated the Mollusca in the Arctic and North-European seas; and the result of my interviews with them, and of examining the extensive collections in the public museums at the above places, was extremely useful in connection with the subject of the present report.

Prof. Wyville Thomson succeeded me on the 19th of July, and made a short but very successful cruise to the northern part of the Bay of Biscay, where he dredged at the extraordinary depth of 2,435 fathoms, or 14,610 feet. Some particulars of this dredging I have already given. Dr. Carpenter replaced Prof. Wyville Thomson on the 12th of August, and explored the sea-bed lying between the north of Scotland and the Faröe Isles. The depths there dredged did not exceed 650 fathoms; but the results are most interesting and important in a biological as well as physical point of view. Prof. Wyville Thomson accompanied Dr. Carpenter in the last part of the expedition. It terminated on the 7th of September.

J. GWYN JEFFREYS

(*To be continued.*)

UTILISATION OF SEWAGE

WE have been requested by the Secretary of the Committee * of the British Association on the Treatment and Utilisation of Sewage, to print the following letter, which has been sent to the Municipal Authorities throughout the country:—

22, Whitehall Place, London, S.W.
November 18th, 1869.

SIR,—I have the honour to inform you that, last year, at the meeting of the British Association at Norwich, a Committee was appointed to report on the Treatment and Utilisation of Sewage. In the first instance, a grant of £10 was placed at the disposal of the Committee, with which to defray the cost of printing and postage incidental to the collection of preliminary statistical information. Through the kindness of Her Majesty's Government, the Committee was enabled to obtain Reports respecting the methods of dealing with town refuse practised in most civilised countries, and that information has now been collected in a more complete form than hitherto existed in any country.

This preliminary work being completed, the Committee was re-appointed at the meeting of the British Association this year at Exeter, and the inquiry was considered to present such important features of social and scientific interest, that the sum of £50 was voted towards enabling the Committee to enter more fully and practically upon the investigation of this subject. The British Association being a purely scientific body, has not at its disposal funds which would be adequate or applicable for the full prosecution of this very large and pressingly-important inquiry. The Committee nevertheless desires to take advantage of the opportunity created by the British Association, to investigate the entire subject in all its bearings—whether chemical, physiological, or engineering, sanitary, municipal, or agricultural—and in a manner worthy of the body they represent.

It is unnecessary to point out the enormous importance, especially at the present time, of a full and complete investigation of this question by the light of the knowledge and experience now gained in the several departments above alluded to; but properly to carry out such an inquiry with a practical end, numerous observations, gaugings, and experiments, aided by simultaneous analyses, are essential; and these cannot be accomplished, especially the analyses, without the continued aid of efficient and therefore highly-paid assistants. Moreover, from time to time it may be necessary for the Committee to purchase extensive apparatus, and to subject various inventions and processes to a thorough and complete test; for it is the desire of the Committee, not only to ascertain, as far as possible, the causes of the sanitary inefficiency of existing works, but also to inquire into every suggestion which affords promise of practical utility, in order that this investigation may be searching, the report practical, and any recommendations that may be made authoritative.

It is the wish of the several members of the Committee to devote, to the utmost of their ability, their personal attention to the work thus sketched out; but the expenses absolutely necessary to enable them to conduct so extended an inquiry cannot but be very heavy, and, unless they are able to secure an adequate fund, they must abandon the attempt to investigate the subject in this broad and comprehensive manner. However, since there is no subject of greater practical and social importance to the public generally, and thus to the various municipal authorities and other governing bodies throughout the country, it is believed that many will share the opinion expressed at the recent meeting of the British Association at Exeter, that the existence of this Committee affords a specially favourable opportunity for such a wide inquiry, and for that reason its members confidently appeal to those authorities who are officially interested in the subject to supply the funds necessary for the investigation.

I am therefore desired to request that you will kindly submit this letter to the body you represent, and I venture to hope you will give the Committee the benefit of your good offices in procuring a subscription proportionate to the population of your town or district.

It is suggested that the subscriptions of towns of different populations might be graduated somewhat in the following proportions:—

Where the population does not exceed 10,000	£5	5	0
Between 10,000 and 25,000	10	10	0
Between 25,000 and 50,000	21	0	0
Between 50,000 and 75,000	30	0	0
Between 75,000 and 100,000	50	0	0
Above 100,000	100	0	0

I beg to call your attention to the accompanying list of members of the Committee, and to inform you that all public bodies subscribing not less than 5*l.* 5*s.* 0*d.* will have the benefit of the information from time to time, as the results of the inquiry partake of a conclusive character, and will receive a copy of the report of the Committee when published.

I have the honour to be, &c.,

GEORGE F. BARNES,
Honorary Secretary pro tem.

* The following are the names of the Committee:—Richard B. Grantham, Esq., M. Inst. C.E., F.G.S., Chairman; J. Bailey Denton, Esq., M. Inst. C.E., F.G.S.; J. Thornhill Harrison, Esq., M. Inst. C.E.; Benjamin H. Paul, Esq., Ph.D., F.C.S.; Profess Wanklyn, F.C.S.; William Hope, Esq. V.C.; Professor Williamson, Ph.D., F.R.S; Professor Marshall, F.R.S., F.R.C.S.; Professor Corfield, M.A., M.D.; M.C. Cooke, Esq.; and Sir John Lubbock, Bart., F.R.S., Treasurer. Subscriptions should be paid to the credit of Sir John Lubbock, on behalf of the Committee, at Messrs. Robarts, Lubbock, and Co.'s, 15, Lombard Street, London, E.C.

TELEGRAPHIC COMMUNICATION WITH FRANCE

LAST Tuesday, November 30, the S.S. *William Cory* left Greenhithe with a heavy submarine cable, to be laid between Salcombe in Great Britain and Cape Finisterre in France. This cable, 105 miles long, has just been made by the Telegraph Construction and Maintenance Company, at their works at North Woolwich, and its special object is to establish direct telegraphic communication between London and Brest, so as to expedite the transmission of messages between Great Britain and America by the French Atlantic Cable.

The new cable is very strong and heavy. The shore ends weigh 20 tons to the mile, and the deep-sea portion weighs very nearly 10 tons to the mile. It contains one conductor only, consisting of a strand composed of seven copper wires, and weighing, when twisted together, 107 pounds to the mile. The insulating medium is gutta-percha, and weighs 166 pounds to the mile. The contractors undertook that the electrical resistance of the conducting strand should not exceed 12·25 ohms per mile, and that the insulation resistance should not be less than 200 megohms (million ohms), at the standard temperature of 24 degrees centigrade. So well have the contractors done their work, that the quality of the cable is better than agreed upon, the conductivity resistance being only 11·8 ohms, and the insulation resistance nearly 400 instead of only 200 megohms per knot. The inductive capacity of this cable is as nearly as possible ·333 Farad. per mile.

The *William Cory*, since 1858, has laid many submarine cables; she carried and laid portions of the French Atlantic cables last summer, and is now employed solely in this new branch of industry. Captain Donaldson has been in charge of her throughout the whole of this period, and he took her out again last Tuesday, on which day she left Greenhithe for Salcombe. For the above details relating to the conductivity, insulation, and capacity of the cable, we are indebted to Mr. C. F. Varley, C.E., engineer to the French Atlantic Telegraph Company, who accompanies the expedition. The apparatus used in testing the cable was that described by his brother before Section A of the British Association at Exeter. By the time these lines are in print the cable may possibly have been laid, but much depends upon the weather. When the weather is fine, it usually takes half a day to lay each of the shore ends of a cable, and the deep-sea portion is ordinarily paid out at the rate of five knots per hour. The time occupied in paying out the deep-sea portion of the cable now under notice should be about twenty hours in all.

DR. PENNY, F.R.S.E.

IN our first number we had to record the death of Thomas Graham, one of the greatest chemists of the century, and formerly an occupant of the chair of chemistry in Anderson's Institution, Glasgow. We have now to announce the death of Frederick Penny, who, with the exception of the short interval between 1837 and 1839, when Gregory was its occupant, has filled it with increasing reputation and success ever since Graham vacated it to go to London, thirty-two years ago. Born in London in 1817, he was devoted to chemistry from his earliest years, and studied in the Apothecaries' Hall under Henry Hennell, F.R.S. It was while here that he was led to inquire into the combining weights of certain of the elements, by finding that the amount of potassic chloride obtained by acting upon pure potassic nitrate with excess of hydrochloric acid did not correspond with the quantity which theory showed should be obtained. Having made sure that the difference was not due to errors in his experiments, he ascribed it to inaccurate equivalents assigned to the elements. As the result of his investigations, he showed that the equivalents current at the time for chlorine, nitrogen, potassium, sodium, and silver were not in strict accordance with experiment, and that the "hypothesis of all equivalents being simple multiples of hydrogen is no longer tenable." [Phil. Trans. 1839. Part i. p. 32.] There can be no question as to the clearness of this paper and the value of the results obtained, and our interest in them is in no way diminished when we find that the equivalents determined by Penny agree in a very remarkable manner with the mean numbers published by Stas, and that this agreement has been pointed out by that chemist. [Fresenius, Zeits. für Annal. Chem. 1868, pp. 164, 168. Compare Penny's Table, Phil. Trans. 1839, i. p. 32, with Stas's Fres. Zeits. 1868, p. 170.]

The paper was published in January 1839, and the same year he was appointed to the vacant lecturership in Anderson's Institution. Dr. Penny himself has had but recently to give an account of his struggles and successes in Glasgow, since settling in it thirty years ago. Recommended by Graham, he went down to a sphere of life and action, more strange at that time to a native of London than it has since become; but he devoted himself strenuously to his work, and at the time of his death had won in Glasgow and the West of Scotland a wide reputation as one of the clearest and most emphatic lecturers, and one of the most painstaking teachers.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents.*]

Lectures to Working Men

I HEARTILY concur in Mr. Stuart's opinion, that the working men of England—speaking at least for the North—are fully aware of the value of Scientific Instruction in its strict sense. The subject has a special interest for me; as in the winter of 1866-7, I started in this city a series of Science Lectures for the People, which, with the kind help of Prof. Jevons, Dr. Alcock, and Dr. Morgan, were undertaken for the purpose of ascertaining whether the working men of Manchester really appreciate the value of science instruction when given in a plain, but scientific form, illustrated with diagrams and experiments made on a scale such as could be seen by a large audience. The experiment proved highly successful. Upwards of 4,000 people attended the thirteen Lectures which we gave, and the class of persons present was exactly that for whom the lectures were designed; whilst the marked attention and interest invariably exhibited by the audiences showed how keenly they appreciated the information they received, and the insight into true scientific methods which they obtained.

The lecturer's words were taken down by Mr. Pitman, and the lectures were each week printed and published by Mr. John Heywood, of Manchester, and largely sold at one penny each at the door of the lecture-room and elsewhere. I printed syllabuses of the chief points of my four lectures, and one was given to each person entering the room. When I say that the subject of my first lecture was the explanation of the principles of the Indestructibility of Matter and of Energy, with a description of Joule's Determination of the Mechanical Equivalent of Heat, I think you will see that mere amusement was not the aim; the same remark applies to all the other lectures, and yet I never met with a more attentive and appreciative audience than these Manchester working men.

Professor Jevons gave us a most excellent lecture on "Coal, its Value and Importance in the Arts and Sciences;" Dr. Alcock gave four capital lectures on Elementary Zoology, and Dr. Morgan a course of four on Elementary Physiology, a subject in which the greatest interest was evinced.

We charged one penny per head for admission, and the penny fees did not nearly cover the necessary outlay, which was defrayed by some friends. Not only was the expense a difficulty, but the work of carrying on such a system was more than could be regularly and gratuitously borne by men whose strength was already sufficiently taxed by their own professional duties. Otherwise the lectures would have certainly been continued, for we were all fully persuaded that no mode of commencing science teaching for the people is so effective as this, or so likely to ripen into a permanent demand for scientific education amongst the working classes. As a proof of this, I may add that for two winters a class was formed in connection with these lectures for regular instruction in Chemistry under an able Government science master—one of my pupils, who had gradually raised himself from the position of a common factory hand. For this instruction sixty working men each paid 2*s*. 6*d*. for thirteen lessons. I often looked in upon them, and a more hard-working and enthusiastic class I never had the good fortune to see.

If such science lectures, *followed up by regular science instruction*, could be permanently established every winter, under careful and thoroughly competent teachers, in each of our great centres of industry, what invaluable results might not be accomplished! This is truly a subject worthy of the attention of some of our wealthy philanthropists; if, indeed, Government does not take the matter up. How much better would it be to devote money to the establishment of such a series of science classes, than, as is too often the custom, to employ it for building an almshouse!

H. E. ROSCOE

Owens College, Manchester, Nov. 23, 1869.

Changes in Jupiter

DURING the months of October and November the planet Jupiter has presented a spectacle of singular and almost unexampled beauty. The belts on the planet are more than usually numerous, and they display a greater variety of colours than I have ever yet seen ascribed to them. The equatorial belt, which has been for years the brightest part of the planet, is now not nearly so bright as the light belts to the north and south; usually it has been free from markings, now it is often covered with markings, which resemble piled-up cumulus clouds: it has generally been colourless, shining with a silver-grey, or pearly lustre—now it is of a rich deep yellow, greatly resembling the colour of electrotyped gold.

The woodcut represents Jupiter as it was seen on the night of the 9th of March in a reflecting telescope with a silvered glass mirror of 12¼ inches diameter. The upper part of the planet is the S. pole. On this portion of the disc there are three dark belts, while on the N. there are only two.

The poles of the planet are ashy blue, and the darker belts nearest to them present a darker tint of the same colour. The bright belts next these are pearly-white, and shine more brilliantly than any other portion of the planet. The dark belts next to the central bright belts are coppery red. As already mentioned, the central belt, which has been for years a pearly-white, is now a rich golden yellow.

Three or four dark markings on the lower part of the southern dark belt nearest the equator will be seen to incline to the left. If our earth were removed to Jupiter's distance, its disc would appear no larger than these dark masses, so enormous is their extent. The rotation of the planet is carrying them towards the right: we may assume that the bright vapour between them is left behind by the planet, which is here travelling at the rate of nearly 3,000 miles an hour.

JUPITER, OCTOBER 9, 1869, 11 P.M. G M.T.

Spectrum analysis has taught us to suspect that any change in the colour of light proceeding from an object, indicates a change in the object itself. If Jupiter, the largest planet in the solar system, has still retained so much heat as to shine partially by his own light, the present considerable change in colour may enable spectroscopists to obtain some information on this interesting subject.

JOHN BROWNING

Cuckows' Eggs

WILL you kindly grant me space for a few remarks in reference to the very interesting paper on the eggs of the cuckoo, by Professor Newton, in your last issue? I have no intention to criticise so able and accomplished a naturalist: my object is simply to elicit information on some points of difficulty; and as Mr. Newton promises a second paper, I should be very glad if he would throw any light on them.

And first as to the colour and markings of cuckoos' eggs. *Are* they so variable as some assert? I must take leave to doubt this. I never met with such extreme varieties, nor can I hear amongst my oölogical friends of any who have done so. One of the most eminent and experienced of living oölogists has stated: "As far as my own experience goes, it teaches me that there are not many birds the eggs of which differ less than those of the cuckoo." On the other hand, Mr. Newton says: "It has long been notorious to oölogists, that the eggs of the cuckow are subject to very great variety of colour." This, then, is a point on which I think further evidence is wanting. Dr. Baldamus mentions sixteen varieties of eggs which he alleges are cuckoos'. Were these seen to be deposited by the bird, or how were they identified as those of the cuckoo? Dr. Baldamus does not appear to have taken them all himself. Is there not room for error here?

Mr. Newton saw these eggs, appears satisfied that they *were* those of the cuckoo, and agrees with Dr. Baldamus in his conclusions, that the object of the practice was that the cuckoo's egg should be "less easily recognised by the foster-parents as a substituted one." How then is this process effected? Mr. Newton's explanation is that each hen cuckoo deposits her eggs only in the nests of one species, that her eggs resemble those of the species whose nest she uses, and that this process is hereditary.

Here it is that I am most in doubt. How is this hereditary habit of laying a particular style of egg maintained? It is quite possible that habits may become hereditary; but is there any instance of a wild species of animal inhabiting one locality and freely intermingling, where some members possess peculiarities of habit which are hereditary which their fellows do not? Mr. Newton will excuse me for saying, that the Golden Eagle he mentions scarcely fulfils these conditions. Is it likely there are sixteen varieties of our common cuckoo which are only to be distinguished from each other by laying a differently marked and coloured egg? Few birds are more vagrant or possess less conjugal or parental affection than the cuckoo. How then are these sixteen varieties to be kept from crossing? And if, as I believe, interbreeding does take place, how can the alleged distinctive style of eggs be preserved? Here I am at fault, and I shall be very glad if Mr. Newton will help me out of my difficulty.

In the face of the alleged object that the egg shall be less easily recognised as a substituted one, how are we to account for the fact that, in this country at least, a larger number of cuckoos' eggs are deposited in the nests of the hedge sparrow than in those of any other species, the speckled brown egg contrasting *strongly* with the greenish blue ones?

W. J. STERLAND

The Corona

IN connexion with Mr. Lockyer's paper "On the Recent Total Eclipse of the Sun," the following observations may be useful.

I observed the total eclipse of July 1860, in company with my friends Professor Chevallier and Mr. B. E. Hammond, at the village of Pancorbo, in Spain. We were on the summit of a mountain of considerable height, about 5,000 feet above the sea, and were therefore under somewhat peculiar atmospheric conditions. I observed specially four things:—

(1) Venus; which was then extremely near the sun, the thickness of the crescent being only 1 or 2 seconds, and therefore very favourably placed for observing whether it has an atmosphere.

(2) The extent of the corona, and its form. This I am sure was very irregular; very nearly, if not quite, permanent during the three minutes of totality; was nowhere less than 25′ in breadth; in one part, the top in an inverting telescope, 40′ in breadth; and in another, the right, was more than 60′ in breadth, running out in a long wavy line like floss silk. I have before me the drawing I made at the time, during the totality.

(3) The amount of light given by the corona. This was estimated by a photometer, consisting of a wedge of dark glass, with a moveable slit, contrived by Mr. Chevallier, and now, I believe, in the possession of the Astronomical Society, with the place marked through which I saw the corona. It was as bright as a small cloud, distant 8° from the sun, 10 minutes after reappearance; or as the moon when 2½ days old, as the sun was setting.

(4) The colours shown by a variety of coloured ribbons during totality. Of these, the only observation that bears on Mr. Lockyer's paper, was that on the extent of the corona. I estimated it twice; once as reaching, to the right, 2¼ diameters of the sun, and once, later on, at nearly 2½ diameters. I had no micrometer, but could not possibly have been wrong by so much as 10′. I wrote down at the time, that it underwent no perceptible change during the eclipse. It remained visible for six seconds after the reappearance of the sun.

I had, and have, little doubt that the corona is in the solar, and not terrestrial atmosphere.

Rugby School, Nov. 11 JAMES M. WILSON

Lightning in a Clear Sky

WE constantly find allusions in ancient classical authors, to lightning and thunder occurring in a clear sky. The former is often explained as referring to the phenomenon commonly known as "summer lightning," or the reflection in the sky of lightning from clouds below the horizon, which becomes visible at night. I have also seen it stated that in the calm and clear atmosphere of Italy, thunder might be audible under similar conditions. These explanations, however, do not meet the case as stated by good observers amongst the ancients themselves. They do not explain, for instance, what is stated by Cicero amongst the portents which preceded the conspiracy of Catiline—"that a Roman citizen was killed by lightning on a cloudless day." Pliny also mentions this case, adding that it happened at Pompeii. If such a phenomenon as lightning, falling from a cloudless sky, is disbelieved by men of science, may not the circumstance stated above be explained by supposing the man to have been killed by the fall of an aërolite? Humboldt, in his *Kosmos*, mentions two such instances.

We also read in Cicero that the earthenware statue of the god (Summanus), which stood on the top of the Capitol of Rome, was shivered by lightning, and its head sent into the Tiber. Is not the distance very great? I have myself seen fragments of an elm-tree struck by lightning, in Eton Playing-fields, about ten years ago, driven to a distance of twenty-five yards. The fragments were several feet long, and some of them must have weighed ten or twelve pounds. I shall be thankful for any information on these matters. C. W. D.

NOTES

We give elsewhere an account of the Anniversary Meeting of the Royal Society last Tuesday; one of the announcements made, however, we prefer to detail here. Dr. John Davy, brother of Sir Humphry Davy, has bequeathed to the Royal Society, in fulfilment of an expressed wish of his illustrious brother, a service of plate, presented to Sir Humphry Davy for the invention of the Safety Lamp, to be employed in founding a medal to be given annually for the most important discovery in chemistry made in Europe or Anglo-America. The directions given in the will, respecting the manner in which the plate should be disposed of, have been fulfilled, and the proceeds invested in India securities, yielding a little more than 30*l*. a year. The Council will determine the form of the medal, and specify the conditions under which it will be awarded.

The Royal Institution Friday Evening Meetings are arranged to commence on the 21st of January. The evening discourses before Easter will probably be given by Prof. Tyndall, Prof. Odling, Prof. Ruskin, Dr. Carpenter, Mr. Clifford, Prof. Sylvester, Dr. Rolleston, Prof. Roscoe, Prof. Huxley, Prof. Williamson, and Dr. Blackie. The Christmas lectures (adapted to a juvenile auditory) will be by Prof. Tyndall, who has chosen Light for his subject: the first will be delivered on the 28th inst. at 3 o'clock. Arrangements have been made for the following courses before Easter:—On the Architecture of the Human Body, by Prof. Humphry, F.R.S.; on the Vegetable Products of Chemistry, by Prof. Odling, F.R.S.; on Meteorology, by Mr. Robert Scott; on Plant Life as contrasted with that of Animals, by Dr. Masters, F.L.S.; Deductions from the Comparative Anatomy of the Nervous System, by Prof. Rolleston, F.R.S.; an Introduction to the Science of Religion, by Prof. Max Müller; on the Sun, by J. Norman Lockyer, F.R.S. After Easter, the following courses will be delivered:—On the Principles of Moral and Political Philosophy, by Prof. Blackie; on Physics, by Prof. Tyndall, F.R.S.; on Astronomy, by Prof. Robert Grant, F.R.S.; on History, by Prof. Seeley.

It is now generally understood that the Earl of Dunraven will not be a candidate for the presidentship of the Royal Irish Academy, and that the Rev. Professor Jellett, B.D., will be elected. Should this be so, we may look for a great revival in the scientific forces of the Academy.

An important meeting has been held this week at Cambridge, for the purpose of considering the question of the abolition of university tests. The Master of Trinity quoted a remark made thirty-five years ago by the present Bishop of St. David's, to the effect that science, as well as literature, morality, and religion, would gain by such a measure; and from what we gather, the reading of this extract gave a tone to the meeting. Here are the resolutions passed:—Proposed by the Master of Trinity, seconded by the Venerable Professor Sedgwick: "That in the opinion of this meeting the time has come for settling the question of university tests; that the mode in which the question is dealt with in the permissive Bill introduced by Sir J. Coleridge is open to grave objections, and that any measure designed to effect such a settlement should include an enactment that no declaration of religious belief or profession should be required of any person upon obtaining a fellowship, or as a condition of its tenure." Proposed by the Master of Trinity, seconded by Prof. Maurice: "That a representation be drawn up and presented by a deputation to the Prime Minister embodying the resolution just passed; that a committee be appointed to draw up such a representation, consisting of the Master of St. John's, the Master of Trinity, the Master of Christ's, Professor Sedgwick, Professor Maurice, the University Librarian, Mr. Ferrers, Mr. Porter, and Mr. Phear; and that the representation, when drawn up, be circulated for signature among all masters, resident fellows, or resident ex-fellows, of colleges, or officers of the University or of any college."

Christ's College, Cambridge, makes a most liberal offer to students of natural science, viz. scholarships and exhibitions, in number from one to four, and in value from 30*l*. to 70*l*., according to the number and merits of the candidates; that is to say, four well-informed students may each obtain a scholarship worth 70*l*. a year, and tenable for some years. The examinations will be on April 5th, 1870, and will be open to any one, whether a member of Christ's College or not, provided his name is not on the boards of any other college in Cambridge, and provided he is not of sufficient standing for B.A. It will be open, therefore, to all undergraduates of Oxford, and to non-collegiate students of Cambridge, as well as to all students who are not members of either University. The candidate may select for himself the subjects of examination, and must send his name, &c., to the Master of the College before March 29th. Further necessary information may be obtained from the Rev. W. Gunson, Tutor of the College.

Professor Pringstein has been elected a correspondent of the Academy of Sciences of Paris, to fill the vacancy caused by the death of Professor von Martius.

We have received the following from our Dublin correspondent:—The Council of the Royal Dublin Society have appointed Mr. H. W. Dunlop, B.A. Dub., C.E., as temporary assistant librarian. The Science and Art Department, on condition that the Library of the Royal Dublin Society should be open to readers from 10 o'clock A.M. to 10 o'clock P.M. each day, Sundays and Holy Days excepted, assented to provide for the extra services of the staff of porters and for a temporary assistant librarian. Perhaps there is no other public library in Great Britain and Ireland that is so completely at the service of the public as this library; and there is none that for its size possesses a larger selection of modern foreign works on literature and science. Its great defect is a useful working catalogue, and it is to be hoped that the Science and Art Department, seeing how successfully the Committee has managed the affairs of this library, will not grudge them the small sum required to compile a catalogue. It may not be uninteresting to mention that the expense incurred in the binding of the works issued by the Patent Office amounts to an average of 50*l*. a year. The works are presented by the Patent Office to several public institutions in Ireland. But while some towns, such as Belfast, store them away in a lumber-room, in Dublin they are carefully arranged and substantially bound. The Library is now open from 10 o'clock A.M. to 10 o'clock P.M.

The Board of Trinity College proceeded on Saturday last to the election of a librarian, and, somewhat to the surprise of the literary circle in Dublin, they adhered to their ancient custom, and elected one of their own body to this important post. The newly-elected librarian is the Rev. Dr. Malet, Senior Fellow and Senior Lecturer of Trinity College. Dr. Malet is well known as a numismatist. He is the author of a catalogue of Roman silver coins in Trinity College, Dublin, and there is no doubt will make both an efficient and popular librarian. The Rev. Dr. Dickson retains his position as assistant-librarian.

A SUBSCRIPTION list has been opened for the purpose of having a model of a bust of the late Professor J. Beete Jukes, by Mr. Watkins, copied in marble, the marble bust to be placed in the Gallery containing the collections of the Geological Survey of Ireland, of which survey Mr. Jukes was so long the acting director. Subscriptions are limited to a guinea, and only about 30*l.* remains to be collected out of the 70*l.* required.

THE death is announced of M. Henry Testot de Ferry, of Bussières, near Macon, the author of more than one treatise on archæo-geology. The work by which he is best known is an illustrated quarto pamphlet, "L'Anciennete de l'homme dans le Maconnais," published in 1867, which gives an account of some of his discoveries of flint implements both in caverns and in superficial deposits in the neighbourhood of Macon. He died at the early age of 43.

A SCIENTIFIC and literary society has just been formed at Winchester. The first meeting was held in the Hall of the Mechanics' Institute on Thursday evening last, at which an inaugural address was delivered by the Rev. C. A. Johns, of Winton House. Mr. Johns, in his address, which is published in one of the local newspapers, reviewed briefly some of the latest scientific discoveries, and suggested several subjects of inquiry within the range of the members of the new society. It appears that the microscope is one of the principal instruments of research with the Winchester naturalists, and hints were thrown out how this instrument might be usefully employed in this locality for the general promotion of science. In particular, a careful examination of the chalk of the neighbourhood was recommended for the purpose of determining to what extent it differed from, or was identical with, the *Porcupine* dredgings. After the address the meeting set to work to frame laws for the government of the society. Some discussion arose with regard to the name of the society, and the admission of ladies to the meetings. It was ultimately decided not to allow ladies to attend the ordinary monthly meetings, and the name agreed upon was "The Winchester and Hampshire Scientific and Literary Society." Mr. Johns was elected president, Dr. Neal treasurer, and Mr. Angall secretary; and ten other gentlemen consented to act with them as managing committee. The use of a large room was kindly offered to the society by Mr. Savage, and as the number of members is already 50, there seems every probability that the society will flourish.

WE learn from the Viennese correspondent of the *Standard* Newspaper that Karl Vogt is giving a course of six lectures at a Roman Catholic College in Vienna, on the Primitive Condition of Man. The first lecture was attended, we are told, by a crowded and highly respectable audience.

TWO Russian travellers, MM. Ewast and Logist, have applied to their Government for a concession to work some gold fields which they say they have discovered in Lapland. They passed a month in the district in question last summer. It is almost uninhabitable, being without vegetation of any kind, and the travellers were obliged to leave it, after obtaining nearly 60 ounces of fine gold, because they had exhausted all their provisions, and none were to be had on the spot.

Land and Water announces that Mr. Frank Buckland, Inspector of English Salmon Fisheries, and Mr. Archibald Young, Commissioner of Scotch Salmon Fisheries, have been appointed by the Government to inquire into the condition of the salmon fisheries of Scotland.

ACCORDING to the *British Medical Journal* the annual salaries of the professors in the Universities of Austria are in future to be uniform—1,800 florins, with an increase of 200 florins every fifth year. Hitherto, the rate of salary has been very various; being at Innsbruck and Lemberg 945 florins, in Vienna 1,680, in Prague 1,635; with a decennial increase of 300 florins.

THE Royal Horticultural Society of Ireland have decided on holding an extra spring show in March for hyacinths and other spring flowers.

THE whales which have been lately stranded on our own shores, one at Longniddry in the Firth of Forth, another at Langstone Harbour, near Portsmouth, and others elsewhere, have given rise to a discussion which promises to become interesting. Mr. Flower holds to the Longniddry whale being either *Balænoptera musculus*, or *B. Sibbaldii;* while Professor Turner of Edinburgh, together with other eminent Scotch naturalists, incline to regard it as an undescribed species. There is, we are glad to learn, every reason to hope that the skeleton will be preserved, in which case the species will be finally set at rest. The measurements of the whale are given by *Land and Water* as follows:—Extreme length 82ft., girth 34ft., length round jaws 39ft., from front of lower jaw to back of mouth 17ft. 9in., breadth across jaws 7ft. 9in., greatest expanse of tail 15ft. 9in., length of flipper 11ft., average length of baleen 30in. to 33in.; length of calf 20ft.

IT appears from the reports of the Viennese meteorologists on the storm which broke over the Austrian capital and other parts of the empire, that it was accompanied by a very remarkable variation in the atmospheric pressure at different points close to each other. Thus, at Lesina, the pressure was 13·5 millimetres, and at Lemberg 10·7 millimetres, under the normal pressure. The greatest variation was in the district round Vienna, where the storm was most violent. Between Bludenz and Ischl there was a difference of 1 millimetre in $6\frac{1}{2}$ German miles, between Ischl and Vienna of one in $3\frac{1}{4}$, and between Vienna and Lemberg of one in 11 only. In Northern Europe the barometer was low, and the thermometer high; in Southern Europe it was the reverse.

THE *Lyttelton Times* of June last gives a report of a meeting of the Philosophical Institute of Canterbury, N.Z., at which the President, Dr. Haast, F.R.S., read a paper on the Saurian Remains lately discovered by Mr. T. Cockburn Hood, F.G.S. in that province, and taken by him to Europe. The paper was accompanied by specimens and drawings: the latter were by Mr. Triphook, and represented the most valuable of the specimens. They differed from other saurian remains, and consisted of large slabs of stone enclosing the upper and lower jaws and part of the skull of a large saurian reptile of the Amphicælian sub-order of crocodilia, to which genera Teleosaurus belonged. It was calculated to have been from 18 to 20 feet in length. The author also stated that in Mr. Hood's collection there were a great many vertebræ, in one specimen fourteen dorsal vertebræ still connected together, which, from their bi-concave character, might have belonged to the same reptile, the impression of whose skull he had exhibited. There were also many bones belonging to Plesiosaurus, of which the principal ones formed part of the paddles or fins of those marine reptiles. The paper concluded by stating that many other bones of crocodilian reptiles were included in this collection, showing that New Zealand was at one time, like parts of the northern hemisphere, the abode of numerous large reptiles.

WE learn from the *Times* of Saturday last, that Canon Greenwell has recently been prosecuting his researches in the prehistoric tumuli with great success. The barrows examined are two very large round ones near Bridlington: they contained an unusual number of secondary interments, accompanied by a fine series of implements, pottery, &c. These tumuli possess a special point of interest in reference to the apparent displacement of the primary interment. We await with interest Canon Greenwell's report on this point. It is to be hoped that the numerous human remains discovered will be described by Dr. Thurnham, or some other competent anatomist skilled in craniology.

BALLOONERS will rejoice at hearing that Messrs. Hachette and Co. have issued a magnificent work on the Aërial Voyages of Glaisher, Camille Flammarion, W. de Fonvielle, and Gaston Tissandier. The illustrations are excellent.

TWO handsome volumes devoted to the "Life and Letters of Faraday" have been issued by Messrs. Longmans, and received by us just as we were going to press. The author is the Secretary of the Royal Institution, Dr. Bence Jones, whose delightful memoir of Faraday communicated to the Royal Society last year has been perused with pleasure by all scientific men.

THE committee of the Council on Education have placed at the disposal of the University of Oxford two of the thirty exhibitions, value 25*l.* each, given by Sir Joseph Whitworth, to assist deserving students in competing for his scholarships in mechanical science.

BOTANY

Spontaneous Movements in Plants

M. LECOCQ, of Clermont Ferrand, records in the *Belgique Horticole* some singular spasmodic movements in the leaves of *Colocasia esculenta.* These motions bear no resemblance to those produced in the Sensitive plant by the warmth of the hand, but occur spontaneously independently of the action of the wind or of any external cause, at irregular intervals, and at different periods of the day and night. M. Lecocq describes the movement as a kind of trembling or quivering affecting the whole plant, sufficiently powerful to tinkle little bells attached to the branches, and on one occasion even to shake the pot in which the plant was contained, and to resist a pressure of the hand, the number of the pulsations varying from 100 to 120 per minute. He states that the *Colocasia* is destitute of the stomata with which the leaves of plants are generally provided, especially on their undersurface, and attributes the phenomenon to the incessant pulsations of the imprisoned sap.

Decomposition of Carbonic Acid by Leaves

M. P. P. DEHERAIN has been continuing his researches on the evaporation of water from the leaves of plants, and the decomposition by them of carbonic acid. His previous investigation had established the fact that these two functions of the leaves proceed *pari passu*, the same conditions favouring the one as the other; and that both are determined by the degree and nature of the light to which the leaves are exposed, and not by the temperature. He now attempts to show that it is not the intensity only of the light which determines the rapidity of the evaporation of the water, and of the decomposition of carbonic acid; but that certain rays of light are far more efficacious than others. A careful series of experiments on the submerged leaves of *Potamogeton crispus*, accurately weighing the quantity of gases emitted, showed that under the influence of yellow light 26·2 c.c. of gas were exhaled, while under the influence of blue rays of the same intensity the plant disengaged only 5·8 c.c. of gas in the same time. A repetition of the experiment established the following laws,—1st. That all the rays of light are not equally efficacious in determining the decomposition of carbonic acid. 2d. That even with the same intensity yellow and red rays act more powerfully than blue or violet. 3d. That the relation which has been established between decomposition and evaporation is maintained also with respect to the relative influence of different rays of light. [Comptes Rendus.]

New Coffee Fungus

THE Rev. M. J. Berkeley forwards to the *Gardener's Chronicle* a letter from the well-known botanist, Mr. Thwaites, of Ceylon, in which he speaks of the consternation caused among the coffee-planters of that island in consequence of the rapid increase of a parasitic Fungus in the coffee-plantations, causing the leaves to fall off before their proper time, and endangering the safety of the crop. It is a singular fact that among more than one thousand species of Fungus which have been received in this country from Ceylon this particular one does not occur; not only is it an entirely new species, but it is with difficulty referable to any recognised section, being intermediate between the true moulds and the *Uredos.* Mr. Berkeley establishes from it a new genus *Hermileia.* A. W. B.

CHEMISTRY

Thallium Salts.—II.

MM. LAMY AND DES CLOISEAUX have again examined the thallous salts named below. The *ferro-cyanide*—

$$Tl_4FeCy_6 + 2Aq.$$

has a beautiful yellow colour, a density of 4·641, and is readily dehydrated by heat. Exposed to dry air, the crystals gradually lose their transparency. Water dissolves more of this than of potassic ferro-cyanide; the actual solubility is shown by the following numbers—

100 grm. water dissolve at 18° . . . 0·37 grm. ferro-cyanide
" " " at 101° . . . 3·93 " "

The crystalline type to which this salt belongs is a doubly oblique prism. It exhibits a high degree of double refraction; fine plates of it, cut parallel to the plane of cleavage, show a well-defined system of rings under the polariser. The crystals are very fragile.

Thallous tartrates and paratartrates are remarkable for the readiness with which they yield large and brilliant crystals. *Hydro-thallous tartrate*, $C_4H_5TlO_6$, generally crystallises in beautiful white prisms, which have a silky lustre, due to the presence of a number of longitudinal striæ; it is soluble in 122 parts of water at 15°, and in 6 parts of water at 101°. The density of the crystals is 3·496, and they are, as already found by Lang, optically and geometrically isomorphous with hydro-potassic tartrate. The *neutral tartrate* is prepared by adding thallous carbonate to boiling aqueous hydric tartrate, until alkalinity ensues. On cooling, large, transparent, lustrous crystals make their appearance; their specific gravity is 4·658; they are unalterable in air at the ordinary temperature; at 100°, however, they become opaque and anhydrous. They dissolve in five times their weight of water at 15°, and in a tenth of their weight of boiling water. The formula of this salt is—

$$2[C_4H_4Tl_2O_6].\ Aq.$$

It crystallises in forms belonging to the clino-rhombic system—

Plane angle of the base . . . . 106°59′26″
Plane angle of the lateral faces . . . 101°57′41″
Obliquity of the primitive prism . . . 110°23′00″

The double refraction is very energetic. The plane of the optic axes is normal to that of symmetry. The acute bisectrix is negative and perpendicular to the horizontal diagonal of the base. The horizontal dispersion is pretty decided, as is also the proper dispersion of the optic axes, ρ being $< \nu$. *Sodio-thallous tartrate*— $C_4H_4NaTlO_6 + 4Aq.$
is prepared in the same manner as common Seignette salt, with which it agrees not only in composition, but also in figure; but it differs from that body in the orientation of its optic axes. The crystals are soluble in half their weight of water at 20°, and effloresce when handled. The acute bisectrix of the optic axes is negative and normal to the base; the dispersion, though considerable (with $\rho > \nu$), is much smaller than in the common Seignette salt. When redissolved in water, and allowed to evaporate spontaneously, the above compound yields a more complex tartrate, having the formula—

$$C_4H_4TlNaO_6 + C_4H_4Tl_2O_6,$$

and crystallising in the rhombic system. As regards form, it may be referred to a right rhomboidal prism of 98°40′, differing chiefly in height from the tartrate just described. The acute bisectrix is positive. *Thallio-stibiosylic tartrate*—

$$C_4H_4Tl(SbO)O_6 + Aq.$$

is less soluble in water than the corresponding potassic salt. The crystals are quite permanent, and have the specific gravity 3·99. Although geometrically isomorphous with the potassic salt, the two tartrates differ completely in optical properties. At 15° to 20° the optic axes are perfectly united for all the colours of the spectrum; but at 70° they separate to the extent of 20°—25°, in the plane passing through the principal diagonals of the bases of the primitive prism. Their acute bisectrix is negative; dispersion inappreciable. *Dithallous paratartrate* is anhydrous, has a density of 4·659, and is capable of crystallising in two distinct forms. The two forms, which both belong to the clino-rhombic system, are distinguished by the following numbers—

	Normal.	Irregular.
Plane angle of the base	68°55′56″	80°16′22″
Plane angle of the lateral faces . . .	90°16′24″	95° 9′36″
Obliquity of the primitive prism . . .	90°20′00″	96°45′00″

In both, however, the dispersion is weak, with $\rho > \nu$; the acute bisectrix is positive and the separation of the optic axes is considerable. Thallium has three *oxalates*, much resembling those of the potassium series; their solubility, however, increases (instead of decreasing) as the oxalic factor accumulates. The *normal oxalate* dissolves in 68 parts of water at 15°, and in 11 of boiling water. The density is 6·31. On heating, it behaves like plumbic oxalate. The crystals of this salt belong to the clino-rhombic system, but are quite unrelated to any of the corresponding potassic or ammonic oxalates hitherto described. The plane of the optic axes is parallel to the plane of symmetry; the double refraction is very energetic. *Hydro-thallous oxalate*—

$$TlHC_2O_4 + Aq.$$

crystallises in the clino-rhombic system; but its primitive form is irreconcilable with that of hydro-potassic oxalate. The specific gravity is 3·971. It is soluble in 19 times its weight of water at 15°, and in less than its weight of boiling water. There is also an anhydrous salt, whose primitive form is an oblique rhomboidal prism, likewise incompatible with the potassic salt. In both, the double refraction is energetic, and the acute bisectrix positive: but, in the former, the plane of the optic axes is parallel to the plane of symmetry; in the latter, it is normal to that plane. In the former, the proper dispersion is strong, with $\rho < \nu$; in the latter, it is weak, with $\rho > \nu$. The oxalate— $Tl_2C_2O_4 + 3H_2C_2O_4 + Aq.$ ("quadroxalate"), is closely akin to the corresponding potassic salt, both in composition and geometrical form. It shows a powerful double refraction. The plane of the optic axes is almost normal to the base. The proper dispersion of the axes is decided, with $\rho < \nu$; the acute bisectrix is negative, and very oblique to the base. The crystals are very fragile.

Thallous *picrate* is anhydrous. Its colour is yellow, when prepared with but once cooling; but, by Deville's method, this is gradually modified to a vermilion-red. At 150° the dry red salt is soon transformed into the yellow modification. Thallous picrate is less soluble than potassic picrate, one part of it requiring 280 parts of water at 15°, while potassic picrate requires 245. Its density is 3·039. Even a temperature of 270° fails to decompose it, but at 300° it detonates with violence. The red crystals are clino-rhombic; they have a vitreous lustre, and the plane of their optic axes is parallel to that of symmetry. The mean value of the index of refraction is $\beta = 1{\cdot}827$ (for the yellow line of sodium).

Reduction of Cupric Salts by Tannin

E. PALLUCCI has pointed out that tannin in all its forms reduces cupric oxide in alkaline solution, and forms a red precipitate of cuprous oxide, just in the same way as glucose does; and that the neglect of this circumstance has led to many errors in the estimation of sugar and vegetable juices, and especially in the valuation of the must of the grape: for this liquid contains the tannin derived from the skins of the grapes; and consequently, if the quantity of sugar contained in it is determined by that of the cuprous oxide thrown down, without regard to the reducing power of the tannin, the sugar in the must, and therefore also the alcohol which it is capable of yielding by fermentation, will be over-estimated. This source of error may, however, be easily eliminated by first treating the liquid under examination with basic lead acetate, which completely precipitates the tannin; the glucose may then be estimated in the filtrate.

The importance of attending to this matter in saccharimetric researches will be evident, when it is remembered that tannin is a substance very widely diffused in the vegetable kingdom; and that many vegetable substances, in which sugar is frequently sought for, contain at certain stages of their growth a quantity of tannin two, three, four, or even five times as great as that of their sugar; the greater number of fruits, not excepting the grape, belong indeed to this category. Other substances besides tannin, as for example gallic acid, pyrogallic acid, and many colouring matters, including that of wine, are also capable of reducing the alkaline cupric solution; but all these, as well as tannin, are completely precipitated by basic acetate of lead.—[Ann. di Chem. app. alla Med., Sept. 1869, p. 132.]

IN the preparation of quinine and cinchonine, a black, tarry substance is found in considerable quantity. This product, the "quinoidine" of commerce, contains a number of cinchona alkaloids, but is not used to any great extent in medicine. MM. Henry, Duguet, and Perret have much increased its value by converting the alkaloids into picrates, thus forming a mixture which can be used with advantage as a very cheap and efficient febrifuge.

GEOLOGY

The Tithonian Stage

PROFESSOR PICTET has communicated to the Swiss Society of Natural Sciences a most interesting report, containing a detailed discussion of a question which has lately acquired much importance, namely, the limitation of the cretaceous and jurassic periods. The Tithonian beds (Titonische Etage) of Oppel, as is well known, occupy a sort of intermediate position between the great jurassic and cretaceous series of deposits, and they have been referred by different authors sometimes to one and sometimes to the other of these great formations. Thus, Professor Oppel himself considered that his Tithonian stage brought the jurassic period a step forward in time, whilst M. Hébert regarded the deposits studied by him as carrying the lower part of the cretaceous formation further back. Of late years these doubtful deposits have been detected in many places, scattered from the Carpathians to the Mediterranean, through Italy, Switzerland, France, and Spain.

Professor Pictet considers that wherever these beds occur, the arrangement of the strata is in accordance with the following sectional view:—

1. Neocomian stage proper.
2. Valangian stage and marls with *Belemnites latus*.
3. Berrias limestone.
4. Tithonian stage.
5. Bed with large specimens of *Aptychus* (Kimmeridgian).
6. Jurassic fauna with *Ammonites tenuilobatus*.

The question to be settled is where, if anywhere, in this section the line of division between the jurassic and cretaceous formations is to be drawn, between 3 and 4, between 4 and 5, between 5 and 6, or finally through the middle of 4, dividing it into a jurassic and a cretaceous Tithonian.

The Stramberg limestone, which the author regards as nearly identical with the limestone of the Porte de France and Aizy, contains 55 species of Cephalopoda, of which 50 have been described as new by Zittel, whilst the other 5 have their analogues in the cretaceous period. This would seem to be in favour of the cretaceous nature of this bed; but the Brachiopoda, which have been thoroughly worked out, tell a different tale: of 38 species 26 are new, 11 belong to the jurassic period, and 1 (*Terebratula janitor*, Pict.) is common to this deposit and that of the Porte de France. It appears, however, that the strict contemporaneity of these fossils is somewhat doubtful, inasmuch as Zittel has found that the molluscan fauna of Stramberg (omitting Cephalopoda and Brachiopoda) is nearly identical with those of Wimmis and Mount Salève, which have been hitherto regarded as Corallian. But neither at Wimmis nor at Mount Salève does *Terebratula janitor* occur, nor are any of the Cephalopoda of Stramberg found there, so that it is possible the Stramberg deposit consists of two beds, of which the newer contains the above-mentioned Cephalopods and *Terebratula janitor*, and the older corresponds with the Swiss deposits at Wimmis and Mount Salève—the latter might then be the highest term of the jurassic series, and the upper Stramberg bed the lowest of the cretaceous, thus carrying the divisional line through No. 4 of the above section. M. Coquand has found the fauna of *Terebratula moravica*, which is also that of Wimmis and Mount Salève, occupying deposits in Provence which are covered by beds containing Kimmeridgian and Portlandian Ammonites, and therefore evidently jurassic. From the consideration of these facts the author infers that there have been in different regions two different orders of succession. In one (Provence, Salève, Wimmis,) the stages are nearly in conformity with those which occur in the rest of France, and the limits of the jurassic and cretaceous periods appear to be clear. In the other, included between the Carpathians and Italy (with a portion of the French Alps, &c.), the Tithonian stage prevails upon the confines of the two great periods.

By an investigation of the palæontology of the beds thus characterised as forming the Tithonian stage, Professor Pictet arrives at the following divisions in ascending order:—

1. The fauna of *Ammonites tenuilobatus*.
2. The fauna of the inferior Tithonian, known principally from Rogoznik, the blue marble of the Apennines, and probably the Tyrolese limestone with *Terebratula diphya*.
3. The fauna of the upper Tithonian or Stramberg limestone (*Terebratula janitor*).
4. The lower Neocomian stage, especially the Berrias limestone (*Terebratula diphyoides*).

Jurassic characters predominate in Nos. 1 and 2; No. 3 is rather cretaceous; hence the divisional line, *if drawn at all*, will fall between Nos. 2 and 3. But the author is of opinion that there is no necessity for drawing this line, and he remarks that the whole of the four stages are combined by strong palæontological analogies. Species pass from 1 to 2, from 2 to 3, and from 3 to 4; Nos. 2 and 3 especially, which would be separated by the line of demarcation of the two periods have about one-third of their species in common. This line would therefore be a very feeble one, and we should have to admit that in this Tithonian basin at any rate the separation of the cretaceous from the jurassic periods is singularly compromised.

[We have given so long an analysis of the argumentative part of Professor Pictet's paper, that we cannot refer to his concluding remarks, except to say that they contain some important observations on the method to be followed in geological investigations.]

PHYSIOLOGY

Reaction of Nerve-Substance.

FUNKE some years ago affirmed that nerve, like muscle, became acid after work, and at death. In this he was supported by Heidenhain, and opposed by Ranke and others. He now reasserts his former statement, using the delicate reagent *cyanin* instead of litmus, and finds strong proofs of the correctness of his views. The matter is not unimportant, as it is one of the few bases on which rests the broad general assertion that nervous [and mental] action is accompanied by material changes. [Centralbt. med. Wissensch. 1869, No. 46.]

Action of Muscarin.

SCHMIEDEBERG and KOPPE have published an account of the pharmacy and physiological action of *muscarin*, the active constituent of *agaricus muscarius* (*amanita muscaria*). This mushroom poison seems to be not unlike the Calabar bean in its action, and belladonna is in many respects antagonistic to it.

MAX SCHULTZE'S *Archiv für Microscopische Anatomie* v. 4, contains, among other papers:

"Ueber die Nervenendigung in der Netzhaut des Auges bei Menschen und bei Thieren." Von Max Schultze. Description of certain fibrillæ ensheathing the rods and cones of the vertebrate retina, and believed by Max Schultze to be the real nerve endings. An important memoir, tending to harmonise the results obtained from the study of invertebrate and vertebrate eyes. "Untersuchungen über den feineren Bau des Pancreas." Von Dr. Giovanni Saviotti aus Turin. Description by a pupil of Köllicker's, of fine intercellular passages in the pancreas, similar to those discovered by Hering in the liver. "Die haaretragenden Sinneszellen in der Oberhaut der Mollusken." Von Dr. W. Flemming in Rostock. A detailed description of certain fimbriated cells in the epidermis of acephalous mollusks, and gasteropods, not wholly unlike, and occuring in the midst of, ciliate cells, but believed by Flemming to be organs of sense. "Ueber Radiolarien und Radiolarien-artige Rhizopoden des süssen Wassers." Von Dr. Richard Greeff, Privatdocenten in Boon. Description of species of *Clathrulina*, *Acanthocystis*, and several species of new genera *Astrodisculus*, *Hyalolampe*, with discussion of their habits, anatomy, &c.

PFLUGER'S *Archiv*, ii. 9 and 10, contains:—"Quecksilberluftpumpe." Von H. Busch. A modification of the mercurial pump employed by Pflüger. The chief novelty is the occlusion of the orifices of the various parts by means of mercurial shoulder cups. "Das Unterscheidungsvermögen des Geschmacksinnes für Concentrationsdifferenzen der schmeckbaren Körper." Von Fr. Keppler in Tübingen. Keppler found it easiest to distinguish by taste variations of strength in "saline" solutions, less easy in "acid" or "sweet" liquids, and least easy in "bitter" liquids, though bitter substances (such as quinine) are those which require the smallest quantity to make a definite impression. "Ueber die Abhängigkeit der Leber von dem Nervensystem." Von E. Pflüger. Nebst Tafel II. und III. An important memoir in which Pflüger extends to the liver, the observations already made by him on the salivary glands and pancreas, affirming the direct continuation of the nerve fibres with the secreting cells. "The hepatic cell is a nucleated swelling of the axis cylinder of a nerve." Contains also many other points of interest, touching the structure of the liver, and strongly supports the views of Dr. Beale. "Ueber den Einfluss des Cyangases auf Haemoglobin nach spectroscopischen Beobachtungen." Von E. Ray Lankester. A short note affirming, in opposition to some German observers, that cyanogen forms a definite compound with Haemoglobin analogous to those of carbonic oxide, &c. "Zur Kenntniss der Wirkungen des Weingeistes." Von Dr. F. Obernier, Privatdocent und Assistenzarzt der medic. Klinik zu Bonn. A somewhat polemic paper contesting the views of Bouvier, &c., noticed in NATURE, No. 2.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, November 30.—Anniversary Meeting.—The President delivered his annual address, in which he touched upon several points of interest. One of the first subjects to which he drew attention was the Royal Society's Catalogue of Scientific Papers, the printing of which proceeds satisfactorily. He remarked: "While the aid to be derived to scientific research from the index according to authors' names is fully recognised, there can be no doubt that the value of the Catalogue will be greatly enhanced by the fulfilment of the second part of the plan announced in the preface, namely, by the publication of an *Alphabetical Index of Subjects*. The preparation of such an "*Index Rerum*" as is contemplated, has been for some time a subject of anxious, as well as careful, consideration by the Library Committee, and they have at length arrived at what, they have reason to hope, will be a most satisfactory solution of the question through a communication with Professor Julius Victor Carus, of Leipsic, who they found would be willing himself to undertake the task. I am happy to announce that the Council, acting on the recommendation of the Library Committee, have entered into a very satisfactory arrangement with Professor Carus, who will be able to commence his labours in the ensuing spring. From the well-known scientific accomplishments of Professor Carus, and his extensive experience in the peculiar work to be performed, as well as the confidence which will be reposed in him by all acquainted with the nature of the undertaking and interested in its success, we may consider the Society most fortunate in securing his services." The Meteorological Department of the Board of Trade, superintended by a Committee of the Royal Society, was next referred to; it is stated to be making good progress. Concerning the great Melbourne telescope the President remarked: "Its performance since erection does not appear to have given the same satisfaction at Melbourne that it did at Dublin; but the defects complained of may arise partly from an imperfect knowledge of the principles of the instrument and inexperience in the use of so large a telescope, partly from experimental alterations made at Melbourne, and partly from atmospherical circumstances. Those who are acquainted with the difficulties which Sir J. F. W. Herschel experienced at the Cape, will not be surprised that they should be felt at Melbourne to a much greater extent, on account of the far greater size of the speculum. But I have no doubt that if the instrument be kept in its original condition and as carefully adjusted as it was at Dublin, it will perform as well in ordinary observing weather. The high impression of its power produced by the trials which were made of it when at Dublin, is maintained by a sketch of a portion of the Great Nebula near η Argus, made by M. Le Sueur during two nights in June last. Some change in this nebula from the time when it was described by Sir J. F. W. Herschel had been indicated by Mr. Powell and other observers, though with instruments so much inferior in power to his 20-foot reflector, that little reliance could be placed on them; however, here the evidences of change are indisputable. The peculiar opening in the nebula which Sir John Herschel has compared to a Lemniscate, is still very sharply marked, but its shape and magnitude have altered. Its northern extremity is opened out into a sort of estuary; one of the remarkable constrictions seen in 1834 has disappeared, and the other has shifted its place. Two stars which were then exactly on the edges of the opening are now at some distance within the bright nebulosity; the nebula has become comparatively faint near η Argus. Another remarkable change is the formation of a V-shaped bay south and preceding the Lemniscate, whose edges are so bright that if it had then existed it could not have been overlooked in the 20-foot reflector. Another feature, which, however, was perhaps not within reach of that telescope, is an oval which M. Le Sueur describes as 'full of complicated dark markings and pretty bright nebular filaments.' The angular magnitude of the changes which have been observed, is so great as to suggest a strong probability that this nebula is *much nearer* to us than the stars which are seen along with it. It may be also noticed that M. Le Sueur saw nothing to make him believe in any development of stars in addition to those seen by Sir J. F. W. Herschel." The Council of the Society believes that an attempt to encourage and aid spectroscopic researches is an object in full unison with the highest purpose of the Royal Society's existence; and they have, therefore, after most careful deliberation, resolved to act on this conviction. A telescope of the highest power that is conveniently available for spectroscopy and its kindred inquiries is being constructed, and will be entrusted to such persons as, in their opinion, are the most likely to use it to the best advantage for the extension of this branch of science; and, in the first instance, there can be but one opinion that the person so selected should be Mr. Huggins. The President said: "The execution of this project was much facilitated by the receipt of £1,300 from a bequest made to the Society by the late Mr. Oliveira; and in the beginning of the year proposals were received from the chief opticians of the time, of which that of Mr. Grubb was accepted last April. The conditions proposed were, that the object-glass of the telescope should be of 15-inches aperture, and not more than 15-feet focus, that the arrangements of its equatorial should be such that it could be easily worked by the observer without an assistant, and that the readings of its circles could be made without leaving the floor of the observatory. Mr. Grubb was fortunate enough to secure two discs which had been exhibited by Messrs. Chance at the French Exhibition. They are of first-rate transparency, and as the construction which has been adopted admits of the lenses being cemented, this object-glass will transmit an unusual portion of light. The respective indices of the glasses were determined by making facets on their edges at an angle of 60", and observing spectral lines through the prisms thus formed with a spectroscope of such magnitude as to admit of their being placed on its table. The distinctness with which even faint lines are seen through 12 inches of the glass is a most satisfactory proof of its purity and clearness. From these Professor Stokes computed the curves for the lenses, and his numbers were almost identical with those which Mr. Grubb had obtained. I may mention that some fears had been entertained that the equality of curvature in the adjacent surfaces might *call up a ghost*, if the lenses were used uncemented, and that this has been tried and no such effect was visible. Subsequently a rather novel addition has been made, bearing upon the radiation of heat from the stars. An object-glass intercepts so much of the heat-rays that, to economise the infinitesimal effect which is expected, a metallic mirror is more promising. The equatorial is, therefore, at the suggestion of Mr. De la Rue, provided with the means of changing the 15-inch achromatic for an 18-inch reflector; and this has been accomplished by means notable for their facility and their safety. The instrument will be ready for trial in December of the present year." The rest of the address referred to the recent dredging expedition. The President then proceeded to the award of the Medals. The Copley Medal was awarded to M. Victor Regnault for the second volume of his "Relation des Expériences pour déterminer les lois et les données physiques nécessaries au calcul des Machines à Feu," including his elaborate investigations on the Specific Heat of Gases and Vapours, and various papers on the Elastic Force of Vapours. The President remarked that the name of M. Victor Regnault had been associated for the last quarter of a century with the most refined and delicate experimental inquiries connected with the measurement of heat. The amount of labour involved in his researches upon the specific heat of simple and compound bodies, upon the dilatation of gases and vapours, upon the comparison of the air-thermometer with the mercurial thermometer, upon the elastic force of aqueous vapour, upon the determination of the density of gases, and upon hygrometry, must excite the astonishment of all who could estimate the difficulty of the problems attacked, the precision of the results attained, and the fundamental character of the data which he had determined. The Council has awarded a Royal Medal to Sir Thomas Maclear, Astronomer Royal at the Cape of Good Hope, for his measurement there of an arc of the meridian. The President reminded his audience that our sole knowledge of the figure of the southern hemisphere rested on the arc of the meridian measured by La Caille, and now remeasured and extended by Maclear. The original measurement, notwithstanding the well-known ability of the great astronomer under whose superintendence it was executed, had not commanded confidence. Maclear's arc has an amplitude nearly four times as great as that of La Caille, and is, on this account, as well as on account of the greater accuracy in detail, far more deserving of confidence. The degree which is derived from it is 1,133 feet shorter than that of La Caille; and as La Caille's is 1,051 longer than that given by the spheroid, which, according to Airy, represents the average of northern arcs, it is evidently a near approximation to the truth. This is even more distinctly shown by the close agreement of the latitudes computed from the geodetic measurements with those given by the sector—that of the north extremity being 0"·4 in defect, that of the south extremity 0"·5 in excess.—A Royal Medal has been awarded to Dr. Augustus Matthiessen, F.R.S., for his researches on the electrical and other physical properties of metals and their alloys. The President remarked that these researches embraced the determinations of the specific gravities, the expansion due to heat, the thermo-electric properties, the electric conducting-power, and the effects of temperature upon the electric conducting-power. Dr. Matthiessen's investigation of the electric conducting-power of commercial copper had resulted in very great improvement of the conducting-power of the copper wire used in submarine telegraphy. Closely connected with this branch of his researches were the investigations which Dr. Matthiessen carried out for the Electrical Standard Committee of the British Association, of which he was one of the most active members. The resistance-coils issued by that Committee, which had been very generally adopted as standard instruments, were all constructed of an alloy of platinum and tin, which, after a long series of experiments, Dr. Matthiessen recommended as specially fitted for that purpose. Under the auspices of the British Association, Dr. Matthiessen undertook, a few years ago, the investigation of the chemical constitution of cast-iron, and of the influence exerted upon the physical properties of that metal by the several other elements which generally occur in association with it. He had lately elaborated a method of producing pure iron, which promised to be fruitful in interesting and important results in the hands of himself and the other chemists with whom he has been associated in this inquiry. Dr. Matthiessen's researches published in the *Philosophical Transactions*, on the action of oxidising agents upon organic bases and on the chemical constitution of narcotics (the latter investigation having been conducted in conjunction with Professor G. C. Foster), furnished proofs of the success of his labours in organic chemistry. His researches were distinguished as well for their diversity as for their uniformly complete and trustworthy character. — The following officers are elected for the ensuing year:—President: Sir Edward Sabine, L.L.D.; Treasurer: W. Allen Miller, M.D., LL.D. Secretaries: W. Sharpey, M.D., LL.D.; and G. Gabriel Stokes, LL.D. Foreign Secretary: Professor W. Hallows Miller, LL.D. The other members of the Council are: Frederick Currie, M.A.; Warren De la Rue, Ph. D.; Sir P. de M. Grey Egerton, Bart.; Professor W. H. Flower, F.R.C.S. Eng.; William Huggins; J. Gwyn Jeffreys; John Marshall, F.R.C.S. Eng.; Augustus Matthiessen, Ph. D.; Captain Henry Richards, R.N.; the Marquis of Salisbury, M.A.; C. W. Siemens; John Simon, F.R.C.S.; Archibald Smith, M.A.; Professor H. I. Stephen Smith, M.A.; Professor John Tyndall, LL.D.; and Professor Alexander W. Williamson, Ph.D.

Royal Astronomical Society, November 12.—First Meeting of Session. Mr. Warren De la Rue, F.R.S., vice-president, in the chair. The Chairman opened the meeting by referring to the illness of Admiral Manners, the president of the society, an announcement which was heard by all present with much regret. The minutes of the last meeting having been read and confirmed, and upwards of 100 presents announced, Mr. Carrington read a paper descriptive of his observatory near Farnham, Surrey, and of a variety of ingenious contrivances for securing its efficiency, and especially the correct measurement of time. Mr. Carrington intends observing with an alt-azimuth, which he has designed to ensure the comfort and consequent accuracy of the observer. The telescope-tube rotates freely on its axis, which is always horizontal; it carries the vertical circle, and in front of the object glass a right-angled prism, the front face of which may be directed on any object by the axil rotation of the tube of the telescope.—The Astronomer-Royal was then invited by the Chairman to describe his recent invention of a method of correcting the chromatic dispersion of the atmosphere. He described the various contrivances by which that object might be secured.

The simplest method of all was the employment of a series of different angles suited to the altitude of the object; but as this has some inconveniences Mr. Simms suggested the employment of an adjustable prism, as, for example, adjustable tilting of the field-glass of the eye-piece. This method, though simple, introduced undesirable optical effects. It appeared necessary, therefore, that the correction should be effected outside the eye-piece; and the best method seemed to be the combination of a convexo-concave and a convexo-plane lens, the convexity of the latter fitting into the concavity of the former, and admitting of being rotated within it, so as to vary the corrective effect according to the state of the air or the position of the object observed. Mr. Cayley, F.R.S., afterwards noticed that the desired effect could be secured by combination of two prisms, in one of which there is a convex, and in the other a concave cylindrical surface of the same curvature; when these cylindrical surfaces are made to rotate on each other, the opposite faces of the combination can assume any relative position between parallelism and an inclination equal to the sum of the refracting angles of the component prisms. Both contrivances are described in Brewster's Optics; and it is satisfactory to consider that the troublesome effect of atmospheric chromatic dispersion can be corrected effectually by contrivances so well known.—The Astronomer-Royal then invited the attention of the meeting to a proposition which had been made by the American observers, that the passage of Venus over the solar chromosphere should be observed by spectroscopists during the transit of 1874, for the purpose of determining the solar parallax. Mr. Huggins described the methods of observation available for the purpose. Mr. Proctor expressed doubts as to the accuracy of the suggested method, remarking that the phenomenon, to be observed to the best advantage, would require other stations than those selected for observing internal contacts, and that the effect of parallax, by causing Venus to cross different parts of the chromosphere, as seen from different stations, would be a fatal objection, since we have no reason for believing that the chromosphere is uniformly deep. He remarked also that we are not merely ignorant of the exact point at which Venus will cross the sun's limb, but of the angle at which her path will be inclined to the limb. Mr. Stone intimated his belief that we should find a number of difficulties cropping up around the new method, which might render observations as unsatisfactory as those made in 1769 upon the internal contact.—After some remarks by the Chairman upon the advantages of applying photography to the coming transits, a paper by Mr. Alexander Herschel, on the November meteors, was read to the meeting. Mr. Herschel shows that there is evidence of a triplicity in the meteoric stream, since in 1868 three distinct maxima were observed in England, America, and China. In 1867 and 1866 also, three maxima were observed, but they were not separated by so wide an interval.—Mr. Proctor then read a paper on the application of photography to the transit of 1874. The paper was illustrated by a chart exhibiting the passage of the earth through the shadow-cone of Venus, and showing along what lines stations should be placed, at any time, so that the relative displacement of Venus might be along a radial line of the sun's disk. By so selecting stations (or times) he remarked, the whole question would become simply one of parallax, no appreciable error would come in through misplacement of the fiducial cross-lines, and so photography would do the best work it was capable of, for determining the sun's distance. In reply to Mr. Proctor's comments on the importance of the coming transits, Mr. Stone pointed out the close correspondence of the results he has deduced from the observations in 1769., with the various other determinations of the sun's distance, and expressed his doubts whether any important improvement can be made in 1874 and 1882.—Mr. Birt then read a paper on the spots which are visible on the floor of the lunar crater Plato, of which he exhibited an interesting drawing.—Mr. Browning read a paper on the changes of colour which the equatorial belt of Jupiter has recently exhibited; and indicated the importance of a careful series of observations directed to the determination of any periodicity which may exist in these changes.—In describing the American photographs of the eclipse of last August, Mr. De la Rue remarked that they confirm the evidence already afforded by his own observations in 1860, and those of Major Tennant in 1868, that the corona, in part at least, is a solar phenomenon.—The meeting closed with an announcement on the part of the Chairman, that a medal had been struck at the Imperial Mint of France in honour of Hind, Goldschmidt, and Luther, on the occasion of the discovery of the hundredth planetoid in 1868.

Geological Society, November 24.—Prof. T. H. Huxley, LL.D., F.R.S., President, in the chair.—Robert Arnold Barker, M.D., Civil Medical Officer, Cachar, Bengal, was elected a Fellow of the Society.—The following communications were read:—(1), On the Dinosauria of the Trias, with observations on the Classification of the Dinosauria," by Prof. Huxley, LL.D., F.R.S., President. The author commenced by referring to the bibliographical history of the Dinosauria, which were first recognised as a distinct group by Hermann von Meyer in 1830. He then indicated the general characters of the group, which he proposed to divide into three families, viz.:—

I. The MEGALOSAURIDÆ, with the genera *Teratosaurus*, *Palæosaurus*, *Megalosaurus*, *Poikilopleuron*, *Lælaps*, and probably *Euskelosaurus*;

II. The SCELIDOSAURIDÆ, with the genera *Thecodontosaurus*, *Hylæosaurus*, *Pholacanthus*, and *Acanthopholis*; and

III. The IGUANODONTIDÆ, with the genera *Cetiosaurus*, *Iguanodon*, *Hypsilophodon*, *Hadrosaurus*, and probably *Stenopelys*.

Compsognathus was said to have many points of affinity with the Dinosauria, especially in the ornithic character of its hind limbs, but at the same time to differ from them in several important particulars. Hence the author proposed to regard *Compsognathus* as the representative of a group (*Compsognatha*) equivalent to the true Dinosauria, and forming, with them, an order to which he gave the name of ORNITHOSCELIDA. The author then treated of the relations of the Ornithoscelida to other Reptiles. He indicated certain peculiarities in the structure of the vertebræ which serve to characterise four great groups of Reptiles, and showed that his Ornithoscelida belong to a group in which, as in existing Crocodiles, the thoracic vertebræ have distinct capitular and tubercular processes springing from the arch of the vertebra. This group was said to include also the Crocodilia, the Anomodontia, and the Pterosauria, to the second of which the author was inclined to approximate the Ornithoscelida. As a near ally of these reptiles, the author cited the Permian *Parasaurus*, the structure of which he discussed, and stated that it seemed to be a terrestrial reptile, leading back to some older and less specialised reptilian form. With regard to the relation of the Ornithoscelida to birds, the author stated that he knew of no character by which the structure of birds as a class differs from that of reptiles which is not foreshadowed in the Ornithoscelida, and he briefly discussed the question of the relationship of Pterodactyles to birds. He did not consider that the majority of the Dinosauria stood so habitually upon their hind feet as to account for the resemblance of their hind limbs to those of birds, by simple similarity of function. The author then proceeded to notice the Dinosauria of the Trias, commencing with an historical account of our knowledge of the occurrence of such reptilian forms in beds of that age. He identified the following Triassic reptilian-forms as belonging to the Dinosauria:—*Teratosaurus*, *Platæosaurus*, and *Zanclodon* from the German trias; *Thecodontosaurus* and *Palæosaurus* from the Bristol conglomerate (the second of these genera he restricted to *P. cylindrodon* of Riley and Stutchbury, their *P. platyodon* being referred to *Thecodontosaurus*); *Cladyodon* from Warwickshire; *Deuterosaurus* from the Ural; *Ankistrodon* from Central India; *Clepsysaurus* and *Bathygnathus* from North America; and probably the South African *Pristerosaurus*.—Sir Roderick Murchison, who had taken the chair, inquired as to the lowest formation in which the bird-like character of Dinosaurians was apparent, and was informed that it was to be recognised as low as the Trias, if not lower.—Mr. Seeley insisted on the necessity for defining the common plan both of the Reptilia and of the ordinal groups before they could be treated of in classification. He had come to somewhat different conclusions as to the grouping and classification of Saurians from those adopted by the President. This would be evident, in so far as concerned Pterodactyles, from a work on Ornithosauria which he had just completed, and which would be published in a few days.—Mr. Etheridge stated that the dolomitic conglomerate, in which the Thecodont remains occurred near Bristol, was distinctly at the base of the Keuper of the Bristol area, being beneath the sandstones and marls which underlie the Rhætic series. There were no Permian beds in the area. He regarded the conglomerates as probably equivalent to the Muschelkalk. It was only at one point near Clifton that the Thecodont remains had been found.—Prof. Huxley was pleased to find that there was such a diversity of opinion between Mr. Seeley and himself, as it was by discussion of opposite views that the truth was to be attained. He accepted Mr. Etheridge's statement as to the age of the Bristol beds.—2. The Physical Geography of Western Europe during the Mesozoic and Cainozoic periods, elucidated by their coral faunas, by P. Martin Duncan, M.B.Lond., F.R.S., Secretary. The author commenced with a notice of the typical species of the coral fauna of the deep seas which bound continents remote from coral-reefs, and then made some remarks upon the littoral corals. The peculiarities of reef, lagoon, and shallow-water species were then explained, with the relations of the two faunas to one another. The author then referred to certain exceptional species, indicated the genera, the species of which constitute the existing reefs, and contributed to form those of the past, and noticed the representatives of some modern genera in old reefs. He pointed out that a correspondency of physical conditions during the deposition of certain strata was indicated by their containing analogous forms—the presence of compound cœnenchymal species indicating neighbouring reefs, and their absence in places where simple or non-cœnenchymal Madreporaria are found being characteristic of deep-sea areas remote from the coral-seas. By applying the principles thus elaborated to the evidence as to the condition of the seas of the European area from the Triassic period to the present time, the author then showed what must probably have been the physical condition of this part of the world at different periods. —Prof. Alex. Agassiz accounted for the circumscribed area of many corals in the Atlantic from the young of many coral species attaching themselves within a few hours of their becoming pelagic. He traced to the great equatorial current which must have traversed the Isthmus of Panama and the Sahara in a precretaceous period, the distribution of certain forms, which the rising of the Isthmus of Panama eventually checked. He thought that the limits of the depth at which true reef-building corals existed would be considerably extended in consequence of recent discoveries by means of dredging. He mentioned the formation of a reef at the present time off the coast of Florida, which threw light on the manner in which mudflats were formed, and the sea eventually filled.—Mr. J. Gwyn Jeffreys objected to the term deep sea being applied to a depth of ten fathoms only, when the tide in some places rose to that extent, and the laminarian zone extended to fifteen. He suggested fifty fathoms as a more appropriate measure. He remarked on the great vertical range of some simple species of corals, such as *Caryophyllia*, amounting to at least 150 fathoms from low-water mark. In deep-sea water it frequently was attached to various shells, such as *Ditrypa* and *Aporrhais*. The only other simple coral of our seas was never found at a depth of less than seventy-five fathoms. The compound corals occurred only at great depths. Dr. Duncan drew a distinction between coral-reef areas and those in which different conditions prevailed. His argument had not so much been based on the depth of the sea as on the presence or otherwise of coral-reefs. The term deep sea had been given by Professor Forbes to depths of ten fathoms and upwards. For such depths as those explored at the present day no term short of "abyssal" was appropriate. Specimens illustrative of his paper were exhibited by Professor Huxley.—The President called the attention of the Fellows of the Society to a proposed memorial to the late Baron von Humboldt, and another to the late Prof. J. B. Jukes, in aid of which contributions were desired. He referred to circulars and letters which were laid on the table, and recommended these memorials to the favourable consideration of the Fellows.

Edinburgh

Royal Physical Society, November 24.—This was the first meeting of the session. Dr. Stevenson Macadam, the President, delivered an address on the subject of Chemical Geology, in which he stated that chemistry had much to do in the explanation of geological phenomena, and though not a believer in the chemical doctrine of volcanic action as generally understood, yet he trusted to show that the geologist must accept the hand of the chemist in climbing up to an intelligent explanation of geological changes on the surface of the globe. The day has now gone by for either Plutonists or *firemen*, or Neptunists or *watermen*, to hold undisputed sway in the interpretation alike of ancient and modern changes; and the truth lies in the golden mean, and may be best sought for in the earnest endeavours to cull knowledge from all the contending elements. The first lesson which chemistry teaches us is to proceed cautiously and modestly to work. The geologist, with hammer in hand and a good share of physical force, is almost taught by the nature of his vocation to expect the same results from the same causes, operating in much the same way, and he becomes bold in theory and difficult to dislodge in his opinion; but the chemist is taught by the very nature of his science to proceed with slow and cautious steps, not only in experimenting, but also in theorising, and he learns soon that the same results need not necessarily proceed from the same causes, and that slight alterations in the mode of working may produce different results. More than that, the same results can be achieved by several modes of working. The President then alluded to chemical reaction as affecting geological phenomena; the weathering of rock masses; the influence of water holding certain gases and salts in solution on mineral substances; the production of limestone and other rocks; and the formation of coal. The effect of heat as well as water in the production of crystalline forms was alluded to, as well as the artificial formation of precious minerals, such as the ruby and sapphire. The cause of volcanic phenomena was neither solely connected with the existence of internal molten masses capable of being squeezed or blown through the external crust of the globe, nor to the presence of large quantities of the alkaline and other metals ready to be burned and ignited on the approach of water; but the President believed that the spheroidal theory of the earth's crust, propounded by himself years ago, coupled with the doctrine of the correlation of the physical forces, was sufficient to account for all volcanic phenomena. The earth is constantly under magnetic and electrical disturbance, and knowing, as can now be proven, that the physical magnetism and electricity can become heat, there seems no necessity for fancying the existence of reservoirs of molten matter waiting for ages to be discharged through the crust, or regions of uncombined chemical elements longing for water to quench their thirst. The President showed experimentally the passage of magnetism into electricity and heat, by means of large magneto-electric apparatus, which heated and fused various metals. The address concluded with reference to spectrum analysis, as indicating the composition of the sun and other stars, and as demonstrating that there is a brotherhood of matter and force throughout the universe.

The following gentlemen were elected:—As foreign members on the recommendation of the Council—Mr. C. Hitchcock, State Geologist, Vermont, U.S.; Premier Lieut. Dr. C. F. Lutken, assistant in the Zoological Museum, Copenhagen; Dr. O. A. Loweson Morch, University Museum, Copenhagen. As resident members—Mr. R. Scott Skirving, Camptown—proposed by J. M'Bain, M.D., R.N.; Mr. H. Budge, C.A., 7, Hill Street—proposed by M. R. Brown.

Dublin

Statistical and Social Inquiry Society, Nov. 23.—Robert McDonnell, M.D., F.R.S., read a paper on Patronage and Purchase in making Hospital Appointments. Dr. McDonnell condemned the system of purchase, adducing many reasons for doing so. In discussing the question he avoided all personalities, not alluding to the practice of any one hospital, but relying solely on the importance of appointments being made, not on account of the amount of money that a candidate could produce, but on account of his general ability and merits.

Paris

Academy of Sciences, November 22.—M. Becquerel communicated an eighth memoir upon electro-capillary phenomena, in which he treated of respiration, and the nutrition of the tissues, and of the muscular currents and the current of the other tissues. The author stated his principle as follows: Two different liquids, separated by a tissue, that is to say, a porous body capable of being soaked by the liquids, give origin to electrical currents resulting from the recomposition of two electricities set free in the reaction of the liquid, the walls of the capillary spaces acting as solid conducting bodies. These currents the author denominated *electro-capillary*, and the object of his paper was to demonstrate their action in the vital phenomena above mentioned, in order to establish an electro-chemical theory of life. —The dispute about wine-heating was advanced a stage by the presentation of a note from M. Vergnette-Lamotte in answer to M. Pasteur's last communication.—Of two astronomical papers by Father Secchi, the first related to the spectrum of the planet Neptune, and to some facts in spectrum analysis, and the second described a new arrangement for the observation of the spectra of the smaller stars, and referred also to the meteors of the 14th November. The author stated that the spectrum of Neptune, like that of Uranus, presents bands of absorption which do not occur in the solar spectrum. Of the three principal bands, one occurs at the limit of the geeen and yellow, about half-way between D and b; a second in the place of the line b in the solar spectrum, and the third, which is fainter, in the blue. Beyond the yellow, in the opposite direction, the spectrum suddenly terminates. The author remarked upon the accordance of this spectrum with the colour of the planet, and upon the indistinctness of its outline under high magnifying powers. The author also indicated a means of obtaining two superposable spectra, and stated that he had observed that the spectra furnished by Geissler's tubes were essentially different according as the light was taken from the tubes, the bulbs, or the luminous sheaths of the wire. In his second paper Father Secchi stated that in order to observe the spectra of the smaller stars, he had adopted the plan of placing a large prism before the object-glass of his telescope, and obtained favourable results, some of which he communicated.—A note by M. F. Massieu, supplementary to a paper presented by him on the 18th October, was read. It related to characteristic functions in thermodynamics.—M. P. Gauthier communicated an essay on the movement of a projectile in the air; M. J. Carvallo, an investigation of the stability of beacon towers: M. E. Roger, a note on some general properties of curved surfaces; MM. Curie and Vigier communicated the results of some experiments upon animals, indicating that turpentine is not, as was supposed by M. Personne, an antidote for phosphorus. They also remarked that the hypothesis that the toxical action of phosphorus is due to its depriving the blood of oxygen was not compatible with the small doses of phosphorus which may prove fatal.—A note from M. Zantedeschi on the calorific rays of the moon was read, in which he indicated that the heating effect of the moon's rays was demonstrated in 1685 by G. Montanari, and in 1781 by P. Frisi. The author also cited his own experiments.—A note on the calculation of the going of chronometers to determine longitudes, by M. H. de Maguay, was read, giving the results of observations upon these chronometers, and upon this M. Yvon Villarceau made some remarks.—A note by M. Bontemps on the coloration of glass under the influence of the solar light, was presented. In this paper the author adduces numerous examples of the production of a greater or less change in the colour of glass by long exposure to the sun's rays.—A note on the physical properties of arable soils, by M. Hervé-Mangon, was read, in which the author called attention to certain physical properties of soils, such as their calorific power, their power of condensing and holding gases, and especially their behaviour with regard to water and aqueous vapour, which are of as much importance as their chemical properties in estimating the qualities of the soils. He described the means by which these properties of soils may be investigated. —An extract from a letter by Mr. C. T. Jackson, of Boston, was communicated, giving an account of the copper-mines of Lake Superior, and of a new deposit of tin in the State of Maine. He mentioned a mass of native copper obtained at a depth of 480 feet in the Phœnix mine last June, measuring 65 feet long, 32 feet high, and 4 feet thick at the exposed end. He estimated that this mass would furnish about 1,000 tons of copper, and stated that it was contained in a true vein, cutting at right angles several beds of trap and other rocks. The gangue consisted of calc spar, quartz, and pretruite. The deposit of tin noticed by the author was said to be in the neighbourhood of the town of Winslow, where the mineral occurs in more than 40 little veins, varying in thickness from ¼ inch to 1 foot, occupying a space between the metamorphic limestone and gneiss which constitute the country. The author obtained from the rough mineral 46 per cent. of tin.—A letter from M. A. Rojas entitled "Echoes of a seismic tempest" was communicated. It contained an account of disturbances, chiefly manifested by the rise and fall of water, which occurred in various parts of South America simultaneously with the great Peruvian earthquake of the 13th August, 1868.—A letter by MM. E. Harny and F. Lenormant, dated at Thebes, was communicated, in which they announced the discovery of traces of the Stone Age in Egypt. They found an immense quantity of worked flints of all kinds upon a small space of the plateau separating the valley of Biban-el-Molouk from the escarpments which look over the ruins of Deir-el-Bahari. They compared the place to what is known in France as a "workshop of the Neolithic period."—M. Balbiani communicated an investigation of the development and propagation of *Strongylus gigas*, in which he described the production and structure of the egg, and the development of the embryo of that parasite, the embryo of which he said, remains in the egg for five or six months in winter, and may remain there for a whole year. The author described his experiments, from which it appears that this parasite does not pass directly from the egg into the animal in which it acquires its perfect development.—M. P. Fischer described the copulation and spawning of the *Aplysiæ* and *Dolabriferæ*, as observed by him in the aquarium at Arcachon. In the *Aplysiæ*, the same individual serves alternately as a male and as a female; and the author mentioned his having several times seen five or six individuals united to form a chain, each of them, except the first and last, performing the function of both sexes at once. In the *Dolabrifera*, which is likewise hermaphrodite, the copulation of the two individuals is reciprocal. The author described the emission and mode of attachment of the ribbon of eggs produced by the *Aplysiæ*, which, according to him, is sometimes as much as 120 times the length of the body of the Mollusk.—A note on the aanatomy of the Alcyonaria, by MM. G. Pouchet and A. Myèvre, was presented, as also some other papers of which the titles only are given.

ITALY

Royal Lombardy Institute of Science and Literature. The following Prize Questions are proposed by this Institute:—

ORDINARY PRIZES OF THE INSTITUTE.

Class of Literature and of Moral and Political Science.

For 1870.—To what extent is it the right or duty of Government to interfere in the education of the people, and how ought this interference to be exercised?

1. To determine whether it is a right or a duty.
2. To inquire how the exercise of such right, or the performance of such duty, can be reconciled with the acknowledged and inalienable principle of liberty, civil, political, and religious. (To be delivered in Feb. 1870.)

Class of Mathematical and Natural Science.

For 1871.—Required an Essay on the physical and chemical nature of the various mineral combustibles of different epochs, with the view of determining whether there are any means of establishing a new classification thereof, which may serve to diminish, if not to remove, the ambiguities relating to the importance of the several deposits of mineral fuel, having regard to their quality, and to the extent of their deposits. (To be delivered in Feb. 1871. Prizes for this and the preceding question, 1,200 lire.)

TRIENNIAL MEDALS OF THE INSTITUTE.

The Royal Institute of Lombardy, according to the fifteenth article of its organic regulations, "adjudges every three years two gold medals, each worth 1,000 lire, for the promotion of agricultural and manufacturing industry; one of which is intended for those Italian citizens who have contributed to the progress of agriculture in Lombardy, by means of discoveries, or of methods not yet put in practice, the other to those who have conspicuously improved, or successfully introduced into Lombardy a given manufacturing industry."

Those who wish to compete for these medals are requested to present their claims, accompanied by the necessary documents, to the Secretary of the Institute, at the Palazzo di Brera in Milan, not later than the 1st of March, 1870.

ORDINARY PRIZES OF THE FONDAZIONE CAGNOLA.

For 1870.—Required a Memoir, treating of the attained or possible advantage to the agriculture of any of the provinces of the Kingdom of Italy, and especially of Lombardy, arising from the introduction, accomplished or possible, of the doctrines or practices recommended at the present day by the progress of Physics, Chemistry, or Meteorology. (For Feb. 1870. Prize, 3,000 lire, including a gold medal, worth 500 lire.)

For 1871.—A Monograph on the poisonous and explosive substances extracted from coal, and on the hygienic measures to be adopted in the preparation, commerce, and transport of these bodies. (To be delivered Feb. 1871. Prize, 1,500 lire, with a gold medal of the value of 500 lire.)

For 1872.—A Memoir giving, together with the necessary proofs by fact, a demonstration or a refutation of the curative or prophylactic efficacy of the alkaline and earthy sulphites or hyposulphites in intermittent fevers arising from malaria, comparatively with other means or remedies already known. (To be delivered in Feb. 1872. Prize, 1,500 lire, and a gold medal, worth 500 lire.)

The Memoirs to which prizes are awarded in the ordinary competitions of the Fondazione Cagnola remain the property of the authors; but the latter are bound to publish them within a year, consulting with the Secretary of the Institute as to the arrangements and characters, and consigning to the Institute fifty copies, after which only will the money be paid.

The Institute and the representative of the Fondazione Cagnola reserve the right of printing a larger number of copies at their own expense.

EXTRAORDINARY PRIZE OF THE FONDAZIONE CAGNOLA.

For 1870.—A prize of 1,500 lire, and a gold medal of 500 lire, to the author of any work, MS. or printed, in Italian, Latin, or French, and published since 1860, which shall satisfactorily demonstrate the efficacy of any means for the cure of Gout.

The Memoirs and printed works must be presented in Feb. 1870; of the latter, two copies must be presented, with precise indication of the passages in which the discovery in question is treated. The prize may be awarded in part, and the award will take place on the 7th of August, 1870. The printing or the custody of the manuscripts to be regulated as for the ordinary prizes of the Foundation.

PRIZES OF THE FONDAZIONE SECCO-COMNENO.

For 1870.—Chemico-microscopic investigation of the curd of milk, to determine whether its active principle resides in a biological ferment, or in any other chemical agent, so as to estimate exactly the quantity required in the making of cheese. (To be delivered Feb. 1870. Prize, 864 lire.)

For 1872.—To determine, on chemical principles, and by appropriate experiments, what are the best anti-fermentatives or antiseptic substances; also the best disinfectants and deodorizers, simple or compound, indicating their various uses and relative costs, with special reference to recent investigations. (To be delivered Feb. 1872. Prize, 864 lire.)

The prize-memoir to remain the property of the author; but he must publish it within a year from the date of award, consigning eight copies to the managers of the "Ospitale Maggiore di Milano," and one to the Institute, for comparison with the MS.; after which only will the money be paid.

PRIZES OF THE FONDAZIONE BRAMHILLA.

For 1870.—Prize of 3,000 lire and commemorative silver medal to any one who, by the 30th of Nov. 1869, shall have established in Lombardy a manufacture of phosphates, prepared for agricultural use, on a scale sufficient for the manuring of at least 200 hectares per annum. (To be delivered Jan. 1870.)

For 1871.—Prize of 4,000 lire to any one who has invented or introduced into Lombardy any new machine or industrial process, or other improvement from which the population may obtain a real and demonstrated advantage. (To be delivered Jan. 1871.)

The competitors for the prizes of this Foundation must present their claims, accompanied by the requisite documents, within the time specified, to the Secretary of the "Royal Lombardy Institute of Science and Literature," in the Palazzo di Brera at Milan.

General Regulations for all the Scientific Competitions.

These competitions are open to all persons, native or foreign, excepting the actual members of the Royal Institute; the Memoirs must be written in Italian, French, or Latin, and they must be sent, post-free, at the times specified, to the Secretary of the Institute, at the Palazzo di Brera in Milan; and, according to the academic regulations, they must be anonymous, and distinguished by a motto repeated in a sealed packet, containing the christian name, surname, and residence of the author.* Particular attention is recommended to this regulation, as in default of compliance therewith, the Memoirs will not be taken into consideration.

To avoid mistakes, the competitors are also requested to state clearly *for which* of the prizes proposed by the Institute they intend to compete.

All the manuscripts will be preserved in the archives of the Institute, authors being at liberty to have copies of them taken at their own expense.

Authors of Memoirs to which prizes are not awarded are at liberty to withdraw the corresponding packets within a year after the adjudication of the prizes, which will take place in solemn assembly on the 7th of August following the close of the competitions.

* This regulation does not apply to the competitions for the extraordinary prizes of the Fondazione Cagnola, or for the prizes of the Fondazione Bramhilla.

DIARY

THURSDAY, DECEMBER 2.

SOCIETY OF ANTIQUARIES, at 8.30.—A Chalice of the Fifteenth Century, and Chalices generally; Mr. Octavius Morgan, M.P., V.P.S.A.
LINNEAN SOCIETY, at 8.30.
CHEMICAL SOCIETY, at 8.30.
LONDON INSTITUTION, at 7.30.—Architecture: Prof. R. Kerr.

FRIDAY, DECEMBER 3.

GEOLOGISTS' ASSOCIATION, at 8.
PHILOLOGICAL SOCIETY, at 8.30.
ARCHÆOLOGICAL INSTITUTE, at 4.

MONDAY, DECEMBER 6.

ENTOMOLOGICAL SOCIETY, at 7.
MEDICAL SOCIETY, at 8.
VICTORIA INSTITUTE, at 8.
LONDON INSTITUTION, at 4.—Elementary Physics: Prof. Guthrie.
SOCIETY OF ARTS, at 8.—The Spectroscope and its Applications: Mr. J. Norman Lockyer.
ROYAL INSTITUTION, at 2.—General Monthly Meeting.

TUESDAY, DECEMBER 7.

CIVIL ENGINEERS, at 8.—On Public Works in the Province of Canterbury, New Zealand: Mr. Edward Dobson, Assoc. Instit. C.E.—On Ocean Steam Navigation, with a view to its further development: Mr. John Grantham, M. Inst. C.E.
PATHOLOGICAL SOCIETY, at 8.
ETHNOLOGICAL SOCIETY, at 8.—Report on the Prehistoric Remains in the Channel Islands: Lieut. S. P. Oliver, R.A.—On the Megalithic Monuments of Brittany: The Rev. W. C. Lukis.
SYRO-EGYPTIAN SOCIETY, at 7.30.—On the Obliteration of the Name and Figure of Amun, and the Restoration of both in the time of Rameses the Second: Mr. Bonomi.

WEDNESDAY, DECEMBER 8.

SOCIETY OF ARTS, at 8.—Prints and their Production: Mr. S. T. Davenport.
GEOLOGICAL SOCIETY, at 8.—Notes on the Brachiopoda hitherto obtained from the Pebble-bed at Budleigh Salterton, near Exmouth: T. Davidson, Esq., F.R.S.—On the Relation of the Boulder-clay without Chalk of the North of England to the Great Chalky Boulder-Clay of the South: Searles V. Wood, Esq., Jun.—On the Iron-ores associated with the Basalts of the North-east of Ireland: Ralph Tate, Esq., F.G.S., and J. S. Holden, M.D.
ROYAL MICROSCOPICAL SOCIETY, at 8.—On Deep-sea Dredgings from the Vicinity of China and Japan: Prof. Rymer Jones, F.R.S.
ARCHÆOLOGICAL ASSOCIATION, at 8.

THURSDAY, DECEMBER 9.

ROYAL SOCIETY, at 8.30.
SOCIETY OF ANTIQUARIES, at 8.30.
ZOOLOGICAL SOCIETY, at 8.30.
MATHEMATICAL SOCIETY, at 8.
LONDON INSTITUTION, at 7.30.

BOOKS RECEIVED

ENGLISH.—The Life and Letters of Faraday, 2 vols.: Dr. Bence Jones (Longmans).—Ornithosauria and Reptilia from the Secondary Strata: H. G. Seeley (Deighton, Bell, and Co.).—Proceedings of the Royal Physical Society of Edinburgh, 1862–6 (Williams and Norgate).—A System of Mineralogy: J. D. Dana and G. J. Bush (Trübner and Co).—More Light, a Dream in Science (Wyman and Sons).—The Best Method of Developing the National Talent for Music: H. L. Bellini (Mallett).—The Origin of Seasons considered from a Geological Point of View: Samuel Mossman (Blackwood and Sons).—The Advanced Atlas, Progressive Atlas, Primary Atlas (W. Collins, Sons, and Co.).

AMERICAN.—Annual Report of the Trustees of the Peabody Academy of Science (Trübner and Co).

FOREIGN.—Voyages Aeriens: Glaisher, Flammerion, W. de Fonvielle and Tissandier (Hachette).—Histoire de la Création: H. Burmeister.—La Chambre Noire et la Microscope, Photomicrographie practique: Jules Girard.—Ueber Thal- und See-Bildung: Prof. L. Rutimeyer.—Beobachtungen und Rechnungen über veränderliche Sterne von Dr. F. W. A. Argelander.—Allgemeine Himmelskunde.—Ueber das Zurückbleiben in den Naturwissenchaften.—Karl Ludwig Freiherr von Reichenbach: Dr. A. R. T. Schrötter.—Eierstock und Ei: Prof. W. Waldeyer. (Through Williams and Norgate.)

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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Registered for Transmission Abroad.]

THURSDAY, DECEMBER 9, 1869

SCIENCE AND THE PUBLIC HEALTH

AMONG the wide range of subjects included in the programme of NATURE, one of the most important to mankind in general is certainly "the public health." We propose in the following article to lay before our readers an account of the way in which the attention of different nations, at various times, has been directed to this matter, until at last it is beginning to be recognised as a necessary study for all.

It would seem at first sight hardly necessary to spend words on defining the aims of a science, of which the name "Health" is so expressive, but the various writers on the subject have not thought so, and the old formula, "the art of preserving the health," has been often changed.

Londe, apparently from a dietetic point of view, says, "Hygiene is the science which has for its object the direction of the organs in the exercise of their functions," a definition which strangely limits the subject, and even excludes the most important and interesting part of it.

Oesterlen, desirous of bringing into view the two great divisions of hygiene, calls it "that part of our knowledge which has to do with the preservation and furthering of the health of individuals on the one hand, and of the community at large on the other."

Michel Lévy says that it is "the clinical study of healthy man," by which definition he wishes to individualise the more general one; but even here we do not find what we want: indeed we prefer the original definition to all these alterations of it. Dr. Parkes thinks so too, for he says, "Hygiene is the art of preserving health, that is, of obtaining the most perfect action of body and mind during as long a period as is consistent with the laws of life; in other words, it aims at rendering growth more perfect, decay less rapid, life more vigorous, death more remote."

And now we come to the extension which Bouchardat has given to the ordinary definition, "Hygiene is the art of preserving the health." But how can we preserve health? Plainly by doing our best to keep away disease. And how can we do this? By checking the causes of disease. To this end we must know these causes,—and here we have the grand object of hygiene; it is the science which studies the causes of disease, and points out the means of avoiding them.

The knowledge of causes is the great aim of all science properly so called, and no study ought to be honoured with that name which has not this end in view.

"Prevention is better than cure" is an old proverb, and, what is more, a very true one, and it is *prevention* that the hygienist studies—prevention of disease of whatsoever kind by the removal of its causes. The means by which diseases are prevented are often those which answer best for their cure; and here we perceive the link which joins hygiene with medicine, and which constitutes what we may call the therapeutical side of our science.

Thus we see that hygiene takes into consideration, incidentally as it were, and in connection with medicine, the treatment of many forms of disease by methods other than the employment of pharmaceutical preparations—these methods are what Fonssagrives calls "the Hygienic Modificators," and are such as exercise, baths, change of employment, sea voyages, residence in a different climate and above all regimen.

As the methods for the preservation of health are of the first importance to all human beings, we may expect to find provisions to this end among the writings of the ancients, especially in the codes of the lawgivers: and such is the case; take for example the writings of Moses,—they are replete with most excellent hygienic regulations, which his followers were obliged to observe under pain of severe penalties.

Look at the institution of circumcision, the provisions for the separation of the lepers from the healthy people, the command not to eat swine's flesh, the prohibition of the marriage of near relations. Besides these and many other important generalities, we find the great Hebrew legislator descending to the inmost details of family life—giving a regimen admirable in its adaptation to the climate of the countries for which it was intended; directing the burial of excrementa and refuse matter of all sorts in the earth; fixing the laws of marriage, of concubinage, of servitude, and of all social relations.

It is to the strict observation of these sanitary regulations that one of the best-known writers on hygiene of the present day, M. Michel Lévy, does not hesitate to ascribe the singular immunity of the Jewish race in the midst of fearfully fatal epidemics; which immunity was so marked in the middle ages, that it brought upon them "accusations the most absurd, persecutions the most atrocious."

We turn now for a moment to China, and find a people in many respects in a very high state of civilisation, a people who had used the mariner's compass ages before it was known in Europe; but a people who, from want of communication with other nations, have made no advance at all, perhaps, for thousands of years, who have gone on increasing in numbers at such a rate that they now form one-third of the population of the whole world, so that their country is crowded to an extent hardly conceivable. Surely we can learn something from them which will be of service to us in the management of our overgrown towns! Yes; in one thing at least they are our masters—they waste nothing; what they take from the earth they give back directly to the earth; every atom of their sewage matter is employed as manure; and how otherwise would it have been possible for so immense a population, without any external resources, to live on such a comparatively limited portion of the earth's surface, and to *keep it fertile* for so many centuries?

One of the best instances of the power of cultivation in improving the condition of a country is to be found in Lower Egypt, formerly the centre of civilisation of the world, now in a most abject condition: the inundations of the Nile, while the country was peopled with intelligent races, were the great source of its fertility, but are now the cause of the insalubrious marshes that generate the Plague, and make that country one of the most unhealthy spots on the face of the globe.

To come nearer to our own country, let us see what were the hygienic conditions of ancient Greece and Rome. Had the practical application of the principles of public health anything to do with the high state of civilisation to which those countries rose—a state which has, in some respects at any rate, never since been equalled? Had it anything to do with the success which attended the Roman armies, and led to the formation of that enormous Roman empire? Let the facts speak for themselves. What strikes one more in reading the classical authors of those countries than the continual mention of gymnasia and of baths? We find that a certain portion of time was set apart daily for bodily exercise, and thus a full development of the body was produced, and the greatest resistance given to those two great enemies of mankind, disease and death. It is true that all this training was part of a grand military system, that the youths were thus encouraged to compete for the prizes in the Olympic games and in the Roman gymnasia that they might become good soldiers; but did this prevent the cultivation of mental acquirements? Again let the facts give the decision. Do you wish to see fine buildings, buildings so well constructed that they have lasted comparatively untouched by decay for centuries? Do you wish to study beautiful sculptures, statues anatomically perfect to the minutest details, and of unsurpassed artistic elegance? You go to Athens! You go to Rome! Do not fancy that we contend for bodily exercise as against mental studies: we merely maintain that a sufficient daily corporal exercise is absolutely necessary for the proper performance of the functions, both of mind and body.

But we have not yet done with Rome. We have mentioned the baths of that city; but how were they supplied with water? Ah! here we have need to hide our faces for shame. Surely we, with all the immense advantages of scientific engineering, manage to supply our cities with water as well as the people of two thousand years ago; at any rate, with all our steam engines and manufactories, we require at least as much as they did. When we turn to the pages of Frontinus, what do we find? That at the time at which he wrote, about A.D. 92, there were actually *nine* large aqueducts by which water was brought into Rome, beside some smaller channels; these aqueducts were in some cases entirely covered over throughout their whole length, and were driven underground or supported by high arches, as occasion required. Several of them, as the Anio Vetus, the Claudian, and the Anio Novus, were from 42 to 49 miles in length, while the total length of the Marcian was actually 54 miles. The water was brought by the two Anios from the river Anio, by the others from various springs and lakes around Rome; the two newest ones, the Claudian and the Anio Novus, were made because "*seven aqueducts seemed scarcely sufficient* for private purposes and public amusements."

The supply appears to have been equivalent to more than 332 millions of gallons per day, or (since the population was certainly not more than a million) at least 332 gallons per head per day—say, six times the amount that we have now in London.

But beside the aqueducts, there was a capital system of sewers at Rome, consisting of the "Cloaca Maxima" and a series of smaller channels flowing into it. The above remarks give an idea of the admirable manner in which the means for the conservation of the public health were made a subject of State legislation in ancient Rome, and of the determined way in which all obstacles were vanquished, in order that the city might be made as healthy as possible.

Not only have we the example of the ancients in these matters, but we have hygiene reduced to a system by Hippocrates, and associated, as it should always be, with medicine. In reading his Aphorisms, one is struck by the excellent dietetic regulations which he gives, for the observance of gymnasts, and for the guidance of physicians in treating acute and chronic diseases. His third section, which treats of the influence of the seasons of the year, and of the various ages of man in the production of diseases, is also very remarkable.

The very names of the works of Hippocrates show how great a hygienist he was. "About Food," "About the Use of Liquids," "About the Diet of Healthy People," and especially his treatises on "Air, Water, and Localities," and on "Epidemics," are works which well entitle their author to be considered the father of experimental hygiene.

After Hippocrates comes Celsus, during the 1st century of our era, who devotes the first chapter of his first book "De Re Medica" to the exposition of rules concerning diet, and recommends the avoidance of too great regularity by healthy persons.

But we must not pass over the works of Galen, which were so numerous as to form a complete treatise of medicine, and which exercised so enormous an influence over the medical practice of the whole world during many centuries. Galen flourished during the latter part of the 2nd century after Christ, and was for some time physician to the gymnasia at Rome. He revived the doctrines of Hippocrates, especially the celebrated one of the four humours (blood, bile, phlegm, and atrabile), and considered that the different temperaments were produced by mixtures in various proportions of these humours with the four elements—earth, air, fire, and water, and with the four physical qualities—heat, cold, moisture, and dryness.

The Sicilian School sprang up in the 11th century, and was the offspring of the ancient Greek and Arabian medical schools. Its practice is handed down to us in a quaint Latin poem, in which a great deal of truth is mixed up with a great deal of trash, and in which we find bad therapeutics based upon faulty pathology. It is from this school that the doctrines of Hippocrates and Galen, together with the fancies of later times, were spread abroad over Europe. Thus we find that the experimental methods of the fathers of medicine were confused with a host of traditions derived from the Arabian alchemists; so that the rational methods of treatment, adopted by Hippocrates and his more immediate successors, were neglected; and diseases were treated instead by a host of supposed infallible remedies, of which the action was not at all investigated. And what do we find as the result of this change of practice? That epidemics raged with the most fearful intensity all over Europe, epidemics which were only known accidentally before, and which, finding favourable conditions for their spread in the utter neglect of hygiénic observances, came from their natural seats in hot eastern countries, and committed unheard-of ravages in Europe. Look at the Plague, that fearful epidemic of the eastern part of the Mediterranean! It is true that we have accounts of terrible visitations of it in Greece, and particularly of one which depopulated Athens in the second year of the Peloponnesian war, when the disease was introduced into that city (then fearfully overcrowded) by a ship from

Egypt, that entered the Piræus: at various times also, and particularly in the year of the city 389 (before the building of the aqueducts), the Roman capital was visited with the same calamity: but this is nothing to the fearful visitations with which all Europe was afflicted during the 14th, 15th, 16th, and 17th centuries.

The last appearance of the Plague in Europe was in 1719, when it was introduced into Marseilles by a ship that had been refused admittance into the port of Cagliari in Sardinia. Even then its course might probably have been stopped, had its malignant nature been recognised soon enough; but this was not the case, and more than 90,000 persons were killed by it. Here we have a clear proof of the value of preventive measures. Sardinia was saved because the king refused the admission of the ship into the port of Cagliari; Marseilles was ravaged because a like precaution was not taken.

In England we are accustomed to manage affairs in a less official manner than they are managed abroad, and the result is that improvements, although more difficult of introduction, are often more surely brought about with us than with our neighbours. It is certainly not because we are less hygienic in our habits than other nations, that we have so few books on hygiene, or that our Medical Schools have not looked upon it as a sister science with Medicine; but because it seemed to take no special line, and because it seemed to be so much everybody's business: now, however, since the formation of the General Board of Health and the Registrar-General's office, such a mass of information with regard to the statistics and to the causes of disease has been obtained, that it seems necessary to make a special study of this science, and no longer to allow it to be taught accidentally as an appendage to Pathology or Therapeutics.

W. H. CORFIELD

SCIENCE EDUCATION IN GERMANY

I.—THE GERMAN UNIVERSITY SYSTEM

THE most striking point of difference between the condition of science teaching in Germany and in England lies in the great facilities and encouragements which, in the former country, are given to the study of science in its highest development. In primary education, we are in England probably doing as much or more in the way of encouraging the teaching of elementary science as is being done in Germany, or elsewhere. It is our richly endowed Universities which have as yet failed to play the important part in this essential feature of modern education which, from their position and means, we have a right to expect them to do, whilst other less wealthy Colleges and educational establishments, quite as capable of giving the highest scientific instruction, have to battle with almost overwhelming difficulties. Government, on the other hand, true to its supposed function of simply assisting those who cannot help themselves, only gives pecuniary aid towards the science instruction of the working classes; and, with a singular want of foresight, provides no systematic means of training the teachers,* who are left to pick up their education as best they may.

* The few Queen's prizes and other exhibitions for instruction in the Royal School of Mines cannot in any respect be considered as a *system* of science education for teachers.

The university system of Germany is now so different in character from that of England, that it is difficult to believe that these institutions, of the same age and standing, were founded on the same type, and perhaps equally so to explain how they came to be so essentially different. The cause of this difference appears, however, to me to lie less in the necessarily varying nature of national character and requirements, than in the simple fact that in Oxford and Cambridge the system of colleges founded originally as benefactions to religious societies by private donors, and still retaining a party and religious character, has swamped (or nearly so) the university; and that the college tuition interferes with, and is indeed often absolutely opposed to, that of the proper educating body which it was intended only to supplement. In Germany the college system does not exist, and the university has always remained supreme in its locality; it knows of no interference, religious or otherwise, in its own sphere; its system of education is regulated according to one principle, and one spirit of emulation pervades the whole staff of teachers.

It is singular to notice that the German universities, which are all of them Government institutions, every professor being a civil servant of the Crown, taking the oaths and receiving salary and pension, do not suffer from what we are apt to consider the deadening influence of Government service. On the contrary, this system now holds, and has always contained, the highest and best intellectual life of the nation, replete with energy both as regards teaching power and original research. This may be explained by the fact that although the universities are State institutions, yet they are practically free as regards their internal government. Each Professor teaches as he thinks best, and Ministerial interference with the regulations of the Senate is of the rarest occurrence. In another point of view, it is well to compare the Government universities of what we Englishmen are even yet too apt to consider as the despotic and illiberal German powers with our free (!) universities. In Germany all, from prince to peasant, who choose, can and do come to the university, provided they bring certificates of having passed the exit examination of their gymnasium, as a proof of due qualification to benefit from the university instruction. Thus, the small government of Baden supports two universities, to the benefits of which persons of all classes, of all religious denominations, and natives of all countries are permitted to enter, without limitation of number, without religious test of any kind, and for the payment of ridiculously low fees. Can we say that our universities are as free? or that we in England possess any other institutions which fulfil for us the duties of these High Schools for the German people?

The university system of Germany has most certainly succeeded in stimulating intellectual activity, and fostering a spirit of original inquiry amongst the teachers, and thus creating a true profession of learned men. On the other hand, it offers sufficient inducement to aspiring students to devote themselves to special pursuits, and raise their aims to something higher than mere "Brodstudien," by opening out to them a path, often arduous and rugged, by which a man of ability may rise, from privat-docent and extraordinary professor, to the highest position of university eminence. This free infusion of new blood into the teaching staff is one great secret of the vitality of the German system; another, certainly, is the well-known principle of "Lern und Lehr-Freiheit." The professor is, on the one hand, perfectly free to treat his subject as he thinks best; and the student has a free choice amongst the various teachers of the particular department of study to which he may devote himself. Can our system, with its far larger pecuniary means, with its hundreds of scholarships and non-resident fellowships, compare in these respects, as inducing men to devote themselves to study, with the German universities?

There is no doubt that the secondary school education in England is inferior, in breadth and completeness, to the strict gymnasial system of Germany. Hence our universities are obliged to act more as finishing schools, occupied with raising the general level instead of carrying out the more scientific, higher, and more original studies which form the professional side of education, the "Fach-studien" which constitute the essential elements of the German system.

In even the smallest German university the four faculties of Philosophy (or art studies), Law, Medicine, and Theology exist in active operation. In the first of these faculties, all those students enter who desire to study either Philology and the cognate subjects, Historical science, the Mathematical sciences, or any of the various branches of Physical science.

The Law students confine themselves to their own Faculty where the theory of the profession is brought before them in a scientific order before they begin to learn the practice of the law.

In Medicine, the danger of a knowledge acquired by practice alone, and the necessity of a scientific education, are too patent to have escaped attention even in England; and hence the establishment of our numerous medical schools, attached to large hospitals. In Germany, such medical schools unconnected with other faculties are unknown; medicine forms an essential feature of every university system; and even comparatively small towns, as Heidelberg and Würtzburg, have their large and well-regulated hospitals, and are able to draw to themselves such men as Helmholtz and Kölliker. On the advantage of association of medical students with those pursuing other studies it is needless to enlarge.

In Theology there are frequently two faculties, one based upon Catholic and the other upon Protestant principles; these are found to work satisfactorily, and in Germany all who enter either Church must have at any rate gone through a regular course of theological instruction.

Another grand point in which the German university excels the English is the much larger proportion of qualified teachers which we find in the former.

As an example of the enormous teaching power in Germany, let us take the Philosophical Faculty in the University of Berlin. Here four professors and five other lecturers give twenty distinct courses each semestre (half year) in the science of Chemistry alone, including several on systematic chemistry, the history of chemistry, the chemical foundations of geology, metallurgy, pharmacy, &c. Under the head of Physics the following ten distinct courses were given by seven Professors during the summer semestre of 1868, and, in addition, a physical laboratory is conducted by Prof. Magnus:—

	Hours weekly.		Hours weekly.
Experimental Physics	4	Physiological Optics	4
Technology	5	Mechanical Theory of Heat	1
Acoustics	4	Hydrography	1
Capillary Theory	2	Physical Geography	2
Theory of Light and of Optical Instruments	2	Instruction in Methods of Physical and Geographical Observations	3

In the Biological subjects, ten professors and lecturers gave twenty-one courses, theoretical and practical. In Classics and allied subjects, thirteen professors and eight lecturers gave twenty-three courses; and on other linguistic subjects, eighteen professors and lecturers gave forty courses. In Mathematics, six professors and lecturers gave thirteen courses. In what we should call Mental and Moral Philosophy, including pædagogy, eleven professors and lecturers gave nineteen courses. In Economic and Agricultural sciences, seven professors and lecturers gave twelve courses. In History and Geography, nine professors and lecturers gave thirteen courses. In *Belles-lettres* and the Fine Arts, seven professors gave ten courses. It must be remembered that all the courses enumerated above belong to the Faculty of Arts (*Philosophische Facultät*), and are exclusive of the three other faculties, in each of which the subjects are represented in a similar proportion.

It is, of course, impossible for us in England to attempt to set up a system on this scale; but we cannot be too fully aware of the miserably insufficient way in which these studies are represented in our country; and we may rest assured that the existence, in due proportions, of a plurality of teachers is an indispensable pre-requisite for both breadth and depth of study. Where only one teacher is charged with one leading branch of study, it is barely within his power to provide the systematic teaching necessary for pass-men; whereas if, as in German universities, several teachers lecture concurrently on subdivisions of a subject, the more advanced students have the opportunity of studying more thoroughly some one section of their science. The teachers are also induced, by the opportunity of lecturing on special subjects, to engage in profounder investigations; and thus that other aim of university institutions—the advancement of science and the promotion of a learned class—is furthered. This is a consideration—at least, however, so far as England is concerned—for a remote future: it is sufficient to insist on the necessity of this plurality of teachers in order to ensure really effective teaching. The same subdivision of each subject appears in all the German universities. Thus in Göttingen, by no means one of the recently founded universities, and not subject in any special degree to those influences which have so remarkably fostered the growth of the sciences of observation and experiment, we find the following courses given in 1868:—

In Göttingen, Chemistry is (against the usage in Germany) attached to the Medical Faculty; there are, however, three divisions—the general, the physiological, and the agricultural. In the first, we find Professor Wöhler, with four skilled assistants; two of these being also professors. In the physiological division is another professor, with one assistant; and in the agricultural division, is one professor and one assistant. There are, further, four laboratory servants.

Professor Wöhler delivers the principal course of lectures on systematic chemistry. His assistants lecture on special branches.

The whole staff directs the laboratory; and over and above these are the two professors of physiological and agricultural chemistry, who conduct their own laboratories.

In Physics, Professor Weber and his assistants, Professors Listing and Kohlrausch, conduct an excellent physical laboratory, and lecture on the several branches of physics—systematic physics, optics, electricity, &c., light and heat, meteorology. Professor Ulrich treats of hydrostatics and hydraulics.

In Natural History, Professor Keferstein lectures on comparative anatomy, and performs zootomical demonstrations in the Zoological Museum during eight hours weekly to the students; for four hours weekly the Museum is open to the public, when the same Professor is present to conduct demonstrations. Two professors lecture on Botany (each six hours weekly), and combine with their lectures excursions and demonstrations in the Botanical Garden; there is also a third assistant professor. Professors Sartorius Von Waltershausen and Von Seebach lecture each four or five hours weekly on Mineralogy and Geology, and conduct practical demonstrations in the Museums.

In Heidelberg, as in Berlin and Göttingen, and in some respects even in a more perfect measure, large provision is made for the study of physical science. The *Physical Laboratory*, conducted by Professor Kirchhoff, is very successful. Once weekly Professor Kirchhoff lectures, with experiments, on a given subject; in the following week each student in the laboratory goes through the experiments for himself, and in this consists the essence of the course. Students can also prosecute independent research for several days in the week.

The *Chemical School* of Heidelberg has always been a celebrated one, and since the appointment of Bunsen to the university its renown has greatly increased. In no other European laboratory, with the single exception of that of Liebig at Giessen, have so many promising scientific chemists been trained, and this has been wholly due to the untiring interest shown in each student by the illustrious Professor, who, devoted heart and soul to his science, imparts to his students a portion of that interest in, and zeal for, original investigation, which are the real marks of a scientific spirit. Many of the chemical students at Heidelberg come, as with us, to study the science for the sake of its subsequent applications to manufactures, medicine, or pharmacy (for all the German druggists and pharmaceutical chemists are wisely compelled to attend a regular university course), but many, probably a large fraction of the number, study the science for its own sake, most of these students intending to qualify themselves for the higher posts of scientific instruction in various countries. Amongst the companions of those who studied at Heidelberg with the writer were men who are now making rising reputations in most of the German universities, or in the various institutions of France, Russia, Portugal, Great Britain, and America.

The *Physiological Laboratory*, conducted by the celebrated philosopher Helmholtz, is a novel and important feature in the Science Department in Heidelberg. A handsome and spacious building has recently been erected for the use of the Professors of Physics and Physiology. This embraces lecture-rooms, laboratories, rooms for apparatus and instruments, and for conducting special scientific investigations, besides dwelling-houses for the professors and their families.

In another article I propose to inquire more closely into the cost of establishing and working the Science Department of the German universities.

HENRY E. ROSCOE

A POINT IN MUSCULAR PHYSICS

SOME Physiologists abound in statements touching the correlation of forces in living things, and are very fond of repeating the old parallel between a muscle and a steam-engine. We have no desire to deny the aptness of the illustration, but it is as well to bear in mind that, in actual point of fact, the exact correlation of heat and mechanical force has not, as far as muscle is concerned, yet been made fully out. The point of failure is this—suppose we have two muscles: let one muscle when it contracts have to pull against a weight and so produce a decided mechanical effect; let the other muscle have no such weight to pull against, and so in contracting produce no mechanical effect (the trifling weight of the muscle itself we may disregard). According to the doctrine of the correlation of forces, the heat given out in the first case ought to be less than that given out in the second, by reason of the total force produced by the combustion of the muscle going out partly as mechanical force instead of wholly as heat. We suppose of course that exactly same amount of contraction takes place in both cases, and indeed that the muscles are perfectly identical in circumstances, except so far as their load is concerned. Heidenhain some few years ago, however, found out that there was, strange to say, more heat given out in the first case. He also discovered the reason of it, which is that when a muscle is put on the stretch, as, for instance, when a muscle has in contracting to pull against a weight, *all the chemical changes in the muscle are augmented*, and that roughly in proportion to the amount of strain.

This observation by Heidenhain seems to us one of very far-reaching and often-recurring importance, though apparently it has hardly as yet gained the attention it deserves. At all events it put a stop for a while to any satisfactory settlement of the question we are considering. Quite recently, however, Fick has devised an experiment which seemed to him to avoid the difficulty that had discomfited Heidenhain. The gist of it is simply this. He has two muscles in every way treated alike except in the following point. One muscle he allows to pull a weight up by the force of its contraction, and then lets the weight, when the contraction has passed over, pull the muscle down again. The other muscle pulls up the same weight in the same way, but at the moment that the contraction is at its maximum the weight is slipped off. The muscle then by virtue of its elasticity returns to the length natural to it when unloaded; directly it has reached this point the weight is slipped on again, and the muscle is again ready for a contraction.

It is obvious that in the first case the muscle does no actual work at all; after the contraction the weight undoes what the contraction did. In the second case, on the other hand, the weight is lifted up to a certain point and left there; real work is done.

Such being the case, the temperature of the first muscle ought to rise higher than the second; and when each muscle has been made to contract a good many times this rise ought to be appreciable. Fick finds in fact that it is so. And so we seem here to have what we desired; for both muscles *during contraction* are subject to the same strain; and hence Heidenhain's objection is obviated.

That cautious inquirer is not, however, yet satisfied. He asks "if during contraction an increase of strain produces an increase in the total chemical processes (metamorphosis) of the muscle, are we to think that the effect of the strain ceases to be felt immediately the contraction is finished, and is not carried on into the period of relaxation?

And moreover, putting the matter to an experimental inquiry, he finds, as a matter of fact, that when two muscles are treated as in Fick's experiment, one strained at all times, and the other strained only during contraction, the amount of chemical change taking place in the first, as evidenced by the generation of acid, is distinctly larger than in the second. So there the question remains for the present.

THE PROJECTED CHANNEL RAILWAYS

THE first question to be asked about a railway between England and France would be properly one upon its importance, and on the value of such a railway to the social and commercial interests of the two countries.

Let us consider the present situation and the circumstances which would affect, favourably or otherwise, a Channel Railway.

A sheet of water, impassable at all times to the bulk of a people, although a highway of their sailors, is a most effectual barrier between two countries. Free intercourse is checked; the exchange of ideas and thought limited to a small class of traders and travellers, not to mention the learned, who in all countries form but a minority of the people.

Two nations so situated are generally cold towards each other, and in time materially differ in their mode of living, in their ideas, habits, and in their institutions. A free intercourse need not necessarily obliterate the peculiarities of different races; but it has always been an effective means of moderating prejudices.

To attempt a description of the numerous and subtle ways by which the mind of populations may be taken hold of—and even be guided—would be beyond our present object; but as a means of self-education and consequent civilisation, there could not be a more powerful instrument than railways, because they offer the readiest, most convenient, and the cheapest means of communication between one individual and another.

Half-a-century ago the bulk of a nation was enclosed within its own walls; only a small minority could afford to travel and to observe, *to exchange and to induce thought.* That in which all schools must necessarily fail, or at least can succeed but indifferently—viz., the education of the million—railways are accomplishing with extraordinary rapidity; their civilising influence is constantly at work: they cover England more than any other country, and accordingly England derives all the benefit which that institution may confer on a people. Railways are also in a great measure covering France, Belgium, Germany, &c.; but there is an essential difference between the effect which they may produce in England and on the Continent. In England they interchange and mix the ideas and habits principally of the Anglo-Saxon race, some twenty odd millions; on the Continent they cause to mingle several great nations of different race: certainly more than sixty millions are there under the operation of railways as an institution.

The civilising influence of railways is, in England, accordingly confined to one groove — one main Anglo-Saxon line—and the effect on the English people cannot but remain elementary: on the Continent, however, their civilising power derives its material from several distinct and essentially different sources, viz., the Teutonic and Gallic races, and some others of minor consequence, the material of which, interwoven and allied by the affinity of thought, forms a compound of a different nature and character, differing as much as compounds differ from their elements.

That these causes have been in operation in the manner indicated, we may easily trace in the relative progress made within one generation in England and on the Continent. When railways were in their infancy, England was, in her institutions and industry, much ahead of any country. Railways have improved the condition of every people, but has the improvement not been very much greater on the Continent? It may be urged, that there was more room for improvement in those countries: that may be so, but this would not affect the case, for there was and is room enough for improvement at home.

Within one generation railways have produced wonderful revolutions on the Continent. The despotic governments of several great nations have given way to truly liberal institutions; continental industry rivals already that of England. And how was all that brought about? The immediate causes of these changes may seem innumerable; and yet, there is only one great cause at the bottom of all this change, viz. *enlightenment of the people;* and we claim a large share of this result for the institution of railways.

If, then, the combination of thought originating from different sources has so much advanced and civilised the Continent, what would be the effect upon England if a railway could suddenly bring the bulk of her people in close contact with the continental nations? A more complex, a higher compound would be formed, and what the ultimate effect of this change might be the future alone could tell; all that can be said with certainty at present is this, that *enlightenment must follow in a potential form.* Excursion trains would take the million to and from either country; excursions to and from Paris would be made with the same convenience and comfort as now between Manchester, Liverpool, London, and other large towns; in short, the social effect of the change would be immense; and how would it affect the commercial interests? Enough has already been said to show that a channel railway in good working condition would accomplish wonders, and it may be easily perceived that, though all will be gainers by the change, England would gain the most.

This being so, then, the next point is to analyse the different projects which have been proposed for bringing the result about. Among these, the Bridge scheme has naturally received considerable public attention. To the non-professional mind it appears a plausible proposition, and enough support has been given to its promoters to enable them to promise wonders.

We have no *definite* plan of the proposed bridge, but we have a Channel Bridge Company; we have not even a definite outline of the main engineering features, but we have the assurance of the success of a model which, in the opinion of the projector, might be enlarged to *any extent*. The span of the bridge is evidently not agreed upon, nor is the construction of the piers determined; we are assured that we may have any span we like, and that there is no difficulty about the piers; in fact, the only thing wanted to complete this great national work in *three* years, appears to be a subscription of eight millions sterling to the credit account of the Channel Bridge Company.

The vagueness of the scheme is the safeguard of its promoters. We cannot even describe the propositions without running the risk of being contradicted on every point; it is even intimated that it is premature to discuss the scientific questions of the Channel Bridge scheme.

We have a few facts, however, on which we may safely enlarge. It is admitted, that from Dover to Blanc Nez, a distance of twenty-one miles, a number of piers are indispensable. In 1868, the distance was to be crossed by ten spans, each over 9,000 feet in the clear, and we have a diagram of that monster bridge. In 1869 rumour will have it that the number of spans is to be increased from ten to thirty, making the reduced span still over 3,000 feet in the clear. With the first proposition we should have had nine piers, with the latter, twenty-nine, washed by the waters of the Channel.

Whatever the ultimate number of piers may be, it is evident that some of them must be constructed in water exceeding 30 fathoms, or 180 feet in depth (according to the Admiralty Chart); moreover, these piers are to be 360 feet above high water, making the total height of the structure of some of them over 540 feet from the bottom of the Channel. Let us see how one of these pyramids is to be constructed midway the Channel.

The projector discards masonry, for no operations 180 feet below water level are practicable; and as the foundations themselves would have to be carried down another indefinite number of feet, the depth and consequent pressure would render life, and therefore work, impossible.

A new construction of piers had to be invented, and herein should be found the virtue of the design; let the agents of the Channel Bridge Company tell their story:—

The project depends in effect on two remarkable innovations in the construction and establishment of the piers and metallic beams. In addition to the considerable height to which the former rise above the water (120 yards), the bases of the piers are sunk to the bottom at a depth varying from 28 to 52 yards. Except the centre one, all the piers at their foundations measure 130 yards in width and 87 yards in length, diminishing upwards, and forming at the summit a square of 66 yards on each side. The centre pier will be half as large again as the others. All the pieces composing the work are of cast-iron, and furnish, without increasing the weight, a power of resistance superior to all other kinds of construction.

As such ponderous piers could not be erected by the ordinary means, M. Boutet proposes to construct on the shore their lower parts or bases to a height sufficient to rise ten yards above high water, and as soon as the iron skeleton is put together and bolted, a number of large sheet-iron buoys are distributed about the immense surface of the base. At low water the metallic framework thus prepared is made to slide upon the shore to low-water mark. The tide, in rising, raises this raft or base of iron lightened by the buoys, and floats it. A tug steamer then removes it to its place, previously indicated by one of a line of buoys attached to an iron cable, stretched across the Straits at a depth of eighteen yards. By raising one of the buoys attached to the raft it is made to descend very slowly, the top being just above the level of the sea when the base touches the bottom. Thus are avoided all the preliminary works under water, which constitute the greatest difficulty in the way of a bridge across the Channel.

Certainly, we have here Baron Munchausen over again. These cast-iron piers, with a base of 390 ft. by 260 ft., over 200 ft. high, we are informed, are to weigh about 2,500 tons. What is the thickness of their metal to be? Information is wanting on this point; but an iron structure of these dimensions, to bed itself on the bottom of the Channel, could not be designed of less than ten times the weight named.

Assuming, for the sake of argument, that the rise of the tide would float that structure away by the means above described—and our business is to analyse the project as it is, not to suggest or attempt to improve on it—may we not ask with surprise, where would the centre of gravity of this floating structure be? Its centre of gravity would be about ninety feet above the level of the water, and at least one hundred feet *above* the centre of displacement. Why do our ships not upset, what insures their stability, and why do they right themselves? Mainly, because their centre of gravity is in its lowest position, *below* their centre of displacement. Here, however, we have a floating structure in which the centre of gravity would be enormously *above* the centre of displacement, and in its highest position. A slight oscillation, a breath of wind would overturn it, and suppose it could be floated away from shore, it would topple over—right itself upside down; the "sheet-iron buoys" would be uppermost, and the structure below them, forming a gigantic wreck somewhere in the Channel.

So much, then, about the piers. It may give the ordinary reader an idea of the character of this scheme. Shall we say anything about the 9,000 and odd feet clear span? At first sight it appears to be a typographical error; surely 900 and odd feet were meant; but then we meet with the fact of the Channel being divided into *ten* spans, so there is no getting out of it.

The whole proposition is the offspring of a highly imaginative mind. Of all the schemes or suggestions to cross the Channel by rail, this is the most incoherent. *There is nothing in it*—not one point of merit. It is not bold, because it lacks the spirit of boldness, viz. Sense. Not a trace of an engineer's mind is to be found in it. Our asylums produce innumerable schemes of this kind, but they are not permitted to disturb the public mind. It is a relief to have done with it. We are glad to say there are several projects which do not lack either sense or ability on the part of the originators. Some of them appear practicable, and one or two highly promising of success, and these will form the subject of our next communication.

DANA'S MINERALOGY

A System of Mineralogy: Descriptive Mineralogy comprising the most Recent Discoveries. By James Dwight Dana, Silliman Professor of Geology and Mineralogy in Yale College, etc., aided by George Jarvis Brush, Professor of Mineralogy and Metallurgy in the Sheffield Scientific School of Yale College. Fifth edition, 8vo. pp. 827, figures 617. (London: Trübner & Co.)

I.

FORTY years ago mineralogy was a fashionable subject in England; wealthy people collected minerals, though probably but few of those who did so ever made mineralogy a serious study. But mineralogy, under the then received doctrines of Mohs, was rather a system than a science; rather a system by which the place of a mineral in a classified list, grouped after little else than external appearances, could be determined by a few simple experiments, than a science dealing with the more subtle properties and qualities of the objects it classifies, and treating external resemblances as of no importance unless associated with analogies in composition or chemical type. No doubt it is to a great progress of mineralogy in this latter direction, associated as it has been with a corresponding development of crystallography and crystallographic optics, that the falling off in the votaries of these sciences is in a great measure due.

The mere collector for collecting's sake would prefer now-a-days to expend his money on shells or his research on fossils or plants, for a tolerable familiarity with which little preliminary education is needed, to investing his means and puzzling his mind with a science which has become a department of chemistry, and needs, besides sound chemical ideas, a thorough practical acquaintance with another and that a mathematical science, namely, crystallography.

To a similar cause is due, in part at least, the comparative indifference with which crystallography is treated by chemists and mineralogy by our geologists.

No doubt these two great sciences, chemistry and geology, between them cover nearly all the ground occupied by mineralogy. But our chemists are engrossed by great problems that may be said to be involved in the nature, if not even in the structure, of the gaseous molecule; they have hardly yet turned to that side of the problem which will one day be illustrated by the physics of the crystal molecule. So again the geologist in his character of historian of the earth is occupied with the relations of the manifold forms of life that have congregated on our globe, and their distribution in time; or else with the great dynamical causes that have engineered this "dædal earth" of ours into its present superficial form. And in England the chemical causes to which so large an amount of change in the character and bulk of rocks and in minerals is due are rarely within the grasp of our leading geologists.

In Germany it is otherwise. There, a preliminary education in mathematics or in chemistry, and by natural sequence in crystallography and mineralogy, is the almost universal introduction to the study of geology. So that to the German student, crystallography, as a science of observation with the goniometer, and of calculation with formulæ, is no rare accomplishment; and the little collection he makes during his student years, whether of minerals or of chemical preparations and crystals, forms a nucleus round which is gathered a great deal of valuable and exact knowledge, which he builds on work with his goniometer and his balance, and often with the microscope at home or his hammer in the field. The School of Mines here is producing a few men with many of these qualifications, but it may be questioned whether a more mathematical basis is not needed in that as in other similar educational institutions in England.

At any rate we do not turn out here the many-sided geologists that Germany produces, as witness the school of chemical geologists with Bischof at its head, or the admirable works on petrology by German authors; for the German geologist does not write on rocks till he has acquired a scientific acquaintance with the minerals that compose them.

In France, again, the nation of Haüy, if mineralogy, perhaps from the smaller importance of French mining industry, is not so widely pursued as it is in Germany, it has nevertheless always had its careful, thorough, and scientific votaries. Indeed, in our own day, the researches of Des Cloizeaux, following up those of Grailich, and his brilliant little constellation of Viennese crystallographers, have shown how absolutely essential is the study of the optical constants of crystals to any complete science of chemistry or mineralogy. We may, indeed, console ourselves for our shortcomings in England by the reflection that to an Englishman is due a system of crystallographic notation, and an extended use in crystallography of spherical trigonometry, which have long given to that science a greater symmetry and simplicity in its formulæ; so that now the system of Professor W. H. Miller is gradually displacing every other on the Continent.

But when we turn from Europe to America, we should expect that we should have to judge by other standards; for there a sterner call summons men to the study of mineralogy than is the case in the Old World. Where any pioneer on a new bit of mountain land may light upon mineral wealth like that of the Washoo district of the territory of Idaho, there is a need for pioneers who are mineralogists; and it is but justice to the American instinct for perceiving, and genius for supplying, whatever is wanted under novel conditions of life, to say, that in mineralogical science and mining enterprise the Americans have been equal to the demands and to the splendid opportunities that the New World has presented to them.

Of this the work, the title-page of which heads this article, is an admirable evidence. Written to meet the wants of eager and intelligent young ore-seekers in the vast stretches of plain and mountain between the Atlantic and the Pacific, it has satisfied these wants perfectly, and helped to produce (we had almost written has produced) an admirable American school of mineralogists. But it has done more than this: it may almost be called the text-book of mineralogy for Europe; and it is so for the reason that its ingenious and talented author is laborious; and is not only laborious, but able to throw off a prejudice like an old garment. It is this freshness of mind and power of work that has made the successive editions of his mineralogy not only *not* reprints, but essentially original books, and even made them an interesting pyschological study of one who may be taken as a typical American man of science.

The chief features that distinguish the large and handsome volume representing Professor Dana's new, that is to say, his fifth edition, are—Firstly, modifications in his system of classification; Secondly, alterations in the nomenclature; and Thirdly, a new chemical notation. Professor Dana still retains his peculiar graphic method for the representation of the zones of crystals and his notation for their planes. Both of these, we believe, he will discard in some future edition which we earnestly hope that he may live to carry through. The notation is rather complicated than simplified by the employment as symbols of the letter *i* in its different phases of italic and capital, which, together with the figure 1, are used to represent what, in fact, are the most frequently recurrent and concurrent planes of a crystal. The far greater elegance of the stereographic projection for the representation of the zones of a crystal than the sort of contracted and symbolised Quenstedtian method employed by Professor Dana will certainly prevent this latter from ever becoming adopted in other works. Passing from the crystallographic to the chemical notation, we may say that Professor Dana accepts a sort of nuclear theory of chemical combination, and illustrates this by a corresponding notation. As, however, the use of this system is only partially introduced into the work, we may dismiss it with the remark that, inasmuch as the use of formulæ of one shape or another to express a particular compound can only be a relative and not an absolute expression of the modes in which its elementary units are combined, when one such formula or system of formulating is to be conventionally selected for adoption, that will be the best to select which expresses best the relations between the compounds from the point of view of the author employing them. Professor Dana's does not seem to us to meet this requirement as from the point of view of the mineralogist.

N. STORY MASKELYNE.

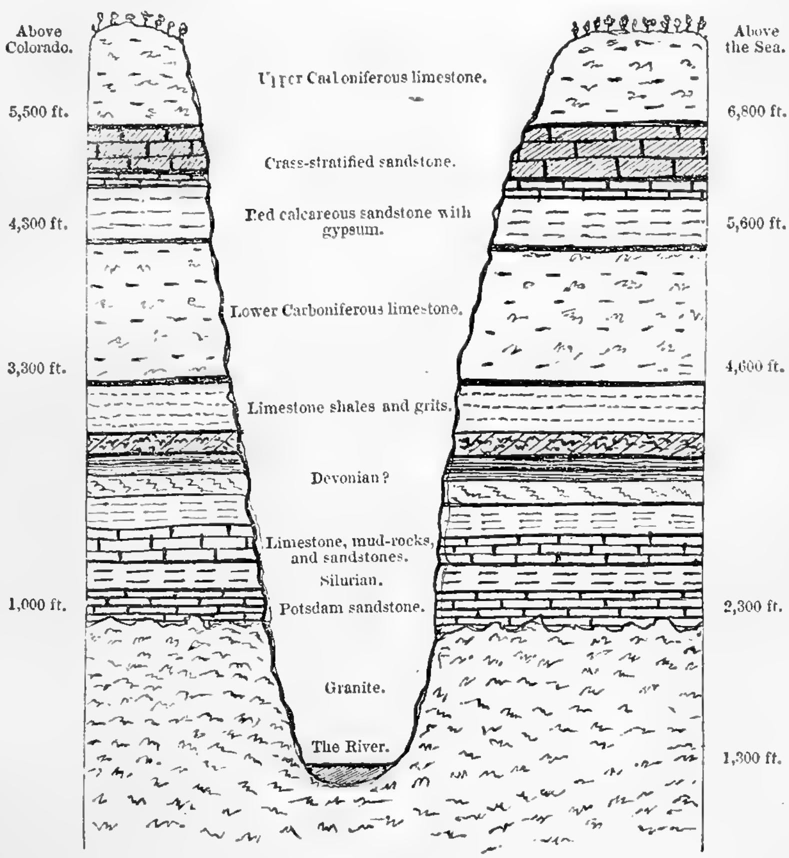
BELL'S NEW TRACKS IN NORTH AMERICA

New Tracks in North America: A Journal of Travel and Adventure in 1867–68. By W. A. Bell, M.B., F.R.G.S., &c. With a map, 20 lithographs, 22 woodcuts, and 3 botanical plates. 2 vols., 236 and 322 pp. (Chapman & Hall.)

THIS is an unusually important book of travels, giving interesting particulars of the vast wild Western country which, though still the home of the Apache and the Buffalo, is every day being more and more brought into subjection by the settlers, traders, miners, capitalists, and railways of the "Anglo-Saxons" of America, as Dr. Bell calls them.

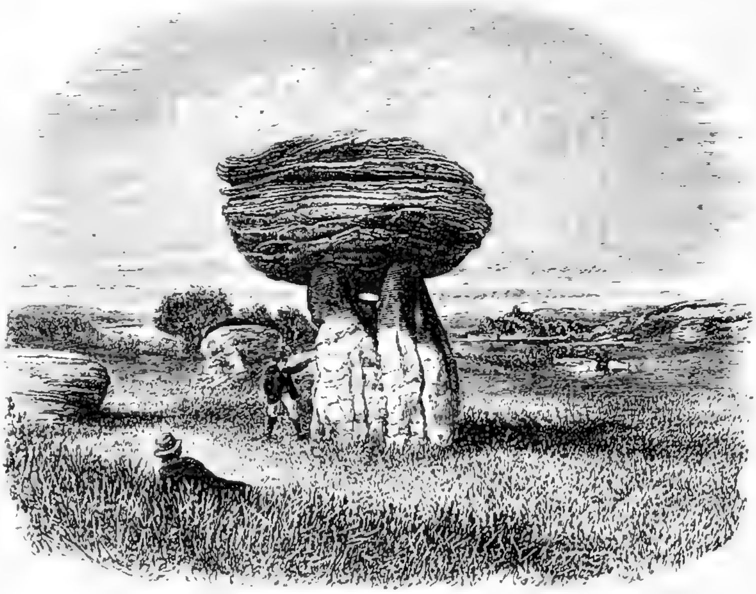
The author was well placed for obtaining reliable information, having been attached in 1867 to the surveying expeditions of the Pacific Railway as photographer and physician. In this manner he travelled "about 5,000 miles beyond the pale of civilisation and railways." His contributions to the physical geography of the astonishing country south-west of the Rocky range are carefully done. He writes a brief treatise on the natural drainage system of the district, and especially of the Great Basin, which is considerably larger than France, and so-called because none of its rivers reach the sea. The reason of this is not that it is a basin with a rim all round to act as an insurmountable barrier to drainage, but rather because it is in reality a collection of hundreds of smaller basins, each of which has its stream and lake, which lose by evaporation and percolation what is supplied by the limited rainfall. Cultivation is, however, increasing the rainfall in Utah, and the Great Salt Lake has consequently of late years been steadily rising. The rainfall from year to year is irregular. At Fort Yuma, on the borders of California and Arizona, it was in four recent years 0·33, 8·57, 4·20, and 2·94 inches. Irrigation must be resorted to for all agricultural operations.

The barren, monotonous mountain ranges of the great basin are rich in minerals. One silver lode, the Comstock, yields annually four millions sterling, or more than all the mines in Mexico, and Nevada furnished twenty million dollars of gold in 1867 to California's twenty-five. Copper and iron are also plentiful, and the unworked coal-fields are numerous. Hydraulic power is now employed in mining in California. The machine used was invented in 1852 by one Mattison, of Connecticut, and directs a stream of water from a two-inch pipe under a pressure of perhaps 200 ft. perpendicular, which gives a tremendous force, against a bank or hill-side, containing *placer* gold, tearing down the earth into the washing sluices



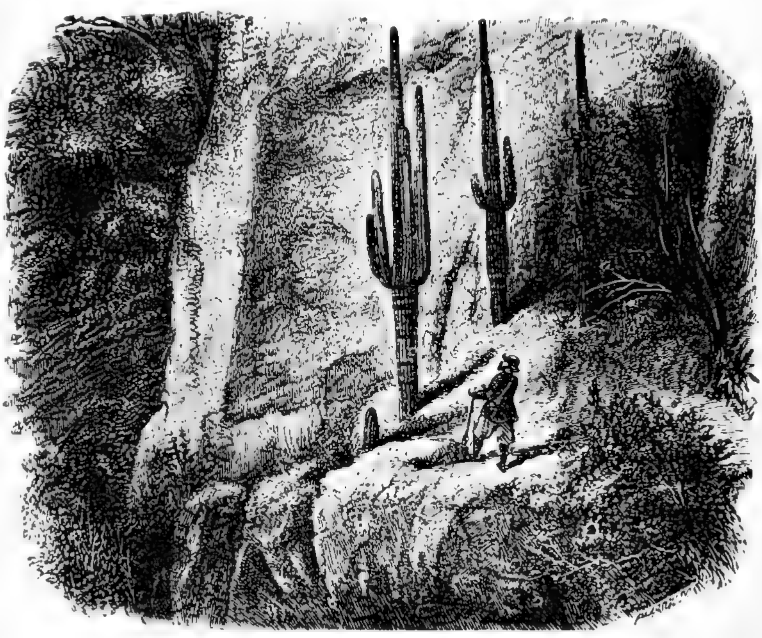
SECTION OF THE CANON OF THE COLORADO ON THE HIGH MESA, WEST OF THE LITTLE COLORADO (BY J. S. NEWBERRY, M.D.)

with great rapidity. This powerful agent is stated to be changing the face of the country: obliterating valleys, levelling hills, turning rivers from their course, and covering fertile tracts miles in extent with bare heaps of gravel.



MUSHROOM ROCK

The most distinctive features of the great basin are the cañons, those narrow, deep, abrupt, and continous chasms at the bottom of many of which run rapid rivers, unapproachable by man or animal. They are due to the action of water, being formed by the passage through a dry region of never-failing and rapid streams, coming from distant sources exterior to the dry country. The water has worn its way in some instances through 1,000 ft. of granite. Where these deep cuttings abound, the country is sterile, for they drain it to the uttermost, and the streams lie far below the reach of surface animal or vegetable life. One cañon, that of the Purgatoire, has been so named because of the "bright, fiery-red sandstone" of which its walls are composed; the effect of the mass of colour is said to be wonderful. In another, the Aravaypa, a cliff below the average, was measured, and found to be 825 ft. high.



THE CEREUS GIGANTEUS

Here, when the sun had left the upper world, and night had really come, the blackness of darkness around was something awful, and the stars which covered the narrow streak of sky above seemed to change the heavens into a zigzag belt, every inch of which was radiant with diamonds.

In the valley beyond this cañon, nearly all the water of the Aravaypa sinks into the earth. But the cañon of cañons is the great cañon of the Colorada, discovered by Lopez de Cardenas in 1540, which is but 100 feet wide at its narrowest, while its greatest depth has been barometrically ascertained to be 7,000 feet, or one mile and a third. The sun only shines into this terrible chasm for an hour a day, and it is 550 miles long. At its bottom runs the swift river from which it takes its name. The account which Dr. Bell gives of James White's flight for life down this previously unexplored cañon on a raft, makes a wonderful sensation story, which appears to have found believers. We reproduce from Dr. Bell's book a geological section of this remarkable gorge.

The alkali flats form another distinctive feature in the basin. They are covered with salts, usually nitrate of soda, and being perfectly barren, form white glistening sheets which, in the dry unsteady atmosphere of the desert, become tantalising mirages. The plateaux of the basin region were the last portions of the West which were raised from the sea; even now subterranean fires are active, and it is quite possible that gradual upheaval may be still going on. Earthquakes are frequent; mud-volcanoes are still to be found in places; huge surface cracks have occurred within the memory of living men, and Dr. Bell counted 52 jets of steam issuing from the ground in one valley. A considerable number of the known species of cactus are found about the Mexican boundary line; of one of these, the *Cereus giganteus*, which is sometimes called the Monumental cactus, we give an illustration: the mistletoe grows in the same region. We also give an engraving of the "Mushroom Rock," one of the many similar monuments, denuded and abraded by water, which are to be found in the arid plains of Kansas. Dr. Bell's book contains thoughtful matter on the Indian races of the past and present sufficient for a monograph on the subject. He writes briefly and sensibly on the Mormons, denying the common assertion that Salt Lake City, setting aside polygamy, is a moral place, and stating that there is an entire absence of religious devotion. The Joe Smith anti-polygamy party are making rapid strides, especially in the numerous outlying settlements in Utah and Nevada.

OUR BOOK SHELF

Lehrbuch der Chimie, *gegründet auf die Werthigkeit der Elemente.* Von. A. Geuther, Prof. in Jena. Erste Abtheilung. (Jena: Dœbereiner, 1869.)

THE doctrine of Quantivalence plays a most important part in the general theory of modern chemistry; but when carried out to the extreme lengths which Dr. Geuther claims for it, this doctrine, so useful in the classification of elements, fails altogether to bear an original meaning. The following is an extract from a table, on page 16 of the above-named work, showing the Quantivalence of the elements according to Geuther:—

H = 1

As	V. III. I.	Na	V. IV. III. II. I.
Ba	II. I.	Os	VIII. VI. IV. III. II.
Br	VII. V. III. I.	S	VI. IV. II. I.
Cs	V. IV. III. II. I.	N	V. III. I.
Cl	VII. V. III. I.	Ag	IV. II. I.
Cr	VI. IV. III. II.	K	V. IV. III. II. I.
Fe	VI. IV. III. II.	Mn	VII. VI. IV. III. II.
Fl	(VII.) (V.) III. I.	I	VII. V. III. I.

Here, for example, we find potassium described as acting as a monad, a dyad, a triad, a tetrad, and a pentad element, and chlorine as a monad, dyad, triad, pentad, and heptad element. What does this do more than express, in a roundabout and inconvenient way, what Dalton long ago enunciated as combination in multiple proportions—that great law round which the whole structure of the science is built up?

The doctrine of Quantivalence is, in strictness, only applicable in the case of gaseous elements and compounds; bodies whose molecular weight can be estimated by their vapours obeying Avogadro's law of volumes, viz. that the molecule of an element or compound is that weight of the body which occupies in the gaseous state the volume of hydrogen gas weighing 2: the Quantivalence of an element being determined by the number of atoms of hydrogen or of chlorine, or other distinctly monad element or radical, which it may be able to take up in this molecular volume. By an extension of this reasoning, we term potassium a monad and barium a dyad metal, because we find that they each form only one compound with chlorine, potassium combining with one atom and barium with two; and we assume that KCl and $BaCl_2$ represent the respective molecular weights of the compound. Many metals, doubtless, may be considered to exhibit a variation in Quantivalence: such as iron in the ferrous and ferric chlorides; mercury in Hg_2Cl_2 and $HgCl_2$: though this difference may be also explained in the case of mercury by the two atoms of metal being joined together. But to term chlorine a heptad because it forms the compound $HClO_4$, or potassium a pentad because we know of the body K_2S_5, appears to be an exaggeration of a useful doctrine almost as unphilosophical as the divisible atoms of M. Delavaud. Apart from these views, Prof. Geuther's book will be welcomed by all chemists as containing clear and concise descriptions of many compounds not mentioned in other manuals, which are of much importance for the theory of modern chemistry. H. E. ROSCOE

Parasitology.—*Zeitschrift für Parasitenkunde.* Herausgegeben von Dr. E. Hallier und Dr. F. A. Zürn. Band I. Zweites Heft. 8vo. pp. 126, with 2 Plates, price 3*s*. (Jena, 1869. London: Williams and Norgate.)

THERE can be no more conclusive evidence of the vigour with which scientific researches are pursued in Germany than the fact that a circulation is found for a periodical publication devoted entirely to the study of parasites, animal and vegetable. We find in the present number reports of observations on the *Aspergillus glaucus*, and two other newly-discovered parasitic Fungi, found in the passages of the ear, and connected with certain forms of deafness, and a description of a cure in the case of the former species by the external application of alcohol. The greater part of the number is devoted to a dissertation by Dr. Hallier on the parasites of infectious diseases. A portion of this paper is occupied by a discussion whether the minute *Myxogastres* found on decayed wood, grass, &c., belong to the animal or vegetable kingdom. Since the only high authority who has maintained the animal nature of these parasites, Dr. de Bary, in opposition to Fries, Berkeley, and others, has since apparently altered his views, the question may now be considered as disposed of. If the apparent spontaneous motion of the young germinating spores of *Trichia* and other Fungi be considered proof of an animal nature, the same argument must be applied to the zoospores of certain Algæ. A. W. B.

Serials

Hardwicke's Science Gossip, for December, contains, among others, articles on the employment of wild flowers for decorative purposes (in gardens), on the invasion of lady-birds, on the structure of the hairs of plants, on variations in the *Primulaceæ*, on the influence of food and light on *Lepidoptera*, and on the natural history of the Ruff and Reeve.

The *Monthly Microscopical Journal* for December (No. 12) contains some remarks on the nineteen-band test-plate of Nobert, and on immersion lenses, by Mr. J. J. Woodward, United States Army; a paper on high-power definition, with illustrative examples, illustrated with a plate of test-objects, by Dr. G. W. Royston-Pigott; and one entitled "My Experience in the Use of various Microscopes," by Dr. H. Hagen. These relate to the instrument and its use. The papers devoted to subjects for investigation are—one by Mr. Staniland Wake, on the Development of Organisms in Organic Infusions, and further remarks on the Plumules or Battledore Scales of some of the *Lepidoptera*, by Mr. John Watson, the latter illustrated with a plate. The Microscopical Society's Proceedings contain some interesting remarks on the Scales of the *Thysanura*, in connection with Dr. Pigott's paper.

The recent numbers of the *Revue des Cours Scientifiques*, a periodical which is hardly so well known in this country as it deserves to be, and which is intended to furnish a general weekly statement of the proceedings of the principal scientific societies both in France and in other countries, contain translations of Dr. Christison's historical account of the operations of the Royal Society of Edinburgh from 1783 to 1811; of Sir Roderick Murchison's anniversary address to the Geographical Society in May last; and of the first of Dr. Bence Jones's lectures on Matter and Force, delivered before the Royal College of Physicians. Of foreign scientific doings, we find a translation of Carl Vogt's paper on the Primitive History of Man, read before the meeting of German naturalists at Innsbrück, and M. Vulpian's lecture on Pathological Anatomy, delivered at the Faculty of Medicine in Paris.

THE DEEP-SEA DREDGING EXPEDITION IN H.M.S. "PORCUPINE"

NATURAL HISTORY (*continued*)

THIS being a preliminary report, I will make only a few remarks as to the Mollusca obtained in the expedition, and with respect to that part of the sea-bed which I investigated :—

1. *The Mollusca are mostly Arctic or Northern.*—This I have shown in my narrative as regards the western coasts of Ireland, which have hitherto been supposed to belong zoologically to what Professor Edward Forbes called the "Lusitanian" province ; and the present remark applies not only to deep water, but to shallow water, and even the bays. In Prof. Wyville Thomson's cruise to the south-west of Ireland occurred two species, which I was quite unprepared to see. These were *Solarium Siculum*, and an unmistakeable fragment of *Cassidaria Tyrrhena*. The former inhabits the Mediterranean, Madeira, Canaries, and the coast of Portugal ; and the latter has not been noticed north of Brittany. Such exceptions, as well as *Ostrea cochlear*, *Murex imbricatus*, and *Platydia anomioïdes*, it is difficult to account for ; but as all these species are said to inhabit deep water, the Equatorial current may have carried them northwards in an embryonic state ; or it is possible that they may be likewise Northern species, and have not yet been discovered in high latitudes. We are nearly ignorant of the Arctic Mollusca, owing to the difficulty of exploration ; and those who assume that the marine fauna of the circumpolar seas is poor or wants variety, ought to see the vast collection made by Prof. Torell at Spitzbergen. The greatest depth at which he dredged there was 280 fathoms. The soundings taken in 1868 by the last Swedish Expedition reached 2,600 fathoms, when a *Cuma* and a fragment of an *Astarte* came up in the *Bulldog* machine. Soundings, however, are very insufficient for zoological purposes. Judging by the results of our own expedition this year, which have increased to such a wonderful extent our list of the British marine fauna living beyond the ordinary line of soundings, it may fairly be taken for granted that the Arctic marine fauna is much less known than ours. I have not the slightest doubt that by another expedition to Spitzbergen, provided with improved machinery, and under the charge of the Professor at Lund or some other able zoologist, the species obtained would be double the present number. It is evident that the majority, if not the whole of our submarine (as contradistinguished from littoral or phytophagous) Mollusca originated in the North, whence they have in the course of time been transported southwards by the great Arctic current. Many of them appear to have found their way into the Mediterranean, or to have left their remains in the tertiary and quaternary formations of the south of Italy ; some have even migrated into the Gulf of Mexico, as I will presently mention.

I cannot see much (if any) difference between the Mollusca from the warm and cold areas of Dr. Carpenter. The number of species from the cold area, which also occurred in the warm area, is forty-four. Other species from the cold area, and not from the warm area, are eleven. Of these last, five are undescribed, and one is apparently sub-fossil and may be a relic of the glacial epoch ; so that there remain five only which are Arctic and North-American, but which were not found in the warm area.

2. *Additions to the British Mollusca.*—Although I am aware that the discovery of what are called "new" species does not rank high as a scientific fact, it is still interesting to all zoologists as well as collectors ; and it must not be forgotten that the important subject of zoö-geographical distribution depends in a great measure on such discoveries, and especially on the relation of any local fauna to other faunæ. The number of species new to our seas and procured in this expedition is no less than 117. Of these, fifty-six are new to science, and eight were supposed to be extinct as tertiary fossils. Sixteen genera are new to the British seas, including five which are undescribed. Some of the species and genera, however, are represented by single specimens, and a few by fragments. These whet one's appetite instead of satisfying it. The total number of species of our marine Mollusca, inclusive of littoral species but exclusive of the Nudibranchs (none of which latter were met with except in the bays), is 451, according to the latest work on the subject, 'British Conchology :' so that more than one-fourth has been added in the course of a few months. All that I could do by continual dredgings in comparatively shallow water during the last sixteen years was to add about eighty species to the number described by Forbes and Hanley. I regard the present (although a large) addition as merely an earnest of future acquisitions. Almost every square mile of the sea-bed yields different species, some being apparently local or restricted in their distribution. In fact the treasury of the deep is inexhaustible.

3. *Relation to North-American Mollusca.*—The late Dr. Gould, in his 'Report on the Invertebrata of Massachusetts' (1841), gave 176 species of marine Mollusca as inhabiting that coast. Mr. Mighels, Prof. Stimpson, and others have since described a few more species, making the total number about 200. I attifie; leas 6ohaieddnts of these as British, a dozen being from the present expedition. The size of North-American specimens is, so far as I have observed, smaller than that of our specimens of the same species, perhaps showing that their common origin was in the Arctic seas of Europe and not of America.

4. *Relation to Mediterranean Mollusca.*—In my last Report on Shetland dredgings, published a short time ago by the British Association, I discussed this subject so fully that it is needless to go further into it, except by calling the attention of the Society and all scientific men, particularly geologists, to the importance of ascertaining what has caused or is still causing the remarkable concordance which is observable between the marine Mollusca in the deeper parts of the North-Atlantic and Mediterranean. I cannot help now thinking that this concordance may be explained by the existence of an undercurrent into the Mediterranean through the Straits of Gibraltar, being probably a branch of the great Arctic current. Dredging researches ought to be carried on in the lower part of the Bay of Biscay, and off the coasts of Portugal and Spain into the Straits for the purpose of determining this vexed and highly interesting question. Dr. Carpenter's last cruise to the west of Shetland, at a depth of 290 fathoms added a remarkable species to our Mollusca in *Platydia anomioides*, a rare Mediterranean Brachiopod. The specimen is twice the size of those from the Mediterranean. *Octopus Cocco* of Verany is another remarkable discovery, and was dredged in 345 and 632 fathoms between latitudes 60° and 62° N. It was only known as Mediterranean, where it is stated by Verany to inhabit a depth of 100 mètres or nearly 55 fathoms. The dimensions of our largest specimen of this Caphalopod considerably exceed those given by Verany. I may here mention that my friend Captain Spratt, who co-operated with Prof. Edward Forbes in his Ægean exploration, has most obligingly placed at my disposal a very small quantity of material which he dredged in 1846, forty miles east of Malta, at a carefully ascertained depth of 310 fathoms. It contains among others the following remarkable species of Mollusca, all of which were found in the Porcupine expedition, and may be considered northern forms :—*Leda pellucida* (Phil.), *Leda acuminata* (Jeffr. M.S.), *Dentalium agile* (Sars), *Hela tenella* (Jeffr.), *Eulima stenostoma* (Jeffr.), *Trophon Barvicensis* (Johnst.), *Pleurotoma carinata* (Biv.), and *Philine quadrata* (S. Wood). This shows how imperfect is our knowledge of the Mediterranean fauna.

5. *Relation to Mollusca of the Gulf of Mexico.*—I hope soon, through the kindness of Professor Agassiz, to have an opportunity of examining and comparing the Mollusca dredged during the last three summers by Count Pourtales in the United States expeditions. The only species which I have yet seen from the Gulf of Florida are *Waldheimia Floridana* and *Terebratula Cubensis.* The former appears to be that variety of *Terebratula septata* (a Norwegian and now British species), which Professor Seguenza has described and figured under the name of *Waldheimia Peloritana*, from tertiary beds in Sicily; and the latter is closely allied to *Terebratula vitrea* (Mediterranean), and is perhaps a variety of that polymorphous species. Not only the external characters, but also the skeletons or internal processes of these American species correspond exactly with those of their European relatives. I must repeat that I am no believer in the doctrine or idea of species being "represented" in a geographical point of view. Species may be identical or allied, but not "representative."

6. *Gulf Stream.*—The northern character of the marine fauna observed during the Porcupine expedition is certainly at variance with the general notion that this "river in the ocean," or any branch of it, flows directly to our coasts; and I have elsewhere * endeavoured to show that the occurrence in northern latitudes of tropical shells, seeds, and timber may be accounted for by the surface-drift arising from the prevalence of westerly winds. But there is unquestionably a marine as well as an aerial circulation, Equatorial and Arctic currents as well as Trade winds.

7. *Nature of the sea-bed.*—In that part of my Report which contains a narrative of the expedition, so far as I was engaged in it, I have given some particulars which it is unnecessary to recapitulate. Some of the pebbles and gravel from my deepest dredgings (1,215 to 1,476 fathoms) have been examined by Mr. David Forbes, the eminent mineralogist; and he has kindly furnished me with the detailed report which I append to this communication. Among the pebbles and gravel were several fragments of true volcanic lava, which throw a considerable light on the course of the Arctic current along the western coasts of Ireland. He is of opinion that these volcanic minerals came from Iceland or Jan Mayen. Mr. Forbes has also, at my request, carefully and completely analysed a portion of the Atlantic mud from 1,443 fathoms, the pebbles and gravel having been previously removed from it by sifting; and the result shows that its chemical composition differs greatly from that of ordinary chalk. The sifted mud contains out of 100 parts 50·12 only of carbonate of lime, and no less than 26·77 of fine unsoluble gritty sand or (rock débris); while chalk consists almost entirely of carbonate of lime, and seldom contains more than from 2 to 4 per cent. of clay, silica, and other foreign material. But I do not say that this single analysis is conclusive. Mr. Forbes's further report on that head, as well as on a specimen of Rockall (for which I am indebted to Staff-Commander Inskip, who procured it in the Porcupine surveying expedition of 1862), also accompany this communication. I may observe that stony ground did not occur during the present expedition beyond about 550 fathoms, the sea-bed at greater depths being covered by mud or what is technically called "ooze." This superstratum appears to consist chiefly of decomposed animal matter mixed with the shells of Pteropods and *Globigerinæ*, which must have dropped from the surface of the sea. I have myself seen living *Globigerinæ* in great abundance taken with *Spiriales* in the towing net; and Major Owen's papers in the Journal of the Linnean Society for 1865 and 1866 leave no doubt not only that *Globigerinæ* and other free Foraminifera live on the surface of the mid-ocean, but that they have the power, by protruding their pseudopodia, of descending a few inches and rising again to the surface. Sessile or fixed Foraminifera, of course, cannot do this; but I have found some of these living on the surface and attached to floating sea-weed (*Fucus serratus*) at a considerable distance from land. The fresh appearance of the sarcode in Foraminifera taken from great depths does not of itself prove that they live there, when we consider the comparatively antiseptic or preservative property of sea-water as well as the extremely minute size of the aperture in each cell which contains the sarcode. Some Foraminifera, however, inhabit only the bottom of the sea.

8. *Bathymetrical conditions.*—So much has been said of late years (by myself among others) as to the depths of the sea being not merely inhabited but replete with life of a highly organised nature, and as to there being apparently no bathymetrical limit of habitability, I will content myself with noticing the Mollusca which were dredged in 2,435 fathoms. They were—(1) *Pecten fenestratus*, a Mediterranean species; (2) *Dacrydium vitreum*, Arctic; (3) *Scrobicularia nitida*, Finmark to Sicily; (4) *Neæra*, an undescribed species, Norwegian; and (5) *Dentalium*, a fine species, also undescribed. The first of these species was known to inhabit depths varying from 40 to 60 fathoms, the second 50 to 300 fathoms, the third 3 to 300 fathoms, and the fourth 50 to 60 fathoms. The *Dentalium* is an inch and a half long; and in 1,207 fathoms was taken a new species of *Fusus*, living and two inches in length. This last species, being one of a zoophagous tribe, must have had for its food prey of a suitable kind and perhaps of dimensions at least equal to its own. Abysmal life is not represented merely by microscopic organisms; and I suspect that there is no difference in size between the animals that live in shallow water and the greatest depths. Nor do I believe that such abysses are dark or devoid of light. Colour is assuredly not wanting, nor the usual organs of sight in the Mollusca and Crustacea. Living specimens of the *Dacrydium* from 2,435 fathoms are reddish-brown; and a fine live specimen of *Trophon latericeus* from 440 fathoms is bright rosecolour. *Dacrydium vitreum* makes a nest (like that of *Modiolaria discors* and *Lima hians*) consisting of a narrow tubular case twice as long as itself. This case is lined with a delicate membrane, and covered with small Foraminifera, particles of sponge, and coccospheres, which are firmly agglutinated. The *Dacrydium* inhabits the broader half, its front or ventral margin lying in the direction of the opening of the case. From 2,090 fathoms came a new species of *Pleurotoma*, alive, and having a pair of prominent eyes on short stalks; and the *Fusus* from 1,207 fathoms was similarly provided. In both these genera the eyes are perfect and not rudimentary. The eyes of the *Oncopus* from 632 fathoms are remarkably large and more highly organised than those of many fishes. The animals of this genus crawl with their arms, head downwards; and the common species (O. *vulgaris*) buries itself in sand and gravel. Instances to prove that colour and visual organs are possessed by animals at very great depths are innumerable; and they would lead us to infer that light (of what nature I cannot suggest) penetrates the sea to its profoundest base. None of the deep-sea animals appeared to be phosphorescent. Perhaps in the next expedition some photometric apparatus may be devised in order to solve this problem.

9. *Oceanic currents.*—The Arctic or Northern current probably runs with greater rapidity and force in some places than in others, where the flow seems to be very slow and feeble. Everywhere (as I pointed out in my Shetland Report for 1863) the motion must be extremely gentle or imperceptible at the bottom in deep water, as we find the most fragile and delicate corallines from stony ground quite uninjured.

10. *Geological considerations.*—Not the least interesting fact derived from this expedition was the discovery, in a living or recent state, of species hitherto supposed to be-

* "British Conchology," vol. i. Intr. pp. xcviii. and xcix., and Report of British Association, 1868, p. 236.

long exclusively to the tertiary formation and hitherto considered extinct. Such are *Leda excisa* of Philippi, and an undescribed species of the same genus (Calabrian and Sicilian fossils), *Scalaria corrugata* of Brocchi (Subapennine), *Kellia pumila*, *Neæra jugosa*, and *Cerithium granosum*, all of S. Wood (Coralline Crag), and an undescribed species of *Fusus*, which I propose to name *Sarsi*, lately found in the Red Crag. Mr. Wood is inclined to refer this last species to *F. Spitzbergensis* of Reeve; I regret that I cannot agree with him in such determination. Our Coralline and Red Crag beds notoriously contain a large proportion of northern species; and I was not far wrong in regarding the former as the "cradle" of the British Mollusca. I may here remark that, as in Shetland, valves and fragments of *Pecten Islandicus*, *Tellina calcaria*, and *Mya truncata* var. *Uddevallensis* (all Arctic species) were dredged in rather deep water, on the western coasts of Ireland; and a perfect specimen of *Leda arctica* was found in Loch Torridon. These shells are apparently in a semi-fossil condition; but it is impossible to say whether they are quaternary or recent.

As regards marine zoology, this expedition has produced results more important than those which have ever been obtained in any previous expedition of the kind by the enterprise of our own or any other nation; and I cannot help expressing a fervent wish that it may be renewed next year. The United States, France, Sweden, and Norway are prosecuting with great success this line of scientific research; and I feel confident that Great Britain, with her vast wealth, naval resources, intelligence, energy, and perseverance, will keep the lead which she has now taken.

As one of the naturalists who were privileged to assist in the late expedition I shall be happy again to place my humble services at the disposal of the Royal Society in continuation of the work, especially in conjunction with Dr. Carpenter and Prof. Wyville Thomson.

J. Gwyn Jeffreys

*** At the Meeting of the Royal Society at which the observations described in the above paper were communicated, Professor Alexander Agassiz gave an account of the principal results arrived at by the American Dredging Expedition. The ground explored was limited to a length of about 120 miles by 60 to 90 miles in width between the Florida Keys and the Northern Coast of Cuba, and although the depth reached was by no means as great as that attained by the last British expedition, not being much more than one-third of it, about 820 fathoms, yet the results were fully as striking, and agree in the main points with the conclusions arrived at by the English explorers. Commencing with the sponges, which contained a great number of siliceous forms, he gave as the results of the examination of Dr. Oscar Schmidt, of Graatz, the specific identity of the majority of the species with Mediterranean, Azoric, and Atlantic species, showing a geographical range quite unprecedented, and extending the Atlantic fauna from the Gulf of Mexico to the Bermudas, the Azores, the Mediterranean, the Western Coasts of Europe, and extending far north to the boreal regions of Norway, Iceland, and Greenland. These same results would apply, as far as the collections have been examined, to the Echinoderms, Mollusca, and Crustacea, though the number of identical species in these branches over this extensive Atlantic area is much smaller. Among the Echinoderms, the *Echini* specially showed several new and interesting forms, recalling types characteristic of the cretaceous period; one genus especially, the genus *Salenia*, is represented in our seas by a most interesting species. Another cretaceous type, a new genus of *Spatangida* (Pourtalesia) was found in deep water in Florida, and like the Crinoid genus *Rhizocrinus*, was also dredged by the Porcupine expedition. Several other species of Echinoderms were also shown to be identical on both sides of the Atlantic.

Prof. A. Agassiz gave besides an instance of one of these so-called cretaceous generic types, which was only the young stage of a well-known genus represented from the time of the chalk through the tertiaries, and which is now found living in the tropical seas, showing how careful we ought to be in our generalisations when drawn from a class where the transformations from the young stages to the adult are as great as they are in Echinoderms. He gave as an example of this the case of two species of Echini, one of which is known under one generic name (*Stolonoclypeus*), as the adult, in Florida, while the young is known under a different generic name (*Echinocyamus*) in Europe, and endeavoured to explain by the action of the currents the migration of the pelagic embryos, many of which remain in a helpless condition for several months, and thus to show how changes of currents, brought about by the elevation or subsidence of portions of continents, would fully account for the present limitation of marine faunæ. The presence of corals at great depths will also materially alter the views generally received of the depth at which reef-builders may work, and modify to a certain extent Darwin's theory of the reefs, and their mode of growth. Prof. A. Agassiz alluded to the probable continuation of the exploration of the Gulf Stream by Prof. Pierce, the superintendent of the W. S. Coast Survey, who was carrying out the plans laid out by his predecessor, Professor Bache; and trusted that the Coast Survey would carry on the investigations so successfully inaugurated, thanks to the enlightened views of Professor Pierce, and the executive ability of the assistant in charge, Count Pourtales. This exploration would consist of a series of normals to the coast of the United States, extending from Georgia to New York, completely across the Gulf Stream, thus extending sufficiently far north to meet upon a common ground the English expedition, which the British Government could not fail to send in consequence of the brilliant results of the two previous years.

SCHOLARSHIPS AND EXHIBITIONS FOR NATURAL SCIENCE IN CAMBRIDGE

THE following is a list of the scholarships and exhibitions for proficiency in natural science, which are likely to be offered in Cambridge during the ensuing year.

Trinity College.—One of the value of about £80 per annum. The examination (in chemistry, physics, physical geology, including meteorology and the elements of mineralogy) will be in Easter week, and will be open to all undergraduates of Cambridge and Oxford. Further information may be obtained from the Rev. E. Blore, tutor of Trinity College.

St. John's College.—One of the value of £50 per annum. The examination (in chemistry, physics and physiology, with geology, anatomy, and botany) will be on 29th and 30th of April, and will be open to all persons who are not entered at the University, as well as to all who have entered and have not completed one term of residence. In this College, moreover, natural science now is made one of the subjects of the regular college examination of its students at the end of the academical year (in May); and exhibitions and foundation scholarships will in consequence be awarded to students who show an amount of knowledge equivalent to that which in classics or mathematics usually gains an exhibition scholarship in the College. In short, natural science is on the same footing as classics and mathematics, both as regards teaching and rewards.

Christ's College.—One to four, and in value from 30*l.* to 70*l.*, according to the number and merits of the candidates, tenable for three and a half years, and three years longer by those who reside during that period at the College. The examination will be in April, 1870, and will be open to the undergraduates of Christ's College; to non-collegiate undergraduates of Oxford; to all undergraduates of Oxford; and any students who are not members of either University. The candidates may select their own subjects for examination. Besides these there are three other exhibitions perfectly open, which are distributed annually among the most deserving students of the College.

Clare College.—One of the value of 50*l.* per annum. The examination (in chemistry, chemical physics, comparative anatomy, physiology, and geology) will be on March 30th, and will be open to students intending to begin residence in October. The candidates must show such acquaintance with classics and mathematics as will qualify them to pass the previous examination.

St. Peter's College.—One of the value of 60*l.* per annum. The examination (in chemistry, botany, comparative anatomy and physiology) will be in June, and will be open to all students who are not members of the University, or who have not commenced residence in the University.

Downing College.—One or more, according to the merits of the candidates, of the value of 40*l.* per annum. The examination (in chemistry, comparative anatomy, and physiology) will be in March, and will be open to all students not members of the University, as well as to all undergraduates in their first term.

Sidney College.—Two of the value of 40*l.* per annum. The examination (in heat, electricity, chemistry, geology, physiology, botany) will be in October, and will be open to all students who may enter on the college boards before October 1st.

Although several subjects for examination are in each instance given, this is rather to afford the option of one or more to the candidates than to induce them to present a superficial knowledge of several. Indeed, it is expressly stated by some of the colleges that good clear knowledge of one or two subjects will be more esteemed than a general knowledge of several.

Candidates, especially those who are not members of the University, will in most instances be required to show a fair knowledge of classics and mathematics; such, for example, as would enable them to pass their previous examination.

There is no restriction on the ground of religious denomination in the case of these or any of the Scholarships or exhibitions in the university or the college.

Further necessary information may be obtained from the tutors of the respective colleges.

It may be added that Trinity College will give a fellowship for natural science once, at least, in three years, and that most of the colleges are understood to be willing to award fellowships for merit in natural science equivalent to that for which they are in the habit of giving them for classics and mathematics.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents.*]

Mental Progress of Animals

I HAVE failed to meet with a satisfactory treatment of this subject either in works of mental philosophy or natural history. Sir John Lubbock, in "Prehistoric Times," refers to the likelihood of the sagacity of man and the wariness of animals proceeding *pari passu;* but he does not develop the idea or aid it by illustration, and I find that the tradition still widely prevails that the instinct and intelligence of animals is a thing fixed and unchangeable; and that the mammals which roamed over the world during the earlier and middle tertiary epoch must be credited with the same amount of sagacity as their representatives of the present day. Such statements are assumptions opposed to the current of any facts we possess on the subject. Much of what has been termed *cunning* in animals will be found to have been very much sharpened and made evident in quadrupeds and birds, owing to the new necessities imposed upon them by man the tamer or man the destroyer.

For it is under one of these two characters that man approaches animals, affecting them in the most complex and vivid manner. No bird or quadruped so high in the mental scale as the dog, horse, rat, rook, or sparrow, has been found in the lonely oceanic isles or in any region free, or all but free, from human influence; not because in these quarters such animals could not exist, but rather it would seem because the aboriginal fauna had no opportunity for the improvement of its wits by coming in contact with an enemy or friend so complex, dreadful, and ingenious as a human being.

One of the first impulses communicated to the wits of the wild animals is that derived from the sense of new wants. Now, this is what man supplies by his cultivated fruits and cereals. A feast is spread before quadrupeds and birds more generous than that of nature. But this banquet is guarded, and often becomes a baited trap in which the simple thief is caught; but a very slight increment of sagacity is sometimes enough to turn the scale, and this quickness of wit, especially in the first ages of society, as among existing savages, would be slowly met by improvement of trap. Necessity—on either side the mother of invention—would at last permit only wary vigilant enemies, since these alone could succeed, to hang round the skirts of kraals and wigwams, approach in twilight the crops near stockaded villages, prowl about places of interment, lodge in sewers, enter cellars; and, keenly alive to every sign of danger, multiply in spite of poison, trap, and gun, and in defiance of trained animals of their own and allied species, and that division of labour which gives us special hunters.

The fear of man is a slowly acquired instinct. Mr. Darwin, in his account of his travels, gives some interesting instances of the fearlessness of birds little exposed to man in South America. The crew of Byron's vessel were astonished at the manner in which the wolf-like dog of the Falkland Islands approached them merely out of curiosity. Compare these traits with the admirably organised expeditions for plunder of baboons, elephants, &c., and the rude customs acted upon for self-preservation of the half-wild dogs of the Peninsula and the East, wherein the care of the weak and young, the usefulness of sentries, the value of signals, the difference between sham and real danger, and the advantage of confusing traces of retreat, seem all to be known, and it will be pretty evident that man the thinker has to a considerable extent reacted on animals wild and domestic. Even in my own quarter it is the steady belief of the shepherds that the common sheep-dog has progressed in intelligence and docility within the last fifty years by careful selection. "Where the dog is not valued for intelligence, as in some Eastern countries, it is a much more stupid animal than with us."

Now were we in vision to behold that wonderful Miocene age, when the great mammals roamed over Europe unpeopled as yet by man, I am convinced that both they and the birds of the period would be less interesting and more monotonous in their habits than those which people Europe at the present day, and have for ages been engaged in a struggle for existence with a being so much superior to themselves; and that in prehuman times the horn, hoof, tooth, and coat of mail, to a far greater extent than now, ensured victories which other and more subtle agencies are now necessary to secure on the part of those animals nearest to man in organisation and habits.

Nov. 21 J. S.

The Suez Canal

I NOTICE in your number of 4th inst. an article relating to the Suez Canal (by Mr. Login, C.E., late of the Ganges Canal), and shall be glad if you will allow me to make a few observations with reference to it.

In making his suggestions, Mr. Login appears to have overlooked the fact that there is already a sweet-water canal connecting the Nile with the centre of the isthmus, and passing through the Wadi Toumilat, which it has watered and fertilised; and, further, that it is proposed, when the actual work of excavation in the maritime canal is completed, to commence irrigating operations on a large scale by means of this canal.

As to diverting the Nile, or one of its mouths, and thereby forming the great maritime canal, that is quite another affair. In the first place, if I remember rightly, the water in the present sweet-water canal, where it meets the great canal, is some twelve feet above the level of the latter—in other words, above the level of the sea. Does Mr. Login think, then, that to carry the water at this level for 50 or 60 miles across and above the shallow lakes of Menzaleh and Ballah and the plain of Suez would have required *less* excavation than the actual scheme? In the second place, as Mr. Login says, there would be locks at either end of the canal, which would be not only costly, but most inconvenient for ships in their passage. In the third place I doubt very much whether the whole stream of the eastern branch of the Nile would suffice to keep the canal and the great Bitter Lakes full. Some time ago, indeed, it was disputed whether the Mediterranean and the Red Sea *together*, pouring into the Bitter Lakes, would raise them to the level of the sea, owing to the influences of absorption and evaporation. The facts, however, proved to the contrary.

Still, Mr. Login is much more ambitious. With a *single* stream (that is to say, taking the eastern branch of the Nile at Damietta), less in volume than the present maritime canal, he proposes not only filling the Bitter Lakes to the level of the sea, but raising them to a level of at least twelve feet beyond it (thereby nearly doubling their present volume). Lastly, if the canal and Bitter Lakes could be filled sufficiently by the Nile spring the dry season, it would be overflowing during the floods, and if it could be filled only in the season of the floods, in the dry season it would be nearly empty.

As to the question of breakwaters at the Mediterranean end, Mr. Login rightly says that the annual deposit along the coast is hardly perceptible. I cannot see, therefore, what improvement the breakwaters he suggests would be upon the present ones, seeing that the easterly current *now* passes the extremity of the west pier with a speed of two or three miles an hour. He therefore not only proposes sending a current of at least five miles an hour for a considerable distance up the canal (as his plan infallibly must)—rendering it in strong prevailing winds almost impossible to get out from between his breakwaters—but also sacrificing a splendid harbour of 550 acres in extent.

I quite agree with Mr. Login in thinking that the Suez Canal will not only outlive all abuse, but become one of the greatest blessings to the civilised world.

Birkenhead, Nov. 11 EDW. RAE

The Poles of Mars

PERMIT me through your columns to inquire whether any experiments have been made, by polarisation, to test the statement that the light from the brilliant spots round the poles of Mars is *reflected?*

If nothing has yet been done, will some correspondent decide the point? G. W.

Nov. 25

Lectures to Ladies

IN the fourth number of NATURE there is a letter signed "M." on this subject, in which it is asserted that nearly all the women who most wish to attend these lectures, and who would most benefit by doing so, "are practically shut out from those at South Kensington and at University College, because none of the lectures are given in the evening." Your correspondent gives South Kensington credit for saying something about "persons engaged in tuition," but she adds that it is a mere mockery, as this very fact prevents their getting out in the daytime.

I can confidently say that the Committee for the Higher Education of Women most earnestly desires to interest and benefit those who are teaching others, and who feel the necessity of a better education for themselves; but I believe that the wider and more general object of the whole movement (of which this small committee for South Kensington and Chelsea forms a struggling and isolated element) is, not *so much* to improve those who are already engaged in teaching, as to elevate the tone of education amongst girls who will eventually be teachers, whether as governesses or as mothers.

This I think is enough reason for giving the lectures in the daytime, for it would be difficult for girls to come out alone to classes in the evening. Of course it is hoped that in time a regular system may be established for the training of teachers and students at once, but meanwhile we can but trust that even these weak forces, if they are rightly directed, may have some good effect, if it is only in awakening an interest in these subjects amongst those who can help.

It is very difficult, in London especially, to get at the class of students which we most wish to benefit. I think the fact is that, in London at least, schoolmistresses and governesses are, with a few exceptions, inclined to be narrow and conservative on the subject of educational improvements. If they would only come forward and interest themselves in the scheme their co-operation would be most valuable.

I hope that your correspondent "M." and others who feel as she does, may see this letter and will understand how difficult it is at the outset to satisfy so many conflicting requirements at once.

The course of lectures on Greek History and Literature which Mr. W. R. Kennedy is now giving on Saturdays at the South Kensington Museum is very thinly attended, which is exceedingly discouraging, especially as particular pains have been taken to make these lectures strictly educational, by means of questions set to be worked at by the students at home.

Brompton, Nov. 30 M. A. B.

The American Eclipse

DR. MORTON, Professor of Chemistry in the University of Pennsylvania, has kindly forwarded me photographs of the phenomena of totality. By combining in the stereoscope pairs of these, separated by intervals of about half-a-minute of time, the black globe of the moon appears projected far in front of the luminous prominences and the corona, which are, therefore, clearly seen to belong to the sun. Glass transparencies from negatives specially selected for this purpose, and appropriately mounted, would show these phenomena in a very striking manner.

WILLIAM CROOKES

NOTES

TO-NIGHT the physicists take their turn at the Royal Society, and the physical constitution of the sun will form one of the subjects dealt with.

WE believe that the communication to be read at the Royal Geographical Society on Monday will be one of great interest.

A PERIODICAL, after the model of the popular *Annales des Sciences Naturelles*, will be commenced in Paris at the beginning of the year. It is to be named the *Annales des Sciences Geologiques*. We are promised an important and fully illustrated memoir on the Geology of Palestine, by M. Lartet. The editors of the new journal will be M. Alphonse Milne-Edwards for the Palæontological, and M. Hebert for the Geological departments.

THE Swedish Academy of Sciences has just issued, under the title "Lefnadsteckningar öfver Kongl. Svenska Vetenshaps Akademicus efter År 1854 aflidna Ledamöter," the first number of a series of biographical notices of those of its members who have died since the year 1854. In the absence of the preface, which is deferred until the publication of the second number, we are unable to say whether all the members of the Academy are thought worthy a special biography, or only its most distinguished members. However this may be, we fear that very few of the twenty men, whose lives are recorded in this first number, are known to fame beyond the limits of their native land, notwithstanding that most of them have left behind them honourable records of scientific labour. We do not say all of them, because we notice an archbishop and a bishop, whose claims to admission to the Academy must, judging from their published works, have rested upon their social position or general attainments rather than upon their scientific labours.

WE have been favoured by Professor Newton, of Yale College, with the following notes as to the November star-shower:—"We were unfortunate here this year in observations upon the November meteors. Both nights, the 13th-14th, and 14th-15th, having been overcast. Through breaks in the clouds we saw a few stragglers, some of which were true November meteors, radiating from Leo, and leaving for an instant the soft trail peculiar to those bodies. But the number of meteors during the hour between three and four a.m. of Monday morning was probably not more than double or treble the usual number for any morning. The small part of the sky visible prevented any reliable estimate of numbers. Similar weather has rendered observation impossible at every station from which I have heard."

FROM a preliminary report made to the Association Scientifique de France, by M. C. Wolf, of the Imperial Observatory of Paris.

we learn that the corps of observers appointed to watch the November star-shower was duly in the Marseilles district as previously arranged. On the night of the 12th, 210 stars were catalogued at Barcelonette, 116 at Marseilles, 120 at Montpellier, and only 31 at Orange (these last being merely sporadic). On the 13th, 130 stars were noticed at Orange. At this place the centre of the shower seems to have been much obscured by clouds, to the great disappointment of the observers. But elsewhere, especially at Turin, Marseilles, Valence, and Toulon, there was a magnificent display. The work of uniting the manifold results obtained, and deducing the distance of the bolides from the earth, as well as their radiant point, will shortly be commenced.

FATHER SECCHI writes to *Les Mondes* that the meteors of the 14th November were splendidly seen at Rome during half an hour when the sky was quite clear. Although this half-hour was not the time for the maximum display, no less than 183 meteors were observed. On the evening of the 13th, the meteors had already commenced to be visible in greater numbers than ordinary.

THE Rainfall Committee for 1860–69, in their report presented to the British Association at Exeter, remark that, as they are now on the eve of completing their decennial return for 1860-69, it behoves them to consider how they may best secure for the ensuing period the attainment of the objects for which they were originally constituted. They state that, even to those least acquainted with the subject, it will be apparent how much more desirable as well as easy it is to compare simultaneous observations than those wherein the observed values and their times are different. The number and distribution of the existing observation stations, though incomparably superior to that which existed some years since, is still capable of improvement; tracts of land, the rainfall of which as water-supply is of high importance, remaining without adequate observations, while other places are, if possible, too well provided. Mr. G. Symons requests us to announce that any persons who may be recording the fall of rain, or intending to record it, will oblige by forwarding to him, at 62, Camden Square, N.W., their names and addresses, in order that duplicate gauges may not be started unnecessarily near to them.

AT a recent meeting of the Ethnological Society some photographs of the great megalithic monuments in Wiltshire were exhibited. We understand that a scheme is now in progress to obtain funds for the purpose of procuring a series of photographic representations of the megalithic monuments found in England and France, and, if possible, in Europe and Algeria. Such a series, in which the compass-bearings and accurate dimensions would be given, would be invaluable to the student of archæology. Any of our readers interested in the work, who wish to know more of the details, are requested to communicate with the librarian, Royal Geographical Society, 15, Whitehall Place.

WE have been favoured by a correspondent with an account of a lecture given by Dr. Hector, at the New Zealand Institute, on the subject of Mining in New Zealand. The lecturer, in considering the mineral substances excavated from the superficial deposits, proceeded in the first place to give a short account of the building material. According to his statement, the number of building stones already worked in New Zealand is very large. They are generally divided into granites, limestones, and sandstones. There is a granite quarry at Adele Island, in Blind Bay; and the valuable stone also exists in unbounded quantities on the west coast of Otago, under circumstances most favourable for excavation and shipment. There is also very great variety in the colour and grain, whilst the quality is generally admitted to be excellent. Pure siliceous varieties of sandstones occur with the coal formations. The freestones are chiefly in the tertiary formation of New Zealand, from sandstone, to clay sandstones, and argillaceous sandy limestones, and pure limestone. The finest is the Oamaru stone, which, the lecturer stated, excelled most ordinary building stones in other parts of the world. There are no roofing-slate mines in New Zealand being worked, but there is no doubt that they exist. After reviewing the building materials, Dr. Hector passed on to the consideration of the valuable sands, the character and distribution of which were thoroughly explained.

WE have received the following note on the subject of the Holborn Valley Viaduct:—"From the position of the cracks in the columns it is evident that they have been bodily strained over towards the roadway. This may be accounted for by the great difference in weight between half the arch over the roadway and half the arch over the footway. Taking one girder and its load in each case, the weight of that over the roadway would be about eighty-five tons, and that over the footway only twenty-five tons; the additional weight over the column is eight tons, making therefore in all one hundred and eighteen tons supported by each column, and resting on a cap of the column which is five feet wide. Consequently, the centre of gravity of these weights is considerably out of the centre line of the column, and so tends to "cant" it over towards the roadway. Now, since a removal of the centre of pressure only one-sixth of the width of the cap from the centre line will double the strain on the edge nearest to the centre of pressure, the extra strain imposed on the side of the column nearest the roadway may be easily conceived. If in addition to this we assume the joints to be badly made (which appears probable), the cause of failure can no longer be a matter of surprise. For if the joints were made with convex faces no force would affect the outside filaments of the column, unless the whole column were crushed; but if concave, it is obvious that the edges would have to sustain the whole load. In the case of the Viaduct, as the load is unequally applied, the evil of the concave faces would be greatly exaggerated, and the column would necessarily be crushed on the faces nearest the roadway which support (as stated above) the greater weight. The report of the engineer may be shortly expected."

WE have received the following notes from our Dublin correspondent:—

Professor Jellett, B.D., has been almost unanimously elected as President of the Royal Irish Academy. One vote was recorded for Sir Robert Kane, F.R.S.

The Botanical Gardens at Glasnevin are known to the majority of the visitors to Dublin; they are beautifully situated on the banks of the little river Tolka, and contain a large collection of rare plants. Some years ago the Committee of Botany of the Royal Dublin Society, acting on the advice of the director of the gardens, purchased a large iron shed, in which they displayed portions of a collection of plants and their products useful to man. This structure was from the first quite unfit for preserving the valuable collection placed in it; the specimens were necessarily crowded together, and any arrangement was impossible. Still, the large numbers that visited this room to study the contents of the cases, and oftentimes to take notes of the history of the specimens, as told on their labels, testified to the great and intelligent interest that was taken in the collection by the public.

The special function of the Science and Art Department appears to be to provide for the improvement of the people in science and art, and they placed on the estimates for the four years between 1865 and 1869, a sum of 4,000*l.* for building a museum at the Botanical Gardens, close to the front entrance gate, through which so many thousand visitors pass in the course of each year. This sum, small though it may appear, would have been sufficient to have built and cased a large plain building, which would have contained all the present collection, and the additions to it, for many years; but though the money was voted by Parliament for several years, it was never applied to this purpose: and we think it but justice to the cause of science in Ireland, to call the attention of the Science and Art Department to this fact, and to urge them to have this sum inserted in the estimates for the coming year.

It is scarcely necessary to remind readers of NATURE of the importance of having the Museum of Economic Botany as close to the Botanical Gardens as possible, especially when, as in this case, these gardens are so largely resorted to; but it may not be amiss to inform them that the numerous members of the Royal Dublin Society have among themselves contributed, as donations, almost all the specimens in the present Economic Museum.

A local committee has been formed in Dublin of the "Veitch" Memorial. Dr. Moore, F.L.S., Director of the Botanical Gardens, Glasnevin, is the chairman, and a considerable number of subscriptions has been received.

AT a meeting of the Ashmolean Society, Oxford, Nov. 29th, Prof. Lawson read a short paper on Chlorophyll. Although he had made no original observations on this subject himself, he had no doubt but that a general view of what had been done recently by others would prove interesting to the Society. In speaking of the optical properties of chlorophyll, he called particular attention to the observations made on this branch of the subject by Professor Stokes; observations which had disproved the old theory that chlorophyll could be separated into two primary substances of a yellow and blue colour (the xanthophyll and cyanophyll of M. Frémy). He dwelt also upon the fact that Mr. H. L. Smith's careful comparison of the spectrum of the endochrom of diatoms with that of chlorophyll went far to prove the two substances to be identical. Chlorophyll had been formerly supposed to be a product of the vegetable kingdom only; but more recently a green colouring matter, closely allied to chlorophyll if not identical with it, had been detected in many of the lower forms of animal life. These discoveries illustrated in a striking manner how the supposed gaps between the two kingdoms were filled up.

AT Clare College, Cambridge, a scholarship, value 50*l*., tenable for three years, will be given for proficiency in natural science. The examination, commencing March 30, 1870, will be in chemistry, chemical physics, comparative anatomy, physiology, and geology. Excellence in one or two of these subjects is preferred to a less perfect acquaintance with a greater number. Further particulars can be obtained from the tutor of the college.

THE *Pall Mall* announces the publication of the seventeenth volume of the Report of the Schools Inquiry Commission. It comprises reports on the schools in what the Commissioners have defined as the north-western district—namely, the counties of Lancashire and Cheshire.

WE understand that it is not the intention of the Government to fill up the vacancy in the curatorship of the Botanic Gardens at the Mauritius, caused by the death of Dr. Meller, but to promote the head-gardener to the highest post of authority.

DR. McQUILLEN has exhibited in the Microscopical Department of the Academy of Natural Sciences at Philadelphia, slides of blood corpuscles of men and the lower animals, to which chloroform and nitrous oxide had been administered, to show that there was no morphological change in these bodies after administration of anæsthetics, as stated by certain physiologists in England. He showed specimens also in which, the blood corpuscles having been brought into actual contact with chloroform and ether, disintegration had taken place.

ON the same occasion, Mr. W. H. Walmsley called attention to the very great merits of glycerine jelly as a medium for the preservation of every description of objects, animal or vegetable. With this the most delicate tissues can be perfectly seen and examined; it preserves the colours, is very tenacious, and "its refractive powers are sufficient to render all inert structures transparent; while even the delicate lines on the scales of a mosquito's wing are as distinctly visible as if mounted dry." The formula for the preparation of this valuable jelly is thus set forth:—Take one package of Cox's gelatine, wash repeatedly in *cold* water, then place in a vessel and cover with *cold* water. Allow it to soak an hour or two, pour off superfluous water, add a pint of *boiling* water, place vessel on fire, and boil for ten or fifteen minutes; remove from fire, and when cool, but still fluid, add the white of an egg well beaten, replace on the fire, and boil until the albumen of the egg coagulates. Strain while hot through flannel, and add an equal portion by *measurement* of Bower's pure glycerine, and fifty drops of carbolic acid in solution: boil again for ten or fifteen minutes, and again strain through flannel; place in water bath, and evaporate to about one half; then filter (through cotton) into 2 oz. broad-mouthed phials. When thus made, the jelly is to be used in the mounting of objects as follows:—Place the stock bottle in a small jar of boiling water; when it becomes fluid, a sufficient quantity must be removed to the slide (previously warmed) with a glass rod; the object (previously soaked for some hours in equal parts of glycerine and distilled water, with a few drops of alcohol) is to be placed in the drop of fluid jelly, a cover applied, and a light weight placed upon it to exclude superfluous jelly. When cold, clean off the slide with a knife, wash in cold water, and finish with a ring of gold size or shellac varnish.

THE volume of the Memoirs of the Geological Survey of England and Wales, just published, consists of an important monograph on the Geology of the Carboniferous Limestone, Yordale Rocks, and Millstone Grit of North Derbyshire and the adjoining parts of Yorkshire, explanatory of sheets 81 N.E. and S.E., and 72 N.E. of the Survey Map. The work is by Messrs. A. H. Green, C. Le Neve Foster, and J. R. Dakyns; and contains an elaborate description of the geology of the district, illustrated with numerous important sections and a few views. Mr. Etheridge has contributed an Appendix and tabular list of fossils, with indications of the localities in which they occur.

ASTRONOMY

Spectroscopic Observations of the Sun

PROFESSOR C. A. Young, of Dartmouth, U.S., has communicated to the October number of the *Journal of the Franklin Institute* the following important observations of solar protuberances, which entirely endorse the work done by Mr. Lockyer in this country. We are enabled to place them thus early before our readers by the kindness of Professor Morton.

September 4th, 1869.—Prominences were noted on the sun's limb at 3 p.m. to-day in the following positions, angles reckoned from North point to the East:—

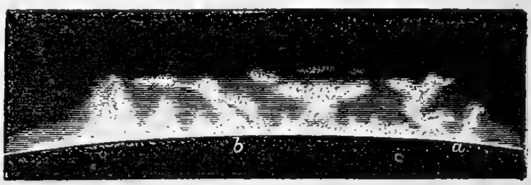


FIG. 1.

1. + 70° to + 100°, very straggling, not very bright.
2. − 10°, large and diffuse.
3. − 90°, small, but pretty bright.

September 13th, 1869.—The following protuberances were noted to-day.

1. Between + 80° and + 1100, a long straggling range of protuberances, whose form was as in Fig. 1. I dare not profess any

very extreme accuracy in the drawings, not being a practised draughtsman, but the sketch gives a very fair idea of the number, form, and arrangement of the immense cloudy mass, whose height was about 50″ and its length 330″ (22,500 miles by 1,350,000). The points *a* and *b* were very bright.

2. +135° small, but very bright at the base, of this form (Fig. 2).

3. −85° of this form (Fig. 3).

The dark spot, marked *c*, was very curious, reminding one strongly of the so-called fish-mouth in the nebula of Orion. I saw no change in it for 20 minutes. On the other hand, the first

Fig. 2.

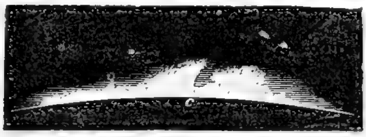


Fig. 3.

series mentioned were changing rapidly, so that at five o'clock the sketch which was drawn at two was quite inapplicable, only the general features remaining unaltered.

4. −128°, about 20″ high, forked, as in Fig. 4.

The structure was *cirrus* in every one but No. 3, which seemed more like a mass of cumulus.

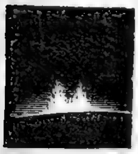


Fig. 4.

To-day, for the first time, I saw b_1 reversed in the chromosphere when the slit was tangent to disc; 1474 was easy; the new line at 2602 cannot be detected as yet.

At 2.25, while examining the spectrum of a large group of spots near the sun's western limb, my attention was drawn to a peculiar double *knobbishness* of the F line (on the sun's disc, not at the edge), represented by Fig. 5, *a*, at the point *e*. In a very few moments a brilliant spot replaced the knobs, not merely interrupting and reversing the dark line, but blazing like a star near the horizon, only with blue instead of red light; it remained for about two minutes, disappearing, unfortunately, while I was examining the sun's image upon the graduated screen at the slit, in order to fix its position, which was at −82½, about 43″ from the edge of the limb, about 15″ inside of the inner edge of the spot-cluster. I do not know, therefore, whether it disappeared instantaneously or gradually, but presume the latter. Fig. 5, *b*, attempts to give an idea of the appearance. When I returned to the eye-piece, I saw what is represented at Fig. 5, *c*, &c. On the upper (more refrangible) edge of F there seemed to hang a little black mote, making a *barb*, whose point reached nearly to the faint iron line just above F. As given on Angström's atlas, the wave-length of F is 486·07, while that of the iron line referred to is 485·92 (the units being millionths of a millimetre). This shows an absolute change of 0·15 in the wave-length, or a fraction of its whole amount, represented by the decimal 0·00030, and would indicate an advancing velocity of about 55·5 miles per second in the mass of hydrogen whose absorption produced this barbed displacement.

Fig. 5.

The barb continued visible for about five minutes, gradually resolving itself into three small lumps, one on the upper, and two on the lower line, Fig. 5, *d*. In about ten minutes more, the F line resumed its usual appearance. I did not examine the C line, as I did not wish to disturb the adjustments and risk losing some of the curious changes going on under my eye.

After the close of this strange phenomenon, I examined, with our large telescope of 6-inch aperture, the neighbourhood in which this took place, and found a very small spot exceedingly close to, if not actually *at*, the place. This was at 2.45. At 5.30 it had grown considerably.

Undoubtedly, the phenomenon seen was the same referred to by Mr. Lockyer when he speaks of often seeing the bright lines of the prominences not only at the sun's limb but on his disc. It is the only time I have had the good fortune to see it as yet.

GEOLOGY

Structure of Eophyton

THE *Geological Magazine* for the present month contains a paper by Mr. Henry Hicks, describing the structure of a fossil, from the Lower Arenig rocks of Ramsey Island, near St. David's, which he considers to be an *Eophyton*, resembling *E. Linnæanum* of Torell. The rocks in which this fossil occurs rest conformably upon Upper Lingula flags, and underlie rocks of the Skiddaw or Tremadoc series.

Mr. Hicks describes and figures the fossil under the name of *Eophyton* (?) *explanatum*. He describes it as a moderately convex stem, about four lines broad, jointed, and ribbed throughout its whole length. At one joint in the specimen described, the ribs bend outwards, as if to form a branch. The stem is covered by a very thin cortical substance, within which it is composed of minute tubular columns, lying close together, and running the whole length from one joint to another.

The *Geological Magazine* also contains papers by Mr. Ruskin on Banded and Brecciated Concretions, illustrated with a plate and several woodcuts; by Mr. Poulett Scrope, on the pretended raised Beaches of the Inland Slopes of England and Wales, severely criticising Mr. D. Mackintosh's recent volume on Geology and Scenery; by Prof. Harkness, on the middle *Pleistocene* deposits of Britain; by Mr. R. Tate, on additions to the list of British *Brachiopoda* of the secondary rocks, including a table showing the distribution of the British *Liassic Brachiopoda*; and by Mr. W. H. S. Westropp, on the occurrence of "albite" in the granite of Leinster. Lord Enniskillen contributes a catalogue of the type specimens of fossil fishes in his collection. The number also contains the usual notices, reviews, and abstracts of the proceedings of societies, correspondence, &c.

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, December 2.—Dr. A. W. Williamson, F.R.S., in the chair. Sir Roderick Murchison, Bart., F.R.S., Messrs. M. H. Cochrane, Edward Smith, T. Walton, M.R.C.S., G. M. Hopwood, John Wiggin, Thomas Gibb, and George Harrison were elected Fellows. A paper on some points of the Chemical Nomenclature of Salts by Mr. H. G. Maden was read. The author advocated the use of the prefixes "proto" and "per" instead of the terminations "ous" and "ic" in the nomenclature of salts, and expressed his preference for the systematic names formed from English words, as "copper sulphate." Dr. Attfield recommended an adherence to trivial names like "calomel" and "corrosive sublimate," when possible, as changes in theory necessarily led to inconvenient alterations in nomenclature. Dr. Williamson objected to Mr. Maden's proposal to revert to the use of the prefixes "proto" and "per," on the ground that they had formerly produced great confusion, particularly in the nomenclature of the chlorides of mercury. He advocated an extension of the use of the terminations "ous" and "ic," which indicated the places of compounds in a series without binding chemists to particular views of constitution. He thought Mr. Maden's preference for English words might be carried too far and produce such terms as "brimstonic acid" and "charcoalic oxide." Mr. Vernon Harcourt expressed his general concurrence with the author. Dr. Odling pointed out that in certain names, such as "ferricyanide of iron," it was advantageous to use both English and Latin names. Dr. Voelcker thought that the employment of different names for the same substance familiarised chemists with different views of constitution. A communication from Mr. J. Hunter on the analyses of sea-water from different depths was read. The author gave the results of observations made during the recent scientific expedition of the *Porcupine*.

Zoological Society, November 25.—Mr. John Gould, F.R.S., V.P., in the chair.—Mr. Sclater made some remarks on the condition of various zoological gardens on the Continent recently visited by him, and on rare animals observed in those establishments. The secretary exhibited on behalf of Mr. John Brazier, C.M.Z.S., the eggs of a megapode (*Megapodius*) from Banks Island, New Hebrides, indicating the existence of a species of this genus in that group of islands. A letter was read from Mr. W. T. Fraser, C.M.Z.S., giving some confirmatory facts respecting the alleged existence of the rhinoceros in Borneo. Mr. R. B. Sharpe exhibited a specimen of *Alcedo grandis*, a rare species of kingfisher from the Terai of Darjeeling. Mr. Andrew Murray exhibited specimens of some articles of food sold in the markets of Old Calabar. These consisted of examples of a frugivorous bat (*Pteropus*) ready trussed, specimens of a rare crustacean (*Callianassa turnerana*), and the larvæ of a Longicorn beetle found in decayed palm-trees. A letter was read from Mr. E. L. Layard, of Cape Town, F.Z.S., containing some remarks as to priority of discovery of the remarkable nesting-habits of the hornbills. Mr. H. J. Elwes, F.Z.S., exhibited a fine pair of horns of the Sinaitic Ibex (*Capra nubiana*), and Mr. H. E. Dresser, F.Z.S., some eggs of the little gull (*Larus minutus*) recently taken in Russia. A communication was read from the Rev. O. P. Cambridge, containing notes on some spiders and scorpions recently collected in St. Helena by J. C. Melliss, Esq. Judging from this collection, which, however, was of small extent, the character of the *Araneidea* of St. Helena appeared to bear a thoroughly European stamp. A communication was read from Dr. O. Finsch, C.M.Z S., and Dr. G. Hartlaub, F.M.Z.S., on a small collection of birds recently received by the Museum Godefroyanum from the Tonga Islands. The species contained in this collection were eleven in number, one of which was believed to be new to science, and was proposed to be called *Myiolestes Heinei.* A communication was read from Surgeon Francis Day, F.Z.S., containing the second portion of his critical remarks on the fishes in the Calcutta Museum. Two papers were communicated by Mr. J. Brazier, C.M.Z.S., on the localities of certain species of land-shells and volutes found in Australia and the neighbouring islands, and on the species of cones met with in Port Jackson, N.S.W. Mr. R. B. Sharpe read a paper on the birds of Angola collected by J. J. Monteiro, Esq., which were accompanied by the notes of the collector. The present collection contained twenty-nine species, many of which were of great interest. A communication was read from Mr. D. G. Elliot, F.Z.S., containing a monograph of the genus *Pelecanus.* The species of pelicans recognised by Mr. Elliot were nine in number. Mr. Sclater exhibited a specimen of a new species of Mexican wren from the Berlin Museum, which he proposed to describe under the name of *Thryothorus nisorius.* Mr. Sclater also read some notes on the identification of two mammals recently described by Dr. Gray from specimens living in the Society's Gardens. A paper was read by Messrs. Sclater and Salvin on Peruvian birds collected by Mr. Whitely, being the fifth of a series of communications on this subject. Mr. John Gould, F.Z.S., exhibited and described a new species of kingfisher from North-Western Australia, which he proposed to call *Dacelo occidentalis.*

London Mathematical Society, November 25.—Prof. Hirst, and subsequently Prof. Sylvester, V.P., in the chair.—The Rev. James White was admitted into the Society, and the Rev. Percival Frost proposed for election. Dr. O. Henrici exhibited a model of the cubic surface $xyz - (\frac{3}{7})^3 (x + y + z - 1)^3 = O$, which has three biplanar nodes; it was constructed in cardboard to a scale of $2\frac{1}{2}$ inches, as unit. A sufficient number (eleven) of sections $x + y + z - 1 =$ constant, cut out in cardboard, are connected in a horizontal position, and kept at their proper distance by three vertical sections $y = z$, $z = x$, $x = y$, with regard to which the surface is symmetrical. The model contains the central part of the surface with the three nodes, and is bounded by a sphere of 8 inches radius, with its centre at the origin, large enough to show the position of the three straight lines in the surface (each counting for nine), and to give an idea how the surface extends to infinity. The interstices between the cardboard are intended to be filled up with plaster of Paris, so as to form a solid model. Mr. Clifford gave an account of an extension of a theorem of Serret's illustrated by tables, one of which, designated A, is annexed, with its explanation.

Power.	2	3	4	5	6	7	8	9	10
Conic	6	8	11	13	16	18	21	23	26
Cubic	—	10	12	15	19	21	24	28	30
Quartic	—	—	15	17	20	24	29	31	34
Quintic	—	—	—	21	23	26	30	35	41
Sextic	—	—	—	—	28	30	33	37	42
Septic	—	—	—	—	—	36	38	41	45
Octavic	—	—	—	—	—	—	45	47	50
Nonic	—	—	—	—	—	—	—	55	57

The tables, for convenience, refer to points instead of lines, and curves of given order instead of curves of given class. The meaning of them will best appear from an example. Thus, in the Table A above, opposite the word quartic and under the power 8 we find the number 29. This means that if the eighth powers of the equations of 29 points are connected by a syzygy, the points are all on a quartic curve. There are, moreover, intersections of the quartic by an octavic, which, in virtue of a theorem of Jacobi's, is an additional piece of information. Mr. Clifford also exhibited a second Table B, constructed in a similar manner for surfaces. Mr. Roberts made a statement of a theorem in invariants, which, however, is so mixed up with other considerations and details, that it cannot well be isolated and its limiting circumstances explained without going into further details than the limits of this notice permit.

EDINBURGH

Geological Society, December 2.—Mr. Geikie, F.R.S., president, in the chair. The first paper was on the Succession of the Laurentian, Cambrian, and Lower Silurian Rocks on the Shores of Loch Broom, being a letter addressed to the president by Sir Roderick Murchison.

Sir Roderick Murchison, in his paper, after alluding to his previous researches in Scottish geology, and especially to the order which he had been enabled to establish among the rocks of the north-west Highlands, proceeded to give the results of a visit which he had paid last summer to the west of Ross-shire. Along the shores of Loch Broom he found clear sections confirmatory of his previously published views. Among the Summer Isles at the mouth of that loch the Laurentian gneiss is found with its usual characteristic petrographical character. It throws off the dull red or chocolate-coloured sandstones which in one mountain, Ben More, must attain a thickness of several thousand feet. These strata are inclined gently towards the east, and are overlapped unconformably by the quartz rock and limestone which form the lowest portions of the Lower Silurian series. From the upper part of the uppermost quartz rock there is a perfect ascending passage with the upper flaggy gneiss, which rolls eastward over the rest of the Highlands. By this fresh appeal to the natural sections of the north-west Highlands, Sir Roderick had been again able to confirm the now established order of succession among these ancient rocks.—Mr. Geikie, F.R.S., afterwards communicated a series of notes for a comparison of the volcanic geology of central Scotland with that of Auvergne and the Eifel. The author began by alluding to the labours of Boué, Forbes, Scrope, Daubeny, and others. He then sketched the area occupied by rocks of volcanic origin between the Grampians and the silurian uplands of the southern counties. The rocks which he proposed to make the subject of more special remark in this paper were of carboniferous age.

They were capable, he said, of being broadly treated under two groups—1st, plateaux; and 2d, points of local eruption. 1. Plateaux of carboniferous volcanic rocks are extensively developed in the western part of the midland valley. They form the range of the Campsie and Kilpatrick fells, and, crossing the Clyde into Renfrewshire, sweep for many miles through the north and north-east of Ayrshire. They occur likewise as fragments on the Clyde islands, Arran, Bute, and Cumbrae. Extensive as the present area of these rocks is, there can be no doubt that it once covered a much greater surface, and that one great plateau of lavas and tuffs stretched from the Ochil Hills to the south of Cantyre. Throughout the wide district where the rocks still remain they retain a remarkable horizontality. They consist of various porphyrites, melaphyres, and tuffs, arranged in beds, which are placed over each other with great regularity. Hence the hillsides wear a terraced appearance from the alternation of harder and softer beds. This feature characterises the Campsie fells and the hills south-westwards to Ardrossan, but it is most conspicuously displayed in some of the valleys at the south end of Bute. One of the distinguishing features of these plateaux is the comparative infrequency with which any vent or true point of eruption can now be detected. Occasionally such a vent is found as a boss of coarse volcanic agglomerate, or of porphyrite or melaphyre; but, as a rule, all the foci of eruption are now buried under the materials which they emitted. Another feature which runs through the plateaux is the apparent continuity of the several beds. Viewed from a little distance, the terraces of trap seem each perfectly continuous for long distances. A closer examination often shows that though the terrace may run on, the rock of which it consists is formed of different sheets, which, though lying on the same plane, have proceeded from different vents. Mr. Geikie then pointed out the structure of some of the volcanic plateaux of central France as illustrative of those features of the Scottish plateaux to which he had referred. (2) While the western half of the Scottish carboniferous area is characterised by the wide extent of its volcanic plateaux, the eastern half is as strikingly distinguished by the abundance of its points of local eruption. Traces of these independent but closely segregated vents are scattered over almost the whole extent of Fife and the Lothians. They belong as a whole to the lower division of the carboniferous formation. The evidence by which their position can now be ascertained consists of masses of stratified tuff, frequently associated with contemporaneous outflows of melaphyre. The number of the vents in some parts of the country must have been very great. During the deposition of the lower carboniferous rocks, the area of Linlithgowshire and great part of Fife and East Lothian was dotted over with little volcanoes, each throwing up its cone of ash, or here and there emitting also a short current of lava. In some places the vents were so closely placed together, that their ejections formed in the end one long volcanic bank, such as the Garlton Hills and the range of heights between Bathgate and Linlithgow. The vents were singularly local in their development. Thus, while they continued in activity throughout Linlithgowshire and Fife, as well as in Haddingtonshire, the intervening area of Edinburghshire remained almost without them. Their long continuance in the districts where they had once broken out is remarkable. During the time represented by the deposition of many hundred feet of strata, the area of Linlithgowshire continued to be the theatre of a wonderful volcanic activity, new cones breaking out as the old ones were washed down. Yet the county of Edinburgh, only a few miles to the east, remained during that long period almost wholly unaffected by any volcanic action. Reference was then made at some length to the extinct volcanoes of Auvergne and the Eifel, and it was shown that in their form and distribution, their small size, the nature of their products, and the protracted period during which they had been in activity, they enable us to realise vividly what was the condition of a great part of central Scotland during the earlier ages of the carboniferous period. The concluding portion of the paper dwelt upon the denudation of the volcanic rocks of Auvergne and of Scotland. Mr. Scrope had shown conclusively that the wide and deep valleys of the Loire, the Dordogne, and other streams of central France had been carved out of volcanic rocks and fresh-water strata by subaërial erosion alone. The form and structure of these valleys were compared with those of valleys which have been excavated out of volcanic rocks in Scotland, and it was argued that the similarity of result was in all probability due to a similarity of cause. In the Scottish valleys the influence of ice, and perhaps, in some cases, also of the sea, had come into play to augment or modify that of the subaërial forces. Yet there was every reason to believe that in Scotland, as in France, the main share of the work had been done by rains, frosts, and streams.

DUBLIN

Royal Irish Academy, November 30.—The Earl of Dunraven, F.R.S., V.P., in the chair. The minutes of the former meeting, having been read and approved of, were signed. The chairman briefly expressed his regret and that of the Academy at the resignation of their former president, Lord Talbot de Malahide, and stated that he was ready to receive the names of any candidates for the vacant office. The Rev. Dr. Lloyd, F.R.S., Provost of Trinity College, proposed that Professor Jellett should be elected president. Among all the members of the Academy he knew of none save one (Rev. Dr. Salmon, F.R.S.), who, in his opinion, from his great scientific attainments, was so eligible for this important post; and his friend Dr. Salmon had announced his determination to withdraw his claims in favour of Mr. Jellett's. Mr. Jellett was distinguished not only for his knowledge of the higher branches of mathematics, but also for his knowledge of their application, a combination not often to be met with in the same individual. He felt sure that Mr. Jellett's presidency would be as distinguished as that of any of his predecessors. Dr. Stokes, F.R.S. (in the absence of the Rev. Dr. Russell, President of the Royal College of Maynooth), seconded Mr. Jellett's nomination. He reminded the Academy of the importance of having for its president one who was well versed in its affairs, and Mr. Jellett, when secretary of the council of the Academy, had acquired this knowledge. He would not refer to Mr. Jellett's position as a man of science, but he would remind that large and influential section of the Academy, the antiquaries, how much assistance they could have, and were constantly having, from science. Archæology was intimately connected with the natural sciences. Even the laws relating to the flow and ebb of the tides were shown by Professor Haughton to be thus connected, for he had calculated the hour of low tide in the Bay of Dublin on the day of the battle of Clontarf, and his hour absolutely coincides with that named in the written record as translated by the late lamented Dr. Todd. Sir William Wilde said that the provost had spoken of Mr. Jellett's position as a man of science, and Dr. Stokes had spoken of his general attainments and knowledge of the Academy's affairs; but he wished to speak of him as a colleague with whom he had been associated for many years, and as an honest, straightforward man, who, irrespective of all party feeling, did what he considered right without fear, prejudice, or favour. The Academy had had "antiquarian" presidents; it was now time to have one scientific president, and so win back many scientific wanderers. He felt sure Mr. Jellett would never forget the interests of the antiquarian party in the Academy, and he looked forward to a bright career for the Academy under Professor Jellett. Dr. Stewart, as a very old member of the Academy, supported Mr. Jellett's claims. There being no other candidate proposed, the ballot was opened and scrutineers appointed. The chairman announced that there appeared, for Professor Jellett, 55 votes; for Sir R. Kane, 1. He therefore declared Mr. Jellett duly elected as president. The chairman then, with a few graceful remarks, in which he congratulated the Academy on its choice, resigned the chair to the new president.—Sir W. Wilde exhibited a number of antiquities found in the counties of Dublin, Londonderry, and Queen's County, among which were a spirally twisted gold torque, either used as a finger ring or a head ornament, three bronze mammillary brooches, some fragments of bronze rings and bracelets, and a semicircular brooch of beautiful decoration and unique form. The remainder of the collection was chiefly of iron, and consisted of three very fine swords with hilts. Sir William also exhibited a collection of antiquities and casts from North and South America.—Professor Apjohn, M.D., read a paper "On a new step in the analysis of sugar." He stated that crude sugar and syrups generally contained three varieties of saccharine matter, and in the case of such a mixture, the method hitherto in use only accomplished the estimation of one of these, that usually known under the name of Cane Sugar. The means of obtaining its amount, by the optical saccharometer alone, or by Barreswil's solution, each being applied before or after conversion, he then briefly explained, pointing out at the same time that neither the optical nor the chemical method could give any information in relation to the amount of inverted sugar or of grape sugar (crystallised glucose) which might happen to be present. This problem, however, he thought could be completely solved by a combination of the processes adverted to, and this he demonstrated by drawing attention to two equations—the one expressing the result of an observation with the saccharometer, the other that obtained by operating on the solution of copper with the syrup both before and after its inversion. These equations involved three unknown quantities, but one of the three (the cane) might be determined by a preliminary observation with the saccharometer, and as by this contrivance the number of unknown quantities would be reduced to two, the problem admitted of a complete solution. This method of analysis he had recently applied to several saccharine substances, and with satisfactory results.

Royal Geological Society, November 10. — Dr. W. Stokes, F.R.S., in the chair.—Rev. Professor Haughton read a paper on the discovery of crystals of Albite in the Dalkley granite; the mineral was found by Mr. W. H. S. Westropp, in small crystals mixed with crystals of fluorspar. The existence of this felspar in the Leinster granite was predicted by Professor Haughton some years since, but it had not been found in a separate crystalline form until these specimens were discovered. This fact adds a new link to the chain of observations made by Professor Haughton relative to the classification and origin of granites, and shows the connection between the three great granite masses of Mourne, Leinster, and Cornwall, in all of which now the presence of albite has been distinctly ascertained. —Dr. Macalister exhibited some human and canine bones brought by Mr. H. Ormsby, Esq., Geological Survey, India, from the celebrated cave Uaimh Fraing, Island of Eigg, the remains of some of the Macdonald clan, who were smothered there in the sixteenth century.—Dr. Foot exhibited human bones from the cave of Dunmore, county Waterford, the remains of an Irish tribe suffocated there in the tenth century.—Specimens of the gold-bearing quartz of South Australia were sent for exhibition by Mrs. Gray, of Nareebnareeb, and of the gold-bearing quartz of the Rocky Mountains by Dr. Trevor, of Mentena.—Mr. Harte, County Surveyor of Donegal, exhibited some specimens of polished red granite from that county, which were of great beauty, similar in appearance to that of Peterhead, Aberdeenshire.

Natural History Society, December 1.—Mr. W. Andrews, V.P., in the chair. Dr. A. W. Foot read a paper entitled "Notes on Irish Lepidoptera collected during the past summer." These notes were chiefly records of a pleasant summer's excursion in which no very great rarities were met with. *Colias edusa* was found abundant in the County Kilkenny, and *Vanessa polychloros* was mentioned on the authority of a friend as having been seen in the County Wicklow. Mr. Williams, Mr. F. W. Kirby, Mr. Montgomery, and Dr. Haughton made remarks on the interest of many of the facts recorded in these notes. Mr. W. Andrews, the chairman, stated that it was a mistake to call *Chrysophanus dispar* the scarce copper; that *C. virgaureæ* was the scarce copper. He asserted that *C. dispar* was not rare in England, and that he had met with it in Kerry. He also said that the *Limenitis* which he had exhibited some years ago as from Tarbert, was neither *L. sibilla* nor *L. camilla*, but something quite different from either; and that those who thought it was *L. camilla* were quite wrong. He said he would bring all these facts before the society at another time. [Perhaps some of our entomological readers will enlighten us on these points. Is it possible that *C. dispar* is not a scarce butterfly? Is not *C. virgaureæ* a continental insect? If the *Limenitis* referred to is not, as competent authorities assert, the *L. camilla* of the Continent, what species is it?]

Newcastle-upon-Tyne

Chemical Society, October 28. Annual Meeting.—Mr. I. Lowthian Bell, F.C.S., President, in the chair. After the transaction of the business of the Society, the President read his address, in which he referred to the more important subjects which had engaged the attention of the Society at the evening meetings. He dwelt at length upon Mr. Pattinson's paper on the relations between English and Foreign Alkalimetry and Chlorimetry, which pointed out the fallacious results arising from the retaining of the old atomic weight of soda. He also called attention to the importance of Mr. B. S. Proctor's paper on the Root of the Rhubarb Plant, which exposed the fallacy which had led druggists and the medical profession, for the sake of mere appearance, to reject the portion of the drug richest in the active principle. The following extract from the address, alluding to the relations of science to the public health, is particularly interesting:—"Among the manifold applications of the truths revealed by means of chemical research, there is none more gratifying to the philosopher or to the philanthropist than that whereby chemistry is rendered subservient to the protection and promotion of the public health. It has been reserved almost for our own time to have it demonstrated that the observance of certain so-called sanitary regulations is connected by the closest bonds with the rate of mortality. This has been proved repeatedly in several large cities, at one time conspicuous for the high annual death-rate among their inhabitants, but which, by the authorities dealing with the causes of offence, now escape from the penalty which never fails to attend on the transgression of any great natural law. We need not, indeed, go far for an example in illustration of the doctrine I am enforcing, for in the very town in which we are now assembled, the rapid increase of population had outgrown as it were some of those means and appliances which must accompany the crowding together of a vast number of human beings on a small area of ground. The municipal authorities of Newcastle were no sooner properly impressed with the gravity of their position, and convinced that the remedy and responsibility rested in their own hands, than the most vigorous measures were resorted to in order to grapple with the evil, and we have, in consequence, to congratulate ourselves on a remarkable alteration in the death-rate of this town. It may not be unworthy of mention that the first quarter of 1866 exhibited a mortality corresponding to 48·4 for every thousand of the inhabitants, and that the average for the whole of that year was a mere fraction within 40, viz., 39·7. Taking 10 years, ending with 1860, it was 35·4 per 1000. It cannot be otherwise than satisfactory to compare this with the three quarters of the present year, which is only 26·2, and for the last quarter the deaths only amounted to 23·3 per 1000; in short, from having held a most unenviable position among the most unhealthy towns of the empire, we are now conspicuous among those in which the mortality is the lowest. I am glad to be able to state that the condition of our atmosphere, as affected by the burning of coal and the emission of objectionable vapours, is now engaging the attention of a Committee, with the Mayor at its head, appointed to inquire into the subject. I trust, now that the public mind has been directed to the evil of a smoke-obscured sky, or poisoned air, before long, the inhabitants will experience a happy change from the result of the labours of those charged with the investigation. It is only, however, due to our chemical manufacturers to state that they are fully alive to the importance of not permitting any unnecessary escape of vapours, having an actual value to themselves, and very inconvenient to others when set at large, and therefore, that they do not intend to rest content with the occasional visit of the Government inspector, or of their own superintendents, but are making arrangements for the permanent and continuous sampling of the gases after they have passed their condensing apparatus. Their observations in this direction, will, I feel assured, be much lightened by a very ingenious aspirator, constructed by one of our members, Mr. Swan, now on the table, to which I would invite inspection. I have, myself, been engaged for some time in an examination of the state of combustion experienced by the fuel in our blast-furnaces, and I am so satisfied that a proper study of the phenomena attending it involves considerations of the utmost importance to the iron-smelter, that I intend availing myself largely of the facilities which the apparatus of Mr. Swan is capable of affording." The officers of last year were re-elected by a large majority.

Norwich

Geological Society, November 11, Anniversary Meeting.—The Rev. John Gunn, F.G.S., President, in the Chair. The President and Hon. Secretaries (Mr. J. E. Taylor, F.G.S., and Mr. John King) were re-elected. In his opening address Mr. Gunn alluded to the death of one of the hon. members of the Society, Mr. Bernard B. Woodward. Referring to a paper by Mr. Harmer, F.G.S., on the Chillesford clay and the crag containing *Tellina balthica*, he stated that he had himself published a diagram of the coast and inland sections of Norfolk, and a description of what seemed to him a downthrow of Chillesford clay, or an upthrow of the chalk. He had also instituted a series of measurements of the various levels at which this bed appeared above the water, with a view to determining the amount of disturbance, and had found the heights ranging from fourteen to thirty-two feet. He thought that the difference between the coast and inland sections might be due to this disturbance. Mr. Gunn then noticed an excursion which had been made by the Society to Aldborough, where the Norwich crag had been found near the railway station, associated with undoubted red crag forms. He also adverted to the paper by Mr. Tylor (read before the Geological Society of London) on Valley Gravels. In the discussion which followed the President's remarks, Mr. Harmer gave an outline of the theory he had put forth in his Paper with reference to the bed of shells containing *Tellina balthica*. Both he and Mr. Searles Wood held this to be the base of the lower drift beds, and contended that a great change in the physical geography of the Eastern counties had taken place between the period when the upper and lower Norwich crags had been formed, and the time when the *Tellina balthica* bed had been deposited. The former had been deposited in an estuary opening to the south, the latter in a similar one opening to the north. This argued an oscillation of level in the meantime. Mr. Harmer also expressed himself against the theory that so-called valley gravels were of fluviatile origin, and pointed to Lopham Ford, where the height of the ground was only twenty feet above water level; and yet which was the point of departure for two streams whose much higher banks at some distance were covered with valley gravels containing flint implements. With regard to the opinion that many of the flint implements had been rolled down or transferred to the lower levels, Mr. J. E. Taylor stated that at Sainton Downham these implements were found in their most perfect and totally unaltered condition at the lowest levels. The chippings and edges were as fresh as when the weapons left the hands of their makers. He suggested that the vicinity of Lopham Ford might have been denuded by atmospherical action since the origin of the present rivers. Mr. Taylor then gave an account of a recent visit to Chillesford, in Suffolk, where he had studied the typical section, and taken an inventory of the commonest fossils and their mode of occurrence. The crag intercalated between the Chillesford clay contained great quantities of *Mactra solida*. This was the shell found so abundantly at Arminghall, near Norwich, in a bed resting on a portion of the Chillesford clay. The usual beds which, in the neighbourhood of Norwich, were found underlying this clay, were absent at Arminghall, so that the clay rested on the solid chalk. He had no doubt, therefore, that the intercalated crag at Chillesford was represented at Arminghall by the *Mactra solida* bed.

Paris

Academy of Sciences, November 29.—The following mathematical papers were read:—On a potential of the second kind which solves the equation with partial differences of the fourth order, expressing the interior Equilibrium of elastic, amorphous, non-isotropic substances, by M. de Saint-Venant, and a note on a certain class of differential equations of the second order by M. Laguerre. A note found among the papers of the late M. Léon Foucault on the construction of the optical plane was read. It gave a description of the method adopted by M. Foucault to obtain a perfectly plane surface of glass, and was supplemented by some remarks of M. A. Martin on his experience in the employment of the same method.—M. P. Gervais presented a note accompanying preparations relating to the anatomy of the Great Anteater.—M. Melsens communicated a memoir on the Passage of Projectiles through Resisting Media, in which he treats of the conveyance of air by projectiles moving through it, and the effect of the compression of the air upon the course of the projectile.—M. Scoutetten presented a note on the Preservation and Improvement of Wines by Means of Electricity. He stated that by the application of a current of electricity generated by a battery, and passed into the wine by means of platinum electrodes, its quality is greatly improved.—M. A. Gerardin remarked upon the unhealthy conditions produced by the discharge of the water of starch manufactories into rivers, and maintained that he had restored some rivers into a healthy condition by causing the water containing albuminous and other organic refuse to be discharged upon well-drained arable land. A paper on a very simple system of floodgates with a constant yield under variable pressure, by M. Maurice Lévy, was communicated, as also a note by the same author on a peculiar system of skew-bridges. MM. P. Desains and E. Branly communicated some investigations on solar radiation. They have found that the calorific action of the sun increases in intensity with the altitude of the place of observation, but that the transmissibility of the rays through water diminishes with the altitude. The transmissibility of the solar heat through water and alum was found to be greater in the morning than at noon, but this was not so strikingly the case in October as in August. The authors stated that their spectroscopic observations were in accordance with the preceding results. A paper by M. J. Moutier on the expansion of gases was presented, as also a note on molecular actions in chlorine, bromine, and iodine, by M. C. A. Valson. In the latter the author described his experiments to ascertain the amount of molecular action in chlorine, bromine, and iodine, by determining the height to which solutions of precisely equivalent quantities of their salts would rise by capillary action. From his results he inferred that if chlorine and iodine could easily be brought into a liquid state, the capillary elevations of the three bodies above-mentioned in a tube 1 millimetre in diameter would be respectively 6, 5·5, and 5 millimetres. The author suggested that the capillarity of substances may be made available in chemical analysis, and remarked that in its physical properties bromine stands nearly midway between chlorine and iodine. MM. Odet and Vignon presented an account of a new method of preparing anhydrous nitric acid, founded upon that proposed by Gerhardt for obtaining the anhydrous monobasic organic acids. They prepared chloride of azotyle by the action of oxychloride of phosphorus upon nitrate of lead or silver. The vapours of this chloride of azotyle were directed upon dry crystals of nitrate of silver at a temperature of 140°—158° F; the products of the reaction were conveyed into a tube immersed in a mixture of ice and common salt, where they furnished colourless prismatic needles presenting all the properties described by H. Sainte-Claire Deville. The authors described a simplified form of apparatus in which the acid may be produced without the preliminary preparation of chloride of azotyle, and indicated the reactions which take place. M. J. Roussin communicated a paper on the preparation of hydrate of chloral and on its characters when pure. His process consisted in submitting the crude crystalline mass obtained by passing dry chlorine through absolute alcohol to strong pressure until it is quite dry, then placing it in a retort with a little powdered chalk and distilling it. M. Dubrunfaut presented a paper on inverted sugar, in which he declared the results lately communicated to the Academy by M. Mauméné to be erroneous.—A memoir by M. E. Van Beneden on the mode of formation of the ovum and the embryonic development of the *Sacculinæ* was read; to this we shall probably advert elsewhere.—M. Marié-Davy presented a third note on lunar radiation, containing the results of his observations on this subject during the month of November. The following papers were also communicated:—On a new means of diagnosis and extraction of iron projectiles and leaden projectiles with an iron nucleus, by M. Milliot; on a new electrical explorer for detecting foreign (especially metallic) substances in the tissues of the human body, by M. Trouvé; on a system of aërial navigation (title only), by M. A. Vaillant; a description of clinical experiments upon the therapeutic effects of bromide of morphine and atropine, and bromide of digitaline (title only), and an indication of a mode of curing stings by cauterisation (by the use of phenic and sulphuric acids), by M. Delagrée; and a note on the supposed influence of subterranean marshes in the development of intermittent fevers, by M. Colin.

Berlin

Academy of Sciences, October 11.—Professor Magnus read a paper on the alteration of the radiation of heat by roughening of the radiating surface, in which he described a series of experiments made by him to determine the cause of this alteration, and stated that in his opinion the increased radiation of a roughened surface depends essentially upon the refraction which the heat undergoes in issuing from the surface of the radiating body. —Professor W. Peters communicated a notice of a new species of Lizard, *Phyllodactylus galapagensis*, from the Galapagos Islands. He remarked that only five species of reptiles were previously known from these islands—one tortoise, three lizards, and one snake. The last he identified with *Dromicus chamissonis*, which also occurs on the continent of America, and with this Dr. Günther's *Herpetodryas biserialis*, from the Galapagos group, may be synonymous. If it be distinct, the number of reptiles from these islands will only be seven.—Prof. Pringsheim read an elaborate memoir on the conjugation of swann-spores, the morphological primary form of reproduction in the vegetable kingdom, and a communication was presented by Dr. K. Schultz-Sellack on the diathermancy of a series of substances for dark heat. The author stated that he had found that many more substances than is generally supposed allow a considerable amount of the dark heat radiated by lampblack at 212° F. to pass through them. He enumerates binary compounds of chlorine, bromine, fluorine, and iodine, and a number of sulphides, and shows their behaviour in this respect by means of percentage tables.

German Chemical Society, November 12.—The following papers were read:—Otto on Mercuric Phenylide.—Kolbe: Lecture Experiment to demonstrate the increase of weight of burning substances.—Kempf on Carbonate of Phenyl.—Carstanjen on the Action of Oxychloride of Chromium on Hydrocarbons.—Henry on Chlorosulphide of Phosphorus.—Radizewsky on the Wax contained in the Straw of Cereals.—A. W. Hofmann on the Action of Iodine on Thiobenzamide.—Friedel: Paris Correspondence.—Richter: Petersburg Correspondence.

Bonn

Natural History Society of Rhenish Prussia and Westphalia.—The autumnal gathering of this society took place on the 11th October, the day so widely observed as the centenary of the birth of Humboldt; and the proceedings were naturally inaugurated by a discourse in commemoration of the great philosopher of whom the Germans are so justly proud. The following are the more important communications submitted to the society:—The veteran Prof. Nöggerath gave an account of the earthquakes, four in number, which since November 1868 have visited the Rhine province, specifying the extent of country subject to their influence, and glancing at the general physical characters of earthquake phenomena. He was followed by Prof. Troschel, who showed the importance of a study of the geographical distribution of animals as indicating the configuration of the earth's surface, and the distribution of land and water at the time of the commencement of the existing period of geological history. The Professor's illustrations were chiefly derived from his investigations of the distribution of sea-fish and land-snails. Professor F. Zirkel, of Kiel, made some communications on the mineralogical constitution of the basalt-lavas of Laacher See and the Eifel. Professor von Rath described a new mineral from Laacher See, which he proposes to call Amblystegite, in allusion to the extreme obtuseness of some of its angles. It is of a reddish brown colour; hardness almost equal to that of quartz; specific gravity 3·454; melts with great difficulty, forming a black glass insoluble in hydrochloric acid. In composition it is allied to hypersthene, but is distinguished from that mineral by the absence of the characteristic cleavage. Extracts from a paper by Professor Fuhlrott on the caves of Grevenbrück and the Hönnethal were then read; and Professor Schaffhausen availed himself of the opportunity of insisting upon the desirableness of a systematic exploration of the bone-yielding caves in which Westphalia is so rich. We are glad to hear that steps are being taken to raise funds for this purpose among the members of the society. The most important finds in the Grevenbrück cave are coprolites of hyæna, and two human lower jaws of primitive form.

Vienna

Imperial Academy of Sciences, November 18.—Professor Unger communicated a memoir on the anthracite deposits in Carinthia. He stated that nineteen species of plants, chiefly ferns, have been detected in the shales accompanying this deposit. They agree with those of the coal-measures, and eight of them occur also in the anthracite deposits of Styria, Switzerland, and the French Alps. Two undescribed Fern-stems were particularly noticed by the author, who took the opportunity of opposing the ordinary notion that the *Stigmariæ* are the roots of *Sigillariæ*. Of the latter he regarded those species which have not furrowed stems, as ferns.—Dr. C. Jelinek presented a preliminary communication upon the hurricane-like storm which visited Vienna on the 14th November. The greatest velocity of the wind was 46·6 Paris feet per second, about noon; the diminution of barometric pressure continued until 6 P.M., when the mercury had fallen 7·17 lines, the velocity of the wind being 36·5 feet per second.—Director Tschermak communicated a memoir on a new salt from Hallstadt. This mineral, to which the author gives the name of Astrakanite, occurs mixed with common salt, anhydrite, and a mixture consisting chiefly of sodium sulphate in the Christina gallery at Hallstadt. It forms a bluish layer, the colour being due to enclosures containing iron, and the crystals, which are very small and occur in druses, being frequently colourless. Its composition is expressed by the formula, $MgSO_4$, Na_2SO_4, 4aq, so that it is the third natural magnesium-sodium sulphate with which we are acquainted. M. Tschermak also presented a paper by M. P. Hausenschild, giving an account of his microscopic examination of the minerals called Predazzite and Pencatite. By the examination of thin slices of the most homogeneous looking specimens, the author found that two minerals may be distinguished in them with certainty, namely, calcite and brucite.—Dr. Samuel Stern presented a memoir entitled "Contributions to the theory of ordinary (not musical) sounds, as an objective character, with reference to the special requirements of medical diagnosis."—Prof. E. Ludwig presented a paper by himself and Dr. J. Hein upon the synthesis of hydroxylamine, which, they said, may be effected by the direct addition of nascent hydrogen to pure nitrous oxide as follows:—

$$NO + H^3 = NH^3O.$$

The process consists in passing nitrous oxide through a mixture of tin and hydrochloric acid, freeing the fluid from tin by sulphuretted hydrogen, evaporating the filtrate from the sulphuret of tin to dryness, washing the residue in cold and dissolving it in hot alcohol, separating the ammonium chloride with platinum chloride, and precipitating the pure hydrochlorate of hydroxylamine by anhydrous ether. The analysis and measurement of the crystals thus obtained proved their identity with Lossen's salt.—The following memoirs were presented, but only their titles are given: By Prof. Hyrtl, "On a præcorneal vascular net in the human eye," and "On an insular intercalated bone in the parietal bone;" and by Prof. B. Lapschin, of Odessa, "On the specific gravity of the water of the Black Sea," and "On the conductibility of cork for heat, and its application to the construction of a barometer." Prof. Julius Wiesner also presented a memoir on the origin and increase of Bactria, the results of which had been communicated to the Academy on the 29th April last.

DIARY

THURSDAY, December 9.

Royal Society, at 8.30.—Spectroscopic Observations of the Sun, No. V.: Mr J. Norman Lockyer, F.R.S.—Researches on Gaseous Spectra in relation to the Physical Constitution of the Sun, Note III.: Dr. Frankland, F.R.S., and Mr. J. Norman Lockyer, F.R.S.—On the Successive Action of Sodium and Iodide of Ethyl on Acetic Ether: Mr. J. A. Wanklyn.

Society of Antiquaries, at 8.30.—On a Faliscan Inscription: Padre Garrucci, Hon. F.S.A.

Zoological Society, at 8.30.—On the Fin Whale recently stranded in Langston Harbour: Prof. Flower, F.R.S.—On the Fresh Water Fishes of Burmah: Surgeon Francis Day.

Mathematical Society, at 8.—Gauss' Theorems and Napier's Analogies: Mr. Crofton.—On the Order of the Discriminants of a Ternary Form: Mr. S. Roberts.

London Institution, at 7.30.—Architecture: Prof. R. Kerr.

FRIDAY, December 10.

Royal Astronomical Society, at 8.

Clinical Society, at 8.30.

Quekett Microscopical Club, at 8.

Society of Arts, at 8.—Indian Conference. On a Gold Currency for India: Mr. A. Cassels.

SATURDAY, December 11.

Royal Botanic Society, at 3.45.

MONDAY, December 13.

Society of Engineers, at 7.30.—Annual Meeting.

Royal Geographical Society, at 8.30.

Medical Society, at 8.

Royal Institute of British Architects, at 8.

Royal Institution, at 2.—Monthly Meeting

London Institution, at 4.—Elementary Physics: Prof. Guthrie.

Society of Arts, at 8.—The Spectroscope and its Applications: Mr. J. Norman Lockyer, F.R.S.

TUESDAY, December 14.

Institution of Civil Engineers, at 8.

Royal Medical and Chirurgical Society, at 8.30.

Photographic Society, at 8.

Anthropological Society, at 8.—Race Affinities of the People of Madagascar: Mr. C. Staniland Wake, F.A.S.L.

WEDNESDAY, December 15.

Society of Arts, at 8.—On India-rubber—its History, Commerce, and Supply: Mr. J. Collins.

THURSDAY, December 16.

Royal Society, at 8.30.

Society of Antiquaries, at 8.30.

Linnean Society, at 8.

Chemical Society, at 8.

Zoological Society, at 4.

Numismatic Society, at 7.

Philosophical Club, at 6.

London Institution, at 7.30.

Edinburgh Geological Society, at 8.

BOOKS RECEIVED

English.—The Monthly Microscopical Journal, December 1869 (Robert Hardwicke).—Chemistry for Schools: C. Haughton Gill (James Walton).—Burton-on-Trent—its History, its Waters, and its Breweries: W. Molyneaux, F.C.S. (Trübner).—Outlines of Chemistry; or, Brief Notes of Chemical Facts: Dr. Odling (Longmans).—Earth and Sea: Louis Figuier (Nelson and Sons).—The Second Table of the Commandments: Dr. Rowland (Longmans)—Heads and Tails: Adam White (Nisbet).—Romance of Natural History, 2 vols.: P. H. Gosse (Nisbet).—Facts and Dates: Rev. A. Mackay (Blackwood).—Physical Ethics: A. Barratt (Williams and Norgate).—Womankind in Western Europe: J. Wright (Groombridge).

Foreign.—Les Pierres Précieuses: J. Rambosson.—Histoire des Météors: J. Rambosson.—Leçons sur la Respiration: P. Bert.—Die Blausäure: W. Preyer.—Landwirthschaftliche Zoologie: Dr. Giebel. (Through Williams and Norgate.)

CONTENTS

NOVEMBER 1869] [PART I

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

"To the solid ground
Of Nature trusts the mind that builds for aye."—WORDSWORTH

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No. 1

No. 2

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No. 4

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PRICE ONE SHILLING AND FOURPENCE

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & Co., 63, Bleecker Street, New York.—THURSDAY, December 9, 1869.

NATURE

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No. 7] THURSDAY, DECEMBER 16, 1869

Registered for Transmission Abroad]

THURSDAY, DECEMBER 16, 1869

DARWINISM AND NATIONAL LIFE

THE Darwinian theory has a practical side of infinite importance, which has not, I think, been sufficiently considered. The process of natural selection among wild animals is of necessity extremely slow. Starting with the assumption (now no longer a mere assumption) that the creature best adapted to its local conditions must prevail over others in the struggle for existence, the final establishment of the superior type is dependent at each step upon three accidents—first, the accident of an individual sort or variety better adapted to the surrounding conditions than the then prevailing type; secondly, the accident that this superior animal escapes destruction before it has had time to transmit its qualities; and, thirdly, the accident that it breeds with another specimen good enough not to neutralise the superior qualities of its mate. In the case of domesticated animals the progress is incomparably more rapid, because it is practicable, first, to modify the conditions of life, so as to encourage the appearance of an improved specimen; next, to cherish and protect it against disaster; and, lastly, to give it a consort not altogether unworthy of the honour of reproducing its qualities. The case of man is intermediate in rapidity of progress to the other two. The development of improved qualities cannot be insured by judicious mating, because as a rule human beings are capricious enough to marry without first laying a case for opinion before Mr. Darwin. Neither would it be easy, nor, perhaps, even allowable, to extend any special protection by law or custom to those who may be physically and intellectually the finest examples of our race. Still, two things may be done: we may vary the circumstance of life by judicious legislation, and still more easily by judicious non-legislation, so as to multiply the conditions favourable to the development of a higher type; and by the same means we may also encourage, or at least abstain from discouraging, the perpetuation of the species by the most exalted individuals for the time being to be found. Parliament, being an assembly about as devoid of any scientific insight as a body of educated men could possibly be, has not as yet consciously legislated with a view to the improvement of the English type of character. Without knowing it, however, the Legislature has sometimes stumbled on the right course, though it has more often blundered into the wrong. Our free trade policy has furnished special scope and special advantages to the energetic enterprising character, and so far has tended to perpetuate and intensify the type which has given to little England her wonderful prominence in the world. On the other hand, the steady refusal to make a career for scientific men has drained away most of our highest intellect from its proper field, and has subjected the rest to an amount of discouragement by no means favourable to increase and improvement. Our laws and customs practically check the growth of the scientific mind as much as they tend to develop the speculative and energetic commercial character.

We do not expect for a long time to hear an orator in the House of Commons commence his speech by announcing, (as a distinguished member of the Austrian Reichsrath recently did, in a debate on the relation of the different nationalities in the empire), that the whole question is whether we are prepared to accept and act upon the Darwinian theory. But even an average English M.P. may be brought to see that it may be possible, indirectly, to influence the character and prosperity of our descendants by present legislation, and none will deny that, if this is practicable, a higher duty could not be cast upon those who guide the destinies of a nation.

A glance at the operation of Darwinism in the past, will best show how potent it may be made in the future. Look at English progress and English character, and consider from this point of view to what we owe it. There were originally some natural conditions favourable to the growth of our commercial and manufacturing energy. We had an extensive coast and numerous harbours. We had also abundance of iron-stone in convenient proximity to workable coal. Other nations either wanted these advantages or were ignorant that they possessed them. These favourable conditions developed in many individuals a special adaptability to commercial pursuits. The type was rapidly reproduced and continually improved until England stood, in the field of commerce, almost alone among the nations of the world. And what is there now to sustain our pre-eminence? Nothing, or next to nothing, except the type of national character, which has been thus produced. Steam, by land and sea, has largely diminished the superiority which we derived from the nature of our coast; and coal and iron are now found and worked in a multitude of countries other than our own. Our strength in commerce, like our weakness in art, now rests almost exclusively on the national character which our history has evolved.

Take another example of the character of a people produced partly by natural conditions of existence, but far more by the artificial conditions to which evil legislation has exposed it. What has made the typical Irishman what he now is? The Darwinian theory supplies the answer. Ireland is mainly an agricultural country, with supplies of mineral wealth altogether inferior to those of England, though by no means contemptible if they were but developed. This is her one natural disadvantage, and it is trifling compared with those which we in our perversity created. For a long period we ruled Ireland on the principles of persecution and bigotry, and left only two great forces at work to form the character of the people. All that there was of meanness and selfishness and falsehood was tempted to servility and apostacy, and flourished and perpetuated itself accordingly. All that there was of nobleness and heroic determination was drawn into a separate circle, where the only qualities that throve and grew were irreconcileable hatred of the oppressor and resolute but not contented endurance. The two types rapidly reproduced themselves, and as long as the external conditions remained unaltered, they absorbed year by year more and more of the people's life; as, if Darwinism is true, they could not but do. And what is the result now? A great part of a century has elapsed since we abandoned the wretched penal laws, and yet none can fail to see in Ireland the two prevailing types of character which our ancestors artificially produced, the only change being that the two types have become, to a certain extent, amalgamated in a cross which reflects the peculiarities of each. Whether future legislation may so far modify the conditions of Irish existence as to work a gradual change in the national character, is a question of much interest, but too large to be discussed just now. In any case we can scarcely expect the results of centuries upon a national type to be reversed in less than a succession of generations.

Still confining myself to the past, let me point again to the very marked qualities which the conditions of their existence have produced in the people of the United States. They started with a large element of English energy already ingrained into them; they have been reinforced by millions of emigrants presumably of more than the average energy of the various races which have contributed to swell the tide. Added to this, the Americans have enjoyed the natural stimulus of a practically unlimited field for colonisation. Only the resolute, self-reliant settler could hope to prosper in the early days of their national existence; and self-reliance approaching to audacity is the special type of character which on the Darwinian hypothesis we should expect to see developed, transmitted, and increased. How far this accords with actual experience, no one can be at a loss to say. There is probably not a nation in the world whose peculiarities might not be traced with equal ease to the operation of the same universal principle. And the moral of the investigation is this: Whenever a law is sufficiently ascertained to supply a full explanation of all past phenomena falling within its scope, it may be safely used to forecast the future; and if so, then to guide our present action with a view to the interest and well-being of our immediate and remote descendants. Read by the light of Darwinism, our past history ought to solve a multitude of perplexing questions as to the probable supremacy of this or that nation in times to come in the field of commerce, as to the effects of emigration and immigration on the ultimate type likely to be developed in the country that loses and in that which gains the new element of national life, and many another problem of no less interest to ourselves and to humanity.

The subject I have thus slightly indicated seems to me to deserve a closer investigation than it has yet received: and, strange as it will sound to the ears of politicians, I cannot doubt that, in this and other ways, statesmen, if they could open their eyes, might derive abundant aid from the investigations of science, which they almost uniformly neglect and despise. H.

THE PROGRESS OF NATURAL PHILOSOPHY

[We have been favoured by Professor Tait with the following extracts from his Introductory Lecture to his class at Edinburgh University, the object of the Lecture being "to show that Natural Philosophy is a *real* science, as tested by steady growth and progression, compared with other so-called Philosophies, which have periodic cycles, and come back after a generation or two into the old, old groove, with the same old rope of sand to be spun over again."—Ed.]

To enumerate in detail all the advances effected in natural philosophy during even the past year would take more time than is usually devoted to a lecture, so that I shall confine myself to a mere mention, not exposition, of a very few of the more interesting discoveries in cosmical science which have recently been made.

First. We have obtained an immense amount of new information as to the constitution of the sun. The total eclipse which was visible in India in the autumn of last year, was singularly well fitted for applying to the strange phenomena of the sun's atmosphere the comparatively novel powers of the spectroscope. Another total eclipse has recently been carefully observed in America, and the results obtained on these two occasions agree well with one another.

One of the most marked phenomena observed in a total solar eclipse is that which, first carefully described some thirty years ago, was called the "red flames;" very singular protuberances issuing apparently from the dark body of the moon, but which were conclusively proved in 1860 to belong to the sun. Had they been lunar phenomena, their dimensions would have been considerable; but it is easily shown that, belonging to the solar atmosphere, their dimensions are *enormous*, a hundred thousand miles being often no exaggerated estimate of their diameter. They must evidently be masses of extraordinary tenuity, else they could not rest in the solar atmosphere, which must be excessively rare at such an elevation. When the spectroscope was directed to them last year, it was at once perceived that they are fiery clouds, consisting mainly of hydrogen gas, heated so powerfully as to become self-luminous. This discovery once made, the total eclipse was seen to be unnecessary, and observations of these singular phenomena are now carried on every day. In fact, in anticipation that such would prove to be their nature, they had actually been sought for before the date of the eclipse. The reason why we can see them, in spite of the comparatively overwhelming light of the sun, is simply this, that the sun's light, which may be said roughly to consist of rays of all degrees of refrangibility, can by a sufficient number of prisms be spread over any desired extent, and thus weakened throughout; while the light from the red flames consists of but a few perfectly homogeneous rays, which may be indefinitely separated from one another, but cannot be individually weakened, by increasing the power of the spectroscope. The process, in fact, closely resembles that by which, with powerful telescopes, astronomers are enabled to observe stars in the day-time. The powerful telescope diminishes the apparent brightness of the sky; but the star has no sensible diameter, and remains undimmed. A singular fact observed is, that while the bright rays in these red flames, which are due to hydrogen, correspond exactly to well-known dark lines in the solar spectrum, due to absorption by the sun's atmosphere; there are others, especially a curious one in the yellow, which have no counterpart among the dark lines. Also the hydrogen lines are sometimes broader, sometimes narrower, than the normal spectrum of incandescent hydrogen requires; sometimes they are slightly displaced from their normal positions in the spectrum. The explanation (on purely physical grounds) of all these phenomena is now being carefully sought, and the connection of the red flames with sun-spots, as well as the singular peculiarities of the spectra of spots, are being recorded for future explanation. In this one direction alone a field has been opened up for inquiries which, even with our present appliances for observation, may well occupy the world for a generation to come.

Another striking phenomenon of a total solar eclipse is the (so-called) Corona of whitish light which appears to surround the dark body of the moon to a considerable angular distance. This also has been proved to belong to the sun. Part of its light is, no doubt, merely sunlight reflected from the matter of the sun's atmosphere, or from cosmical bodies revolving about the sun; for it has long been known to be partially polarised. But it is only within the last few months that *its* spectrum also has been observed, and found to consist mainly of bright lines—*i.e.* of a few rays of definite refrangibility. The positions of the most marked of these have been measured, and they are found to correspond with those of the light of terrestrial auroras! This is one of the most startling results yet obtained by observation; for the aurora is intimately connected with, or at all events has an important effect on, terrestrial magnetism, and it has been known for some time that disturbances in the sun have a marked effect on the magnetism of the earth.

Our sun is a variable star. It has been proved that its spots have an eleven-year period of maximum frequency. Laborious calculations are now in progress at Kew Observatory, with the view of tracing the cause of this periodic effect; and it seems already to be traced with some certainty to the planets, principally to Mercury, Venus, and Jupiter; the first, though very small, being very near, and the last, though very distant, being very large. Now, the red flames, or hydrogen clouds, are intimately associated with sun-spots. Hence we connect *their* frequency with the variability of sunlight. Now, it is only a year or two since an exceedingly well-marked case of a temporary star was visible in the northern hemisphere; a star, usually of inconsiderable magnitude, scarcely visible to the naked eye, suddenly blazed out with brightness rivalling that of Sirius. The spectroscope showed that it owed this increase of its light almost solely to incandescent hydrogen, the chief material of the flame-cloud that hovers over a *solar* spot.

Nor is it only in solar and stellar phenomena that these extraordinary recent advances have been made. Bodies even more puzzling and anomalous than the sun and stars are common enough in the universe. Many nebulæ, long imagined to be immense groups of stars, at such enormous distances that the several constituents were indistinguishable by the most powerful telescopes, have been shown to shine as glowing gas merely, rendering it probable that we have to deal with objects which, though certainly at vast distances from the earth, are probably not vastly farther away than some of the nearest stars. Possibly, in some cases, they may be much nearer, in which case they may be suns which have cooled, and are still surrounded by glowing gas, due to the impacts of small cosmical masses, or meteorites, on or near their surface. Or they may be vast systems of small cosmical masses in the act of grouping themselves by mutual gravitation, impact, and friction into a new star, the incandescent gas being due to the impacts and the friction. In them we may be actually watching the formation of a solar system.

Finally, let us consider what we have recently learned about comets—bodies which have hitherto puzzled the astronomer quite as much as have the nebulæ. Several ingenious speculations have recently been published on this very interesting subject, but I shall only mention one with any detail. There seem to be good grounds for imagining that a comet is a mere shower of stones (meteorites and fragments of iron). This at least is certain, that such a shower would behave, in its revolution about the sun, very much as comets are seen to do, and that, as we have reason to believe is the case with comets, it would be drawn out after a few revolutions, if it described a closed path, so as to be spread over the greater part of its orbit. If the earth, then, were at any time to intersect the orbit of the comet, it would pass through a stream of such stones, all moving approximately in parallel lines and with equal velocities. On entering the earth's atmosphere with the enormous relative velocity due to revolution about the sun in differently sized orbits, described sometimes with a retrograde motion, these fragments of stone would, by the laws of perspective, describe paths all apparently diverging from one point in the heavens, and these paths would be rendered visible by the incandescence of the meteorites due to friction of the air. Now this is exactly what we see, markedly in August and November every year, less definitely at other fixed periods. And the orbits of the August and November meteorites have been determined, and found to be identical with those of two known comets. I cannot enter very fully into this most interesting subject now, but I may say a few words more in explanation. Unfortunately, since spectroscopes have been in everybody's hand, no notable comets have appeared. [How strange it *now* seems to us that the magnificent comets of 1858 and 1860 were allowed to pass without having been looked at through a prism by anyone, whether as a matter of chance or of curiosity!] Such small comets as have been observed have given *continuous* spectra from their tails, so far as could be judged with regard to an object so feebly illuminated. This, then, it would appear, is simply reflected solar light. The heads, however, give spectra somewhat resembling those of the nebulæ I have just mentioned—the spectra of incandescent gases. This is quite consistent with the descriptions given by Hevelius and others of some of the grander comets; which presented no peculiarities of colour in the tail, but where the head was blueish or greenish. Now these appearances are easily reconciled with the shower-of-stones hypothesis. For the nucleus, or head, of a comet is that portion of the shower where the stones are most numerous, where their relative velocities are greatest, and where, therefore, mutual impacts, giving off incandescent gases, are the most frequent and the most violent. This simple hypothesis explains easily many very striking facts about comets, such as their sometimes appearing to send off *in a few hours* a tail many hundreds of millions of miles in length. Wild notions of repulsive forces vastly more powerful than the sun's gravity have been entertained; bold speculations as to decomposition (by solar light) of gaseous matter left behind it in space by the comet have also been propounded; but it would seem that the shower-of-stones hypothesis accounts very simply for such an appearance. For, just as a distant flock of seabirds comes suddenly into view as a dark line when the eye is brought by their evolutions into the plane in which they fly, so the scattered masses which have lost velocity by impact, while they formed part of the head, or those which have been quickened by the same action, as well as those which lag behind the others in virtue of the somewhat larger orbits which they describe, show themselves by reflected solar light as a long bright streak whenever the earth moves into any tangent plane to the surface in which they are for the time mainly gathered.

It is a most valuable principle in physical science, never to be lost sight of, that we must not seek to explain by the assumption of new species of force or action any phenomena which have not been recognised to be inexplicable by means of properties of matter or motion already proved to exist. Before leaving this subject I must refer to the extraordinary fact, lately ascertained, that the spectrum of the head of one of the smaller comets is that of incandescent vapour of *carbon*, of a substance which, with the most tremendous heat attainable in our laboratories, we cannot even melt, much less reduce to vapour: so that to find its spectrum we are obliged to employ it as it exists in olefiant gas or other combined form. But it is premature to speculate further on such incomplete data as we yet possess with respect to the spectroscopic appearances of comets. It is not rash to venture the prediction that the very first application of the spectroscope to a really fine comet will give us at least as much additional insight into the nature of these bodies as the total eclipse of 1868 gave with regard to the atmosphere of the sun. P. G. TAIT

DANA'S MINERALOGY

A System of Mineralogy: Descriptive Mineralogy comprising the most Recent Discoveries. By James Dwight Dana, Silliman Professor of Geology and Mineralogy in Yale College, etc., aided by George Jarvis Brush, Professor of Mineralogy and Metallurgy in the Sheffield Scientific School of Yale College. Fifth edition, 8vo. pp. 827, figures 617. (London: (Trübner & Co.)

II.

EXCEPT in the subdivisions of the silicates, Professor Dana has adhered pretty nearly to the classification adopted in his fourth edition; which accords also in its general features, though not in its details, with that on which the minerals in the British Museum are arranged. The arrangement of the silicates in his new edition is a step that must be called tentative towards a simpler and more philosophical classification of these numerous and important salts. We certainly feel some hesitation in adopting either the terminology or the divisions Professor Dana introduces. The terms bi- and uni-silicate are not happy for the expression of oxygen ratios; not so happy, for instance, as the term singulo-silicate used for the latter by Rammelsberg, or the ortho-silicates of Odling. We own to a partiality for the view of Dr. Odling regarding the different classes of silicates, on the ground partly of the harmonious relations he introduces between these and other multibasic salts, and also from the satisfactory way in which these very important minerals group themselves as ortho-, para-, or meta-silicates. We may take another occasion for illustrating this, and pass on to Professor Dana's new and scholarlike handling of the whole question of nomenclature.

Our author has shirked no labour or odium in the way he has faced this question. That trivial names are absolutely necessary in mineralogy no one who has dealt with the subject at all philosophically will question. Even such semi-trivial terms as ferrous aluminic garnet, calcioferric or magnesio-aluminic garnet, are almost too long for use; but how should the composition of these bodies be described by names purely chemical?

Generally, therefore, we feel bound to acquiesce in the use of a trivial name for each mineral, and to subscribe to the rules Professor Dana has laid down for such names. These may be stated as the use of the termination *-ite*, except in names that have a hold on literature or use; some care in adhering to proper etymological principles in derivative names; and, finally, the law of priority of claim accorded in general, but with proper exceptions, to the first describer of a mineral. In applying these rules, Dana retains, so far as wec an enumerate them, some thirty-four names not ending in *-ite*, and changes about forty-seven of the names more or less generally received.

We cannot, however, concur in the Professor's criticism in his derivation of the spellings in all cases from the pseudo-Latin names given to metals by the chemist. Thus, to call nickeline "niccolite" and not "nickelite" is to lose sight of an essential part of the original form of a word of which, in fact, our familiar term "Old Nick" is the English shape. Surely, too, bismuth ochre should become not bismite, but bismuthite. Nor can we agree with the dismissal by Dana of the term hemimorphite, which was given to the monohydrated dizincous silicate by Kenngott. Our author reverts to the old name of calamine, between the use of which and of smithsonite, as names sometimes attached to the zinc carbonate, sometimes to the silicate, there has long existed a confusion that is best ended by the adoption of at least one new name. And Kenngott's term had at any rate this great merit, that it seized a characteristic of the crystallised silicate, by virtue of which it stands conspicuous among almost all other minerals, and certainly is distinguished from the other calamine, the character, namely, of being truly hemimorphous; that is to say, of presenting a given crystalline form all the planes that should occur on one side of a plane of symmetry, and none of the planes of that form that would, if the crystal were holosymmetrical, be met with on the other side of that plane of symmetry. We plead, therefore, strongly in behalf of Kenngott's name. As regards the merging of the term hornblende in that of amphibole as carried out by Dana, we would prefer to see the whole nomenclature of these augitic and hornblendic minerals so handled that we might have a general term for all the groups of minerals united under a common chemical type; and separate terms, still generic, that might embrace the minerals, whether of prismatic, oblique, or anorthic type, that present the kind of homœomorphism that demarks these groups. The trivial names for the different species or varieties under each group would remain nearly as they are. Now Professor Dana selects the term amphibole for the most general of these expressions, and he includes under a pyroxene sub-group enstatite (prismatic), wollastonite (oblique), and what he further calls pyroxene (oblique but homœomorphous with enstatite); and then after a spodumene sub-group he introduces an amphibole subgroup. We venture to think that the term "amphibolic minerals" used for the whole might well be made to embrace: Firstly, an augitic group, including as its members, (*a*) enstatite, with hypersthenic minerals, (*b*) diopside, with sahlite, hedenbergite, and the fassaite (aluminous varieties, (*c*) spodumene and petalite, (*d*) achmite, (*e*) rhodonite and babingtonite; Secondly, a hornblendic group, embracing as its subdivisions, (*a*) kupfferite with anthophyllite, (*b*) tremolite, with actinolite, grünerite and the pargasite (aluminous) varieties, (*c*) arfvedsonite; Thirdly, wollastonite.

Of course only a few leading varieties are here noticed. As regards other names introduced by Professor Dana, we are fain to accept even so uncomfortable a name as prochlorite in place of chlorite, a term to the chemist's ears so ambiguous in its sound. To most of Professor Dana's other changes, also, we with more or less of readiness subscribe; though against the barbarous conversion, not newly introduced into this edition of Dana, of one of the most ancient terms in mineralogy, pyrites, into pyrite, in flagrant defiance of all etymological principle, we must continually protest.

We have noticed the more important novel features in this fifth edition. There is still much to be said regarding the degree of fulness with which different parts of the descriptions of the minerals are given, such as the pyrognostic characters, and the treatment of the chemical analyses. But when we consider the vast amount of matter collected into some 800 closely-printed pages, the scrupulous care with which so enormous a number of references has been made to the labours of mineralogists, extending over the whole area of the scientific literary works of a century past—ay, and often into the two or three centuries before that; when we remember that the progress of the science up to 1868 is thus fully, conscientiously, and elaborately recorded, we can only thank Professor Dana, in the name of European mineralogists, for the very valuable volume by which he has so much lightened their labours: and with his name we must associate that of the accomplished mineralogist who has shared his labours, Prof. Brush. If in fulness their joint work does not come up to the now, alas! almost obsolete work of Hausmann, it is three times more portable. W. H. Miller's invaluable book, modestly called by him an edition of Phillips, is again a mineralogical crystallography. The only book that at present professes to cover the ground occupied by Professor Dana's work is the admirable *Manuel* of Des Cloizeaux, of which, however, only one volume has yet appeared, but which unites to the sort of originality in crystallographic and physical research which gives Miller's work its value, something of the universality of treatment which Dana gives to his mineral species. We wish, indeed, that M. Des Cloizeaux could have given up the microscopic fractions that characterise the French system of crystallographic notation, and torment the crystallographer's hardly-used eyes, for the more elegant notation of Miller, as he has in fact adopted the stereographic projection. But we look keenly forward to the publication of the second volume at the hands of the new member of the Institute; and, while we do so, we feel confident that as in matter it will be as masterly as the first, and as indispensable to the scientific mineralogist, so it will satisfy scientific needs that differ in kind from those felt by a large proportion of the practical men in whose hands Professor Dana's book will still be a standard treatise.

We have said enough to point out the extreme value of Professor Dana's book, which, taken as an indication of the present state of science in America, is of the best possible augury; and we may add that mineralogy is not the only science represented in high-class American text-books. Chauvenet's "Astronomy" is another instance which at once suggests itself.

N. STORY MASKELYNE

BIBLIOTHÈQUE DES MERVEILLES

L'Acoustique, ou les Phénomènes du Son. Par R. Radau. Ouvrage illustré de 114 vignettes.—*L'Optique.* Par F. Marion. Ouvrage illustré de 70 vignettes sur bois, et d'une planche tirée en couleur.—*L'Electricité.* Par J. Baille. 71 vignettes.—*Les Forces Physiques.* Par Achille Cazin. 58 vignettes. (Hachette; Paris and London.)

Thunder and Lightning. By W. de Fonvielle. Translated from the French and edited by T. L. Phipson, Ph.D., F.C.S.—*The Phenomena and Laws of Heat.* By Achille Cazin. Translated and edited by Elihu Rich. (London: Sampson Low, Son, & Marston.)

THESE works form part of a series having the general title, "Bibliothèque des Merveilles," which will be extended to about a hundred volumes, and will form a Cyclopædia of the more prominent wonders of the universe —of all that is "most admirable in Nature, in the sciences, in industry, in history, in man." It is published under the direction of M. Edouard Charton, and the main object to be attained by it is "seconder l'heureux mouvement qui porte aujourd'hui toutes les classes de la société vers l'instruction." The majority of the volumes which have already appeared relate to applied science, and here we may remark that MM. Hachette have done much to disseminate a taste for science among all classes by the publication of works suited to the most varied capabilities and the most varied means. Commencing at one end of his series, we have twenty and thirty franc "editions de luxe" of the *Le Ciel* and *Phénomènes de la Physique* class; and, passing through various gradations, we arrive at length at the two-franc volumes of the "Bibliothèque des Merveilles." The last volumes have much to recommend them; they are, for the most part, popular in style; they are well illustrated, well printed, and undeniably cheap, and they are written by men, among whom are many who are engaged in giving instruction in one or other of the multifarious educational establishments of France. We have no series of books in this country to compare for excellence and cheapness with these, and this mainly arises from the fact that science does not form an essential part of our educational system, as it does of that of France. The volumes of the "Bibliothèque des Merveilles" can be sold in France at less than one-half the price which would be demanded in this country, because the publisher can feel certain when he issues his work that a large number will find their way into the various schools and colleges of the Empire.

M. Radau's "Acoustics" is quite a type of a French popular scientific work; with every desire to convey as much information as possible, the author will not give up a certain amount of light amusing matter, and a popular style. How surprised we should be in this country to see a woodcut of a dancing bacchante (somewhat like Salvioni) in a chapter entitled "Le Timbre," and not far from a representation of the "Progression d'une vibration longitudinale." A vague unscientific reader might be led to find an analogy between Cagniard de la Tour's syren and Radau's bacchante; the bacchante occupies a full page, while the syren has a little strip of space in the text, and we ultimately discover that the former has been introduced solely for the purpose of showing the *crotalon.* Among the many good features of this book, we may mention that it enters somewhat fully into the growth of music, and traces the connection between the science of sound and the art of music. From this we learn that the names of the first six notes were introduced by Guido of Arezzo, in 1026, and that they were the commencement of words taken from a hymn which is still sung on S. John's Day :—

> "*Ut* queant laxis *re*sonare fibris
> *Mi*ra gestorum *fa*muli tuorum,
> *Sol*ve polluti *la*bii reatum,
> Sancte Ioannes."

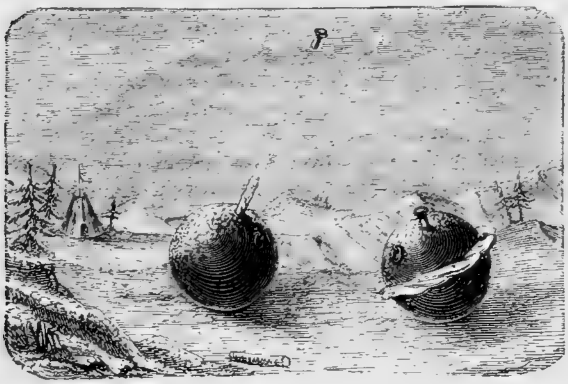
The seventh note was designated *si*, in 1684, by Lemaire, and was taken from the initials of Sancte Ioannes. We may mention the chapters on the reflection of sound, on interference, and on the voice, as being of special interest. In the first of these the famous echo of Athanasius Kircher is described ; the echoes in this case are produced by walls placed at certain distances apart, and at right angles to another wall ; the observer cries :—

> " Tibi vero gratias agam, quo clamore?"

and the echo answers :—

> " Clamore—Amore—More—Ore—Re.

The work on "Electricity," by M. Baille, is of a less popular character than the above ; it treats solely of the applications of electricity, and is divided into four parts: Electric Telegraphy, Induction Machines, the Electric Light, and Galvanoplastic Art. M. Cazin has previously published a work on Heat in this series, and his "Forces Physiques" is of the same character ; they are essentially sound, accurate in detail, and are well adapted for those who are commencing the study of physics. Many of these works have been translated into English, and we are glad to know that the greater number of the books of the "Bibliothèque des Merveilles" which have not yet appeared are now in course of translation, among them



EXPANSIVE FORCE OF FREEZING WATER

L'Acoustique, which ought to be used in all schools in which music is taught, and therefore notably in Ladies' Schools. M. Marion's *L'Optique* has been translated by Mr. C. W. Quin, who has introduced a chapter on the spectroscope, unfortunately without an illustration. The work is concluded by a full account of the ghost illusion of which we heard so much a few years ago. M. de Fonvielle's "Thunder and Lightning" retrogrades somewhat from the works noticed above, in that it is of a more sensational character. Thus we have full-page woodcuts of "a murderer struck by lightning;" of a broad stream of lightning meeting a lady as she comes upstairs; of an explosion of gas by lightning, and so on. The best woodcuts in the book are those which represent the photographic reproduction of an electric spark. M. Cazin's work on

[illegible]

"Heat" is strictly scientific in character, and might with advantage be used as an elementary text-book in schools.

We hope before long to find this series of books altogether naturalised in this country, and no time could be more fitting, since science has at length been recognised as a useful educational engine.

G. FARRER RODWELL

OUR BOOK SHELF

Chemical Exercises. — *Arithmetical Exercises for Chemical Students.* By C. J. Woodward, B. Sc. (London : Simpkin, Marshall, and Co., 1869).

MR. WOODWARD, who is lecturer on chemistry and physics at the Midland Institute, Birmingham, has printed, under the above title, a set of ten very useful cards, to assist students in familiarising themselves with the more common numerical calculations of chemistry. Each card contains, first the *data*, and secondly the *method* of a particular kind of calculation ; this is followed by a number of questions. Ten subjects are gone over in this way. I may describe them as : (1) the metric system; (2) conversion of thermometric readings, and reduction of gaseous volumes : (3) specific gravity; (4) formulæ as yielding percentage composition ; (5) percentage composition a source of formulæ ; (6) weight and chemical effect ; (7) volume and chemical effect ; (8) reactions of gases ; (9) the crith and thermal units ; (10) specific, atomic, and latent heat. This range is amply sufficient for all ordinary purposes.

Although there are great conveniences in the use of a card system of instruction, especially when clearness in the printing is as well attended to as in these specimens, an objection lies against it that, in this case particularly, a good deal of repetition is unavoidable. In Mr. Woodward's *data*, the same symbolic values are tabulated over and over again. Could not these have been collected in a single group, once for all? Much space might also have been gained for questions by giving what corresponds to a title-page only on the first card. Thoroughly systematic names, based on a *single* principle now in use, ought alone to be employed in elementary teaching. "Argentic chloride," "silver chloride," "corrosive sublimate," are names of three quite distinct kinds which, we have found, the author employs without comment. A nomenclature card would indeed be a valuable prefix to the series. It would also be an advantage to append answers to all the questions.

Clearly expressed rules, and good examples of the mode of applying them, are so obviously useful to students, that it only remains to add that Mr. Woodward has done his work well. E. J. M.

Agricultural Engineering.—*Der Cultur-Ingenieur.* Herausgegeben von Dr. F. W. Dünkelberg. (Brunswick, 1869.)

THIS periodical, a quarterly journal in its second year of publication, professes to deal with all questions of applied science affecting agriculture. The papers contained in the present number are mostly of a thoroughly practical character. They treat of such matters as the testing of steam-engines at agricultural exhibitions, the examination and adjustment of levelling instruments, the cause of boiler explosions, the mean velocity of water in canals and rivers, and the usefulness and profitableness of various machines for agricultural purposes. One paper gives a description of English locomotives for use on ordinary roads. The journal is well got up and amply illustrated.

The Microscope and its Use. By Dr. H. Hager. (*Das Mikroskop und seine Anwendung.* (Berlin: Springer.)

THIS little work gives, in less than a hundred pages, first, a brief account of the microscope and of microscopic appliances; secondly, a still more rapid description of common microscopic objects. It is, in fact, very much like our own "Carpenter on the Microscope," on a very reduced scale. The first part is written with great sense, and very much to the purpose. We are not surprised that the little work has received in Germany the unusual honour of a third edition.

Freshwater Radiolaria.—*On some Freshwater Rhizopoda, new or little known.* By William Archer. (*Quarterly Journal of Microscopical Science*, July and October, 1869.)

MR. ARCHER, of Dublin, who is well known as one of the contributors to Pritchard's "Infusoria," and a careful observer, has for the last two or three years chronicled in the Proceedings of the Dublin Microscopical Club, published in the *Quarterly Journal of Microscopical Science*, the occurrence of Radiolarian-like Rhizopods in the moor-pools of Ireland. At the end of last year Dr. Focke, of Bremen, described and figured a few of the same forms, bearing a likeness to some which have been considered as belonging to the genus Actinophrys, or sun-animalcules, of Ehrenberg. Mr. Archer has at length published the description of his new species, with full illustrations in three folding coloured plates. Many of these new freshwater Radiolarians, like the marine forms which they appear to represent in fresh water, carry siliceous spicules; they are mostly globular, and have a capsule surrounded by protoplasmic matter, which is drawn out into very long and delicate threads or rays, whilst the spicules are aggregated so as to form a loose sort of skeleton. In one large species Mr. Archer found several globular capsules united in one individual (*Raphidiophrys*). The contents of the capsules are coloured green in some instances, in other species they are red, or colourless. These most interesting animals are found only in moor-pools, and are, therefore, not to be got at by every observer. It is, therefore, very curious that besides Mr. Archer's and Dr. Focke's publications in this year, Dr. Richard Greef, of Bonn, should also have turned his attention to them, without being aware of Mr. Archer's work. In No. 3 of Max Schultze's *Archiv* for this year, Dr. Greef has a paper and plates, describing some species and genera *identical* with those of Mr. Archer, who, however, has precedence by some months. The fresh-water Radiolaria, it has been suggested, stand in the same relation to the more exuberant and highly developed marine Radiolaria, as do the fresh-water Hydrozoa represented by Hydra to the much more numerous, more brilliant, and varied marine Hydrozoa. E. R. L.

The Annals and Magazine of Natural History.—No. 24. December, 1869. (Taylor and Francis.)

THE last number of this journal contains several valuable papers, of which the most important is undoubtedly Mr. Carter's description of the Development of *Sorastrum spinulosum*, which will be read with interest by botanists. Dr. Leconte, of Philadelphia, contributes a list of beetles collected in Vancouver's Island by Messrs. H. and J. Matthews, with descriptions of a considerable number of new species. Dr. Leconte does not cite any of the species from the same locality described by Mr. Francis Walker in Lord's "Naturalist in Vancouver's Island and British Columbia;" in all probability he will find that some of his supposed new species are already described.—Mr. T. Vernon Wollaston publishes a continuation of his paper on the Coleoptera of St. Helena, the general results of which we propose to give on its completion.—A third entomological paper is by Mr. Fred. Smith, on the Parasitism of *Rhipiphorus paradoxus*, in answer to a communication in the November number by Mr. Andrew Murray, in which that gentleman maintained that the larva of *Rhipiphorus*, which is always found in the cells of wasps, is a parasite rather in the classical than in the natural history sense of the term; that is to say, that it merely lives upon the food furnished to the wasp-larva, and does not feed upon the substance of the latter. In opposition to this view, Mr. Smith cites observations made by himself and by the late Mr. F. Stone, which show clearly enough that the larva of *Rhipiphorus* is not hatched until the wasp-larva is approaching maturity, that it speedily fastens upon its companions, and appropriates the latter's materials with so much avidity as to attain its full growth in about forty-eight hours.—Other purely zoological papers are—A description of a new British spider belonging to the genus *Epeira*, by Mr. John Blackwall; descriptions of two new species of sun birds from the Island of Hainan, by Mr. Robert Swinhoe; and a notice of some nondescript bones in the skull of osseous fishes, by Mr. George Gulliver. The bones referred to in the last-mentioned paper are to be found in the head of the codfish at the hind part of each post-frontal bone. There is one on each side of the head, and their form is that of a sub-conical cup. The author calls them *expost-frontal ossicles.* Similar limpet-shaped ossicles hitherto unnoticed occur in other parts of the head.—In a joint paper on the Nomenclature of the Foraminifera (the thirteenth of a long-continued series), Messrs. Jones, Parker, and Kirkby describe the extraordinarily varied forms under which a species, to which they attribute the name of *Trochammina pusilla*, presents itself. These forms, which have of course received a great number of different names, are represented by the authors on a plate; they occur fossil in almost all formations from the Permian to the Tertiaries, and some of them are living in our present seas.—In a short contribution to Jurassic Palæontology, Mr. Ralph Tate indicates the necessity for breaking up the great genus *Cerithium*, and notices that the genus *Kilvertia*, established in 1863 by Lycett, at the expense of *Cerithium*, is identical with *Exelissa*, Piette (1861), of which he describes a new British Liassic species. He also proposes the formation of a new genus, *Cryptaulax*, for another group of *Cerithia*, in which the aperture more resembles that of *Chemnitzia*, and the posterior canal is concealed by the outer lip.

THE JAPANESE

JAPAN is a country of which the outer barbarian world as yet knows little. By slow degrees, however, the great wave of progress is making inroads even in that jealously guarded group of islands; but as yet it is but in three places, not in themselves of much importance, that the country is open to foreign commerce. The capital is only accessible to diplomatic agents, and the excursions which have been made into the interior have been of an imperfect kind.

Yeddo, with the great volcanic cone of Fusiyama prominent in all the views of the city; Yokohama, Kanagawa, Kagosima, the Central Sea,—these names bring before us almost all that we really know about Japan. There are maps of the empire to be found, which show the divisions and towns of the great island of Nippon, and also of the smaller islands of the group; but we know little of them, except their names and their relative position. The day is yet to come when the physical geography of this fine group of islands will be laid bare to the researches of Western men of science. The latitude of the islands, together with the influence of that warm ocean current which may be called the Pacific Gulf Stream, ensures for them a mild climate; and rice, cotton, and silk are among the varied productions of this favoured country. At the same time, it must not be forgotten that earthquakes are not unusual, that the volcanic fires are not yet extinct in Japan, and that the shores are sometimes visited by the fierce typhoons which desolate the neighbouring seas.

The people themselves, however, their religion and government, their houses, their manners and customs, have been subject to observation in the different towns open to foreigners; and several accounts have been laid before the public. Of these, none is more interesting than the narrative of his life in Japan which has been given to the world by M. Aimé Humbert,* the Swiss minister in Japan, who arrived there in the year 1863, and who has prepared a narrative of his sojourn in Yokohama and Yeddo, and his excursions in the neighbourhood of these places, which is extremely lively and interesting. M. Humbert's observations are chiefly upon the people; and his remarks, and the number of illustrations with which the descriptions in his two magnificent volumes are enriched, bring before us the Japanese, at least of the cities, with very great vividness. They live and move before our eyes: we see them in their temples, in their court dresses, in their everyday life, in their amusements, in the pursuit of their trades and professions, in the exercise of justice, in the celebration of their annual fêtes.

The Japanese, M. Humbert thinks, are of diverse origin. Some possibly came from China, some were Mongols from the neighbouring Corea; but doubtless many derive their descent from ancestors whose frail boats were drifted from the Malaysian Archipelago far to the south. The Japanese are not a tall race; the head and chest are generally large, the legs short, the hands small and often beautiful, the hair long, smooth, and black, the nose well-defined, the eyes more prominent than those of Europeans, the dominant colour of the skin an olive brown, though the colour varies from an almost copper brown to a dull white. The women are lighter in colour than the men, and in the higher classes they are often perfectly white.

In their domestic relations the Japanese are kindly, especially to their children, for whom they have intense affection, and for whose pleasure they will make any sacrifice. The Japanese takes but one wife; but he has it in his power to take secondary spouses, and not unfrequently avails himself of the privilege. The Japanese women are in a state of extreme subjection to their lords.

The religion of the vast mass of the people is Buddhism, with a vast array of bonzes or priests, and great temples, colossal idols, and a complicated system of worship. One of the grandest of the idols is well described by M. Humbert; it is the image of Diaboudhs, the great Buddha:—"The road to the temple is distant from all habitations; it winds between tall hedges, then a straight road mounts up between foliage and flowers, then a sudden turn follows, and all at once, at the end of an avenue, is seen a gigantic divinity of copper, seated in a squatting attitude, with the hands joined and in the attitude of contemplative ecstasy." The acceptance of the Buddhist doctrine of the ultimate passing of man into annihilation produces, it is said, in the Japanese, that wonderful disregard of human life which is one of their most remarkable characteristics. But besides the Buddhist theology, there is also a worship of the Kamis, or ancestral divinities, which prevails in Japan. The Kamis are not always the ancestors of separate families; the greatest of them, indeed, are the fabled ancestors of the whole Japanese race. But the belief in these ancestral deities leads to a vast amount of reverence being paid to the memory of the dead, and to annual visits to the tombs of the departed. These visits to the hills of the dead which surround the towns

HOTEÏ

are distinguished by much illumination of torches, and terminate with a setting afloat of little boats, each with lights, which drift down the river at night, and of which the lights are one by one extinguished. There is, besides, a belief in a number of tutelary deities, some of whom are half-mystic heroes—gods who preside over the events of life, whose *fêtes* are occasions of much national rejoicing, and whose influence contributes to counteract the sombre effects which an exclusively Buddhist belief would produce. Of one of these, Hoteï, the accompanying illustration gives a representation, the fac-simile of a Japanese drawing. Hoteï is the personification of contentment in the midst of poverty. He is the sage who possesses no worldly goods—the Diogenes of the great Nippon. His sole belongings are a scrap of coarse hempen cloth, a wallet, and a fan. When his wallet is empty he only laughs at it, and lends it to the children in the street, who use it for their games. For his part, he converts it by turns into a mattrass, a pillow, a mosquito-net: he seats himself on it as on an inflated skin to cross a current of water. Hoteï leads a somewhat vagabond life. He is sometimes met mounted on the buffalo belonging to a cultivator

* Le Japon illustré, par Aimé Humbert, ancien plénipotentiaire de la Confédération suisse. 2 vols. 4to. L. Hachette et Cie, Paris.

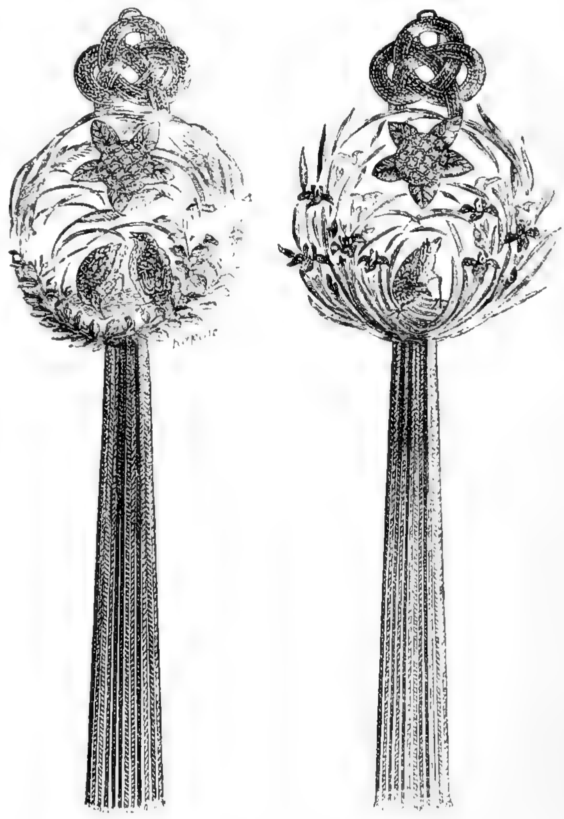
of the rice-fields. All the country-folk are his friends. He sleeps under the trees; and the children awake him. Then he takes them in his arms, tells them stories of the sky, the moon, the stars, all the magnificence of nature, treasures which no one knows better than himself how to enjoy.

The government of Japan is a species of feudal confederation, with a theocratic head. The Mikado, the son of the gods, and hereditary emperor, is the representative of the sacred power; but the civil and military administration rested until very recently in the hands of his lieutenant-general, the Tycoon, whose headquarters were in Yeddo. The great princes, or Daimios, are in many instances almost independent, and they are only held in subjection by being obliged to have a double residence; one on their own estates, and the other in Yeddo, where their families are kept as hostages for their good behaviour. The Yaconins, or military following of the Daimios, constitute a turbulent class of the population, bound solely to their feudal lords, and ready for any fray that may happen. It is among the Japanese of the upper classes that the act of *hara-kiri* is practised. This is a suicide, nominally accomplished by plunging a knife into the bowels, but really, in cases of punishment, by the assistance of the person who stands prepared to strike off the head of the victim at the moment when the knife is placed for the fatal blow.

The Japanese are a cultivated people, with letters and literature partly of Chinese origin, but modified in order to adapt them to Japanese use. They have also a distinct national history; and their literature, though not rich in philosophical disquisitions, abounds in legends, in fables, in satirical descriptions. The Japanese have also highly developed artistic tastes; and painting, drawing, and sculpture are followed as distinct professions. The Japanese drawing does not always satisfy European exigencies with regard to perspective; but the colouring is brilliant, and in Japanese sketches, whether of plants or animals, people or landscape, there is a breadth, life, and truth, which many European artists of much higher pretensions might envy. In fact, the best notions that we can obtain of Japanese life and its surroundings are to be derived from the numerous sketches by Japanese artists which exist, and which represent the people pursuing their daily occupations. M. Humbert has profusely illustrated his work with pictures—partly facsimiles of native work, partly drawn after sketches made by Japanese artists. The Japanese have what the Chinese seem to be deficient in, a strong sense of humour; and this they exhibit in a very striking manner in their sketches, in which human beings are represented by typical animals. Thus, sketches may be seen in which an old bonze is represented as a wolf, a group of Buddhist nuns as weasels, and a company of rats acting as rice-merchants.

The artistic tastes of the people and their love of Nature are both illustrated by their passion for flowers, and by the skill with which they are cultivated. No feast is considered perfect without flowers, and flower-shows meet with as much approbation in Japan as in England. The Japanese gardeners exhibit great skill in the arts of raising new varieties of flowers, of grafting plants, so that different flowers and leaves grow in what appear to be branches of the same plant; and they are, above all, learned in the manufacture of dwarfed plants, which are in great request as house ornaments. The Japanese delight in gardens, and they lay out small pieces of ground with wonderful skill, contriving to "give ample space to narrow bounds" with much ingenuity. The vast *enceinte* of Yeddo encloses much garden ground, and the people make at least three definite excursions to the suburbs at different times of the year, to see with their own eyes how the seasons progress. These excursions are often made as picnics, in which merry family groups take part. The Japanese have also a great fondness for aquaria; every house possesses one, and an aquarium, with small fish in it, is a very common object to be seen in houses.

The Japanese common people, both the *bourgeoisie* and the lower orders, take life with as much enjoyment as possible. The *fêtes* of various gods, who are patrons of one or other of the numerous industries exercised, afford occasion for long processions, with great displays of banners and symbols, for much merriment, and a not always dignified or moderate consumption of saki. Nor are the pilgrimages made to the sacred snow-covered Fusi-yama and to the various habitations of holy hermits altogether without alleviations. The events of domestic life—births, marriages, deaths, presentations of children in the temple, the coming-of-age of boys, when they have completed their fifteenth year, visits to the burial-places of ancestors—all afford occasion for friendly meetings, and for much ceremonial.



SILKEN ORNAMENTS

Theatrical entertainments, and the performances of wrestlers, acrobats, jugglers, and ballet dancers are among the public amusements to which the Japanese are passionately attached. The theatres at Yeddo to which foreigners have had access are chiefly those patronised by the *bourgeoisie;* but among the audience are to be found nobles who assume a dress intended to show that they pay their visit incognito. Wrestlers are under special imperial patronage, and are much favoured by the people. The contests consist chiefly of struggles as to which of two competitors shall by mere weight push the other out of a circle marked off by bags filled with straw. Japanese wrestling is utterly unlike what is understood in England by the same term; and the men engaged in it are generally in a fleshy condition which, among ourselves, would be considered utterly incompatible with a state of "training." The feats of performers who execute wonderful tricks of balancing, and of jugglers who do the "butterfly trick," which has lately been so popular among ourselves, elicit great applause. So popular also are ballet performances, that even the priests, in some of the great temples, engage in sacred dances to add to the "legitimate" attractions of the places of worship. Fencing is a favourite amusement, and is taught to women.

The public baths where men and women conduct their ablutions in the sight of all the world, and the tea-houses, at which women wait on the guests, are two features of Japanese life which are very strange to European eyes.

The town of Yeddo has a very striking physiognomy, so to speak. To the south are the suburbs on the shores of the bay; in the centre the citadel and the dwellings of the nobility; to the south-east, the trading town; to the east, the quays and bridges of the great river, and on the left bank the industrial city of Hondjo; to the north lie the temples, the fields where fairs are held, the theatres and public places of amusement. The western quarters are occupied by the general city population; and the suburbs of the north and west are full of verdure and flowers.

Yeddo has been calculated to have 1,800,000 inhabitants, although as an important city it only dates from the beginning of the 17th century. It is the northern termination of the great military road, the Tokaido, which traverses the empire from Nagasaki to Yeddo, near to which are built towns, villages, and many houses of the nobility, and along which the Daimois pass when proceeding to their compulsory residence in Yeddo. The modes of travel in use are either horseback, or palanquins carried by men. These latter are of two kinds; the norimon, closed on all sides, and in use among the upper classes, and the cango, light in construction, open at the sides, and used by the common people. As the Daimois pass along with their two-sworded retinue, all passengers give way to them, those that are on horseback dismount, and all stand bending low till the great man has gone on his way. The refusal of foreigners to submit to this fashion has led to the murder of more than one.

Yeddo is a busy town. Cotton and silk manufactures of a delicate kind, the making of porcelain, dyeing, tanning, the working in metals, the carving of stone, wood, and ivory, the manufactures of paper and of leather are all carried on in the town. (An illustration of the delicate silk embroidery which is made by the Japanese is given in the accompanying woodcuts, which represent silken dress ornaments.) In the suburbs, especially of the northern part, the gardens of the florists, the rural tea-houses, and the rice-fields are found. Minor industries —those of the makers of chop-sticks, of toothpowder, of dolls, of makers of mats, basket-work, and boxes, down to that of the humble rag picker—are to be found exercised in the small shops, or in the streets of Yeddo. The streets are full of life. The trades are carried on by the artisans, the jugglers and acrobats exercise their skill, men, women, and children pass along, bent on amusement or pleasure; here an enormous artificial fish, or a flag displayed at a house, announces the birth of a child; there a wedding procession takes its way; a Daimio passes, and all bow to the ground; an alarm of fire from one of the many watchtowers of the city calls out the firemen; the watch goes on its rounds; beggars exercise their arts as a kind of sacred trade—in a word, all the complicated machinery of a busy town life is to be seen in active operation, in what was the great capital of the Tycoon.

A jealous exclusion of foreigners prevailed in Japan for more than two centuries and a half; the only favoured people being the Dutch, who were permitted to build a small factory at Decima, and to send thither annually two trading vessels. The arrival of foreigners and their trade were regarded by the Tycoon and the nobles with dislike, chiefly because of the possibility that the introduction of new ideas might upset the old order of things; and the residence of foreign Ministers in Yeddo was rendered so uncomfortable, and even dangerous, that the legations settled in Yokohama as their permanent place of residence.

Recent events have effected a great change in the government of Japan. The Mikado, the theocratic emperor, has abolished the office of Tycoon. He has left his sacred city, and established himself, temporarily at least, in Yeddo, where the legations are in greater security than before. The export of tea and silk, already great, is increasing: and it is possible that Japan, so long isolated, may in time resume her relations with the outer world, and become, as her early records show her to have been, a busily trading, progressive nation.

It will be seen from the foregoing notice that M. Humbert's volumes contain an immense mass of valuable information as well as exquisite illustrations and lighter matter.

J. A. CHESSAR

FOOD OF OCEANIC ANIMALS

THE receipt of an interesting paper by Professor Dickie, entitled "Notes on range in depth of marine Algæ," lately published by the Botanical Society of Edinburgh, induces me to call the attention of physiologists to the fact, that plant-life appears to be absent in the ocean, with the exception of a comparatively narrow fringe (known as the littoral and laminarian zones), which girds the coasts, and of the "Sargasso" tract in the Gulf of Mexico.

During the recent exploration in H.M.S. *Porcupine* of part of the North Atlantic, I could not detect the slightest trace of any vegetable organism at a greater depth than fifteen fathoms. Animal organisms of all kinds and sizes, living and dead, were everywhere abundant, from the surface to the bottom; and it might at first be supposed that such constituted the only food of the oceanic animals which were observed, some of them being zoophagons, others sarcophagons, none phytophagons. But inasmuch as all animals are said to exhale carbonic acid gas, and on their death the same gas is given out by their decomposition, whence do oceanic animals get that supply of carbon which terrestrial and littoral or shallow-water animals derive, directly or indirectly, from plants? Can any class of marine animals assimilate the carbon contained in the sea, as plants assimilate the carbon contained in the air?

Not being a physiologist, I will not presume to offer an opinion; but the suggestions or questions which I have ventured to submit may perhaps be worth consideration. At all events the usual theory, that all animals ultimately depend for their nourishment on vegetable life, seems not to be applicable to the main ocean, and consequently not to one-half of the earth's surface.

J. GWYN JEFFREYS

GOLD DIGGERS IN THIBET

THE Thibetan gold-field of Thok-Jalung in lat. 32° 24′ 26″ and long. 81° 37′ 38″ was visited by the pundits employed by the G. T. Survey, in 1867 (August). The camp was pitched in a large desolate plain of a reddish brown appearance, the tents stand in pits seven or eight feet deep for protection against the cold wind, the elevation being 16,330 feet, yet the diggers prefer to work in the winter, when nearly 600 tents are to be found there; the soil when frozen does not "cave in." They have no wood, but use dried dung for fuel, and the water is so brackish as to be undrinkable until frozen and remelted. They live well, taking three meals a-day of boiled meat, barley cakes, and tea stewed with butter. They will not use the Himalayan tea, as too heating and only fit for poor folks.

The gold is obtained from an excavation a mile long, twenty-five feet deep, and ten to two hundred paces wide, through which a small stream runs; the implements used are a long-handled kind of spade, and an iron hoe.

The water is dammed up, and a sloping channel left; at the bottom a cloth is spread, kept down by stones so as to make the bottom uneven; one man sprinkles the auriferous earth over the channel, and another flushes the channel by means of a leather bag, the pieces of gold fall into the inequalities and are easily collected in the cloth by lifting up the stones. The yield is large, nuggets of two pounds weight are found; the gold sells on the spot at rather less than thirty rupees per ounce. A gold commissioner or "sarpon" superintends all the goldfields, a string of which extends along the northern watershed of the Brahmaputra, from Lhasa to Rudok. Each field has a chief or master, but anyone may dig who pays the annual licence-fee of one sarapoo or two-fifths of an ounce.

The curious posture for sleeping, universal among the Thibetans, was observed here. They invariably draw their knees close up to their heads, and rest on their knees and elbows, huddling every scrap of clothing they can muster on their backs; the richer rest thus on a mattress rising towards the head. The poorer avail themselves of a suitable slope on the hill side, or pile stones and earth to a convenient height. This position is most probably adopted in order to secure as much warmth as possible for the abdomen, the thighs pressing against it and excluding the air.

The gold-diggers recreate themselves with tobacco smoked in iron pipes, and, notwithstanding the hardships of their laborious toil, seem very merry, singing songs in chorus, in which the women and children join.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents.*]

Lectures to Ladies

YOUR correspondent "M." in her letter, which appeared in NATURE No. IV., on the subject of the exclusion of teachers from the lectures to ladies at South Kensington and University College, is scarcely just in her remark that "at University College they don't pretend to care for such an audience." The committee of the Educational Association certainly do not *pretend* to care for governesses, but give a more substantial proof of their care by admitting them on reduced terms.

All honour to "M." for advocating the claims of governesses; but has she not, in her desire for improving their mental faculties, omitted to take an account of their physical powers? To the question, therefore, which she has propounded—"How can any one who is hard at work all day go to a lecture in the forenoon?"—I am tempted to reply, in the American fashion, by asking another: "How can any one who is *hard* at work all day go to a lecture in the evening?" There is also the minor consideration that the hire of a lecture-room (the majority of our classes being held in a hired room) for the evening is nearly twice that of a room for the morning, so that it would be a somewhat hazardous experiment to institute evening classes on the chance of ladies who are engaged in teaching all day attending in sufficient numbers to pay the rent.

In conclusion, I hope that if "M." can spare a few minutes of her valuable time some forenoon, she will look in at one of our lectures; and if she sees, or rather hears, anyone answering the description of "Lady Barbara, who sneers aloud," I will use my utmost endeavours to get up an evening class for "M." even though she should be the only pupil.

THE HON. SEC. OF THE LADIES' EDUCATIONAL ASSOCIATION, LONDON

Chrysophanus Dispar

YOU ask for information about *Chrysophanus Dispar*. The statement that it has been met with in Kerry is not in itself improbable, and entomologists will be interested in having it confirmed; but when we find it said in the same paragraph that the insect is not uncommon in England, it will be received with doubt. *C. Dispar* has hitherto been found in only one locality in these islands, the neighbourhood of the fens formerly surrounding Whittlesea Mere. Other localities appear in works on entomology, but have never been authenticated. Owing partly to the drainage of the fens, and partly to the indefatigable efforts of dealers and other collectors, the insect has been quite extinct, I believe, for nearly twenty years.

Of late years the subdivision of species in entomology as well as in other departments of Natural History has been somewhat checked. What formerly appeared as those distinct species of *Polyommatus*, in our books of British Butterflies, under the names of Agestis, Artaxerxes, and Salmacis, are now all referred to the first-named species. Agestis is absent where Salmacis is found, and both where Artaxerxes is found, and the variety is referred to the difference of latitude. In the same way entomologists no longer recognise any specific distinction between *C. Dispar* and *C. Hippothoe*, widely-spread continental species. I possess a fine series of *C. Dispar* reared from larvæ taken in the year 1846. The spot in which they were found is close to the Holme station, 69 miles from London on the Great Northern Railway. They fed exclusively on the common water dock (*Rumex Palustris*). It is a curious illustration of the obscure causes which regulate the geographical range of species, that though the plant is abundant in the whole range of fen country, and generally throughout England, the butterfly was always confined to that immediate neighbourhood.

C. Virgaureæ was introduced into catalogues of British Lepidoptera on the authority of dealers, but its claims to be a British species were never authenticated.

Eton, Windsor. C. W. D.

The Brighton Aquarium

WOULD it be unduly troubling you were I to ask you to inform me, throug the medium of the columns of NATURE, if the much-talked-of Brighton Aquarium is really to be "started"?

H. H. MOTT

The Cloaca Maxima

WILL you pardon me for asking a question which probably I ought to be able to answer myself? Mr. Corfield, in his interesting comparison of the hygienic performances of the ancients and ourselves, mentions the well-known Cloaca Maxima as one of the great glories of the Romans. Can he tell us how they got the sewage into it? I presume the invention of Bramah was not known in those times, and I was a little disappointed in not finding in his able paper a solution of a mystery which has puzzled me since my childhood. What did the Romans want with a Cloaca Maxima, and how did they use it?

Dec. 11th. IGNORAMUS

Lightning in a Clear Sky

THE following extract from the "Life of Charlemagne," by Eginhard, a contemporary, may be interesting to C. W. D. "Cum Carolus imperator ultimam in Saxoniam expeditionem contra Godefridum, regem Danorum, ageret, quadam die, cum, ante exortum solis, castris egressus, iter agere cœpisset, vidit repente delapsam cœlitus cum ingenti lumine facem a dextra in sinistram per serenum aera transcurrere; cunctisque hoc signum, quid portenderet, admirantibus, subito equus quem sedebat, capite deorsum merso, decidit, eumque tam graviter ad terram elisit, ut fibula sagi rupta balteoque gladii dissipato, a festinantibus qui aderant ministris exarmatus non sine adminiculo levaretur. Jaculum etiam quod tunc forte manu tenebat, ita elapsum est ut viginti vel eo amplius pedum spatio longe jaceret." J. M. W.

NOTES

IT is stated that the Council of the British Association for the Advancement of Science have determined to ask the permission of the Lord President of the Council to appear before him as a Deputation, to urge upon the Government the need of a Royal Commission to inquire into the Present State of Science in England. We may congratulate ourselves that in Lord De Grey we have a Minister whose well-known large and scientific sympathies ensure a careful consideration of the important proposition to be laid before him.

MOST of our readers know ere this that the Government has determined not to fill up the appointment of the Mastership of the Mint vacant by the death of the lamented Graham. The duties are to be performed by Mr. Freemantle, who deserves all praise for what he has done; and the Mint is, for the future, to be looked upon as an outpost of the Treasury. One hoped, seeing how rare are the scientific rewards in England, that a post that had been held by a Newton, a Herschel, and a Graham, might have been left as it was; but we hear that the Government have, in this case, some real justification for what they have done. In fact, it is the tendency shown by this action—a tendency to cut down everything, especially everything scientific—and not the action itself, which is more in question.

THERE is more and later news from Livingstone, who, judging from his letter to Dr. Kirk, published in the journals, is still weak in health. All we need give is his own idea of the work he has yet to accomplish:—"As to the work to be done by me, it is only to connect the sources which I have discovered from 500 to 700 miles south of Speke and Baker's with their Nile. The volume of water which flows north from latitude 12° south is so large, I suspect I have been working at the sources of the Congo as well as those of the Nile. I have to go down the eastern line of drainage to Baker's turning point. Tanganyika, Nyige Chowambe (Baker's?) are one water, and the head of it is 300 miles south of this. The western and central lines of drainage converge into an unvisited lake west or south-west of this. The outflow of this, whether to Congo or Nile, I have to ascertain. The people of this, called Manyema, are cannibals, if Arabs speak truly. I may have to go there first, and down Tanganyika, if I come out uneaten, and find my new squad from Zanzibar."

WE take a remarkable instance of resolute self-sacrifice from Mr. Hayward's account of the Turki rebellion against the Chinese dominion in 1863:—The Chinese garrison was shut up in the fort of Yarkand, and for 40 days besieged by the Turki army: the only terms offered were that all should embrace Islam. The old Amban—the Chinese Viceroy of Turkestan—summoned his officers to a council, held in an upper room, the lower room was piled with barrels of gunpowder, with a train leading from beneath the chair of state. The officers assembled, wrangling about the probable ransom that would be taken. The Amban's sons moved among them, offering tea and sweetmeats, his daughters knelt weeping by his side, he himself sat calmly smoking his long pipe. Suddenly cannon shots were heard, and the shouts of Allah Akhbar announced the advance of the enemy to storm. A hint of the Amban's resolution spread among the assembly, amidst the confusion he spoke a short farewell, and calmly turning his pipe-bowl, shed the embers on the train—and all was over.

WE learn that the account of Professor Jacobi's new process for the electro-deposit of iron, which has recently appeared in this country, does not include several improvements of great scientific interest which have recently been developed, an account of which we hope shortly to give.

THE following notice has been issued by desire of the Lord Chancellor:—"The electors to the Savilian Professorship—namely, the Archbishop of Canterbury, the Lord Chancellor of Great Britain, the Chancellor of the University of Oxford, the Lord Bishop of London, the Secretary of State for the Home Department, the Lord Chief Justices of the Queen's Bench and Common Pleas, the Lord Chief Baron of the Exchequer, the Dean of the Arches, and the Warden of New College (who may, if it be their pleasure, call into council the Vice-Chancellor of the University of Oxford)—will proceed to the election of a Savilian Professor on Thursday, the 10th day of February, 1870, or as soon thereafter as may be. All candidates are required to be of the full age of 26 years, and, if Englishmen, to be Masters of Arts at the least. The other regulations respecting the Savilian Professor may be seen in the University Statute sanctioned by Her Majesty the Queen in the year 1858. Candidates are to send their applications, addressed to Gordon Whitbread, Esq., 31, Great George Street, Westminster, S.W., on or before the 24th of January, 1870."

Here is another note from Oxford:—The examiners for the Radcliffe Travelling Fellowship—Dr. Acland, Dr. Rolleston, and Sir B. C. Brodie—have given notice that the next examination for a Fellowship will commence on Monday, January 31, at 10 a.m. Candidates are requested to send their names on or before Wednesday, January 19, by letter addressed to the Regius Professor of Medicine, Museum, Oxford.

THE exploration of the caves at Wellington, in the western district of New South Wales, under the direction of Mr. Krefft and Dr. A. M. Thomson, is making good progress, and many remains of extinct animals, some of which are new to science, have been discovered. A trial shaft is already put down in the centre of the Breccia cave, to the depth of fifteen feet, and bones are still found at that depth.

As already stated in this journal, the University of Edinburgh has just made arrangements to enable ladies who wish to do so to study medicine. Those who avail themselves of the opportunity are taught in separate classes from those of the other medical students, each Professor at the University holding one class for men and another for women. Five lady students have already presented themselves for the medical matriculation examination. In London there is a "Female Medical Society," under the presidency of the Earl of Shaftesbury. The objects of the Female Medical Society are—"1. To promote the employment of properly educated women in the practice of midwifery, and the treatment of the diseases of women and children. 2. To provide educated women with proper facilities for learning the theory and practice of midwifery, and the necessary branches of medical science." To carry out these objects, the Society established a "Ladies' Medical College" five years ago, and eighty-two ladies have during that period availed themselves of the facilities it offered; most of them have since started in business, and are succeeding admirably.

DR. PETERMANN, of Gotha, the well-known German geographer, publishes an interesting article in the *Cologne Gazette* on the mission of Dr. Nachtigal to Central Africa. The latter was sent by the King of Prussia, on the 18th of February, 1869, to present Sultan Scheick Omar with some valuable gifts from King William, in recognition of the friendly reception given by the Sultan, in 1866, to Herr Gerhard Rohlfs and Herr Von Beuermann, an officer of the Prussian army. Dr. Nachtigal proceeded to Mursuk (near which place Miss Tinné was murdered), but finding that there was no prospect at present of reaching Bornu in safety, he proceeded on an expedition to Tibesti, in the Tibbu country, leaving the presents at Mursuk. Similar expeditions, says Dr. Petermann, have been undertaken by various eminent travellers during the last fifty years. In 1820 the Tibbu country was visited by Lyon; in 1822 by Denham, Clapperton, and Oudney; in 1853 by E. Vogel; in 1855 by Dr. Barth; in 1862 by Herr Von Beuermann; and in 1866 by Gerhard Rohlfs. Most of these attempted to go through Tibesti, but without success; and Dr. Nachtigal is the only European who has ever accomplished this dangerous feat. He left Mursuk on the 6th of June last, and returned on the 8th of October, after a series of wonderful adventures and escapes, which are related in a report addressed by him to Dr. Petermann, and now in the press.

THE Weekly Bulletin of the Scientific Association of France, dated the 12th instant, contains letters from Algeria recording a series of violent earthquake shocks experienced at Biskra, Seriana, and Sidi Okba, in the Province of Constantine. The disturbances extended from the 16th to the 19th of November, and appear to have been of a very alarming character. The fact that no great damage was done to buildings is ascribed to the movement being chiefly vertical. The horizontal direction is stated by an observer to be from south-west to north-east, and by another from north-east to south-west.

SCHOPENAUER'S treatise on the "Philosophy of vision and colours," which originally appeared upwards of fifty years ago, and which has hitherto been treated with unmerited neglect by the great writers on physiological optics, has just reached a third edition. An interleaved and annotated copy of the second edition prepared by the author himself in 1854 was found amongst his papers, and has formed the basis for the present "improved and augmented" reissue, which appears under the editorship of Julius Frauenstädt.

WE desire to call special attention to the singularly interesting address of the new Rector of the University of Vienna, Carl von Littrow, on a subject which does not at first sight appear to be of a very interesting character, viz., the backwardness of the ancients in the sciences. This backwardness he ascribes, firstly, to an actual want of the power of accurate observation; and, secondly, to a restless spirit of speculation. The illustrations of these positions are drawn from astronomy, the science to which in early times the greatest care was devoted. Of the instances adduced to show that the ancients, notwithstanding their fine feeling for form, evidenced in the remains of classic art, had not even the most primitive power of observation, we may mention the following. According to the elder Pliny, whose estimate is very much higher than those of Hipparchus and Ptolemy as recorded in the Almagest, the number of fixed stars is 1,600; whereas, in our own day, Argelander, working in such a comparatively unfavourable climate as Bonn, records on his maps no less than 3,256 stars visible to the naked eye. Again, Argelander gives nineteen as the number of nebulæ and star-clusters visible in our latitudes, while Hipparchus mentions only two, and Ptolemy but five; both of these observers entirely passing over such remarkable objects as the nebulæ in Orion and in Andromeda. The group of the Pleiades was considered of great importance for ancient navigation, and was constantly watched; and yet only seven of its stars were discovered. Indeed most of the early observers could only see six; the seventh was lost sight of for centuries; and ultimately, when the middle star in the tail of the Great Bear first attracted attention, the conclusion arrived at was that the latter was the missing seventh star of the Pleides. Nowadays cases are known of people who are not astronomers seeing from fourteen to sixteen stars in the Pleiades; and it is by no means uncommon for persons of good sight to see eleven. The star α in Capricornus was seen by man for thousands of years without its being noted that it is a double star, a fact that any child would discover now if its attention were directed to it. It would be interesting to know what is the capacity of individuals of savage races as regards discriminating celestial objects. Light might then be thrown upon the question, how far the observational defects of the early astronomers were due to mere carelessness, and how far we inherit a schooled eye from generations of ancestors who gradually accustomed themselves to the accurate discrimination of external objects.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, December 9.—Dr. W. A. Miller, V.P., in the chair. The following papers were read:—

"Spectroscopic Observations of the Sun."—No. V. By J. Norman Lockyer, F.R.S.

The author first referred to several new facts of importance as follows:

"I. The extreme rates of movement in the chromosphere observed up to the present time are—

Vertical movement	40 miles a second
Horizontal or cyclonic movement .	120 ,,

"II. I have carefully observed the chromosphere when spots have been near the limb. The spots have sometimes been accompanied by prominences, at other times they have not been so accompanied. Such observations show that we may have spots visible without prominences in the same region, and prominences without spots; but I do not say that a spot is not accompanied by a prominenee *at some stage of its life*, or that it does not result from some action which, in the majority of cases, is accompanied by a prominence.

"III. At times, when a prominence is seen bright on the sun itself, the bright F line varies considerably, both in thickness and brilliancy, within the thickness of the dark line. The appearances presented are exactly as if we were looking at the prominences through a grating.

"IV. Bright prominences, when seen above spots on the disk, if built up of other substances besides hydrogen, are indicated by the bright lines of those substances in addition to the lines of hydrogen. The bright lines are then seen very thin, situated centrally (or nearly so) on the broad absorption-bands caused by the underlying less-luminous vapours of the same substances.

"V. I have at last detected an absorption-line corresponding to the orange line in the chromosphere. Father Secchi states* that there is a line corresponding to it much brighter than the rest of the spectrum. My observation would seem to indicate that he has observed a bright line less refrangible than the one in question, which bright line is at times excessively brilliant. It requires absolutely perfect atmospheric conditions to see it in the ordinary solar spectrum. It is best seen in a spot-spectrum when the spot is partially covered by a bright prominence.

"VI. In the neighbourhood of spots the F bright line is sometimes observed considerably widened out in several places, as if the spectroscope were analysing injections of hydrogen at great pressure in very limited regions into the chromosphere.

"VII. The brilliancy of the bright lines visible in the ordinary solar spectrum is extremely variable. One of them, at 1871·5, and another, at 1529·5 of Kirchhoff's scale, I have detected in the chromosphere at the same time that they were brilliant in the ordinary solar spectrum.

"VIII. Alterations of wave-length have been detected in the sodium-, magnesium-, and iron-lines in a spot-spectrum. In the case of the last substance, the lines in which the alteration was detected were *not* those observed when iron (if we accept them to be due to iron alone) is injected into the chromosphere.

"IX. When the chromosphere is observed with a tangential slit, the F bright line close to the sun's limb shows traces of absorption, which gradually diminish as the higher strata of the chromosphere are brought on to the slit, until the absorption-line finally thins out and entirely disappears. The lines of other substances thus observed do not show this absorption.

"X. During the most recent observations, I have been able to detect traces of magnesium and iron in nearly all solar latitudes in the chromosphere. If this be not merely the result of the good definition lately, it would indicate an increased general photospheric disturbance as the maximum sunspot period is approached. Moreover, I suspect that the chromosphere has lost somewhat of its height."

The author appends a list of the bright lines, the position of which in the chromosphere have been determined absolutely, with the dates of discovery, remarking that in the case of C and F his observations were anticipated by M. Janssen:—

Hydrogen

C. October 20, 1868.
F. October 20, 1868.
near D. October 20, 1868.*
[* *Hydrogen?*—G. G. S.]
near G. December 22, 1868.
h. March 14, 1869.

Sodium

D. February 28, 1869.

Barium

1989·5† March 14, 1869.
2031·2 July 5, 1869.

Magnesium and included line

b^1, b^2, b^3, b^4 } February 21, 1869.

* *Comptes Rendus*, 1869, 1 sem. p. 358.
† This reference is to Kirchhoff's scale.

Other Lines.

Iron	1474.	June 6, 1869.
?	1515·5.	June 6, 1869.
Bright line	1529·5.	July 5, 1869.
?	1567·5.	March 6, 1869.
?	1613·8.	June 6.
Iron	1867·0.	June 26.
Bright line	1871·5.	,,
Iron	2001·5.	,,
?	2003·4.	,,
? band or line near black line, very delicate . . .	2054·0.	July 5.

Other lines besides these have been seen at different times; but their positions have not been determined absolutely.

The author points out that taking iron as an instance, and assuming that the iron-lines mapped by Ångström and Kirchhoff are due to iron only, he has only been able, up to the present time, to detect three lines out of the total number (460) in the spectrum of the lower regions of the chromosphere,—a fact full of promise as regards the possible results of future laboratory work. The same remark applies to magnesium and barium.

The paper then proceeded as follows:—

"Dr. Frankland and myself have determined that the widening out of the sodium-line in the spectrum of a spot which I pointed out in 1866, and then stated to be possibly an evidence of greater absorption, indicates a greater absorption due to greater pressure.

"The continuous widening out of the sodium-line in a spot must therefore be regarded as furnishing an additional argument (if one were now needed) in favour of the theory of the physical constitution of the sun first put forward by Dr. Frankland and myself—namely, that the chromosphere and the photosphere form the true atmosphere of the sun, and that under ordinary circumstances the absorption is continuous from the top of the chromosphere to the bottom of the photosphere, at whatever depth from the bottom of the spot that bottom may be assumed to be.

"This theory was based upon all our observations made from 1866 up to the time at which it was communicated to the Royal Society and the Paris Academy of Sciences, and has been strengthened by all our subsequent work; but several announcements made by Father Secchi to the Paris Academy of Sciences and other learned bodies are so opposed to it, and differ so much from my own observations, that it is necessary that I should refer to them, and give my reasons for still thinking that the theory above referred to is not in disaccord with facts.

"Father Secchi states that the chromosphere is often separated from the photosphere, and that between the chromosphere and the photosphere there exists a stratum giving a continuous spectrum, which he considers to be the base of the solar atmosphere, and in which he thinks that the inversion of the spectrum takes place.

"With regard to the first assertion, I may first state that all the observations I have made have led me to a contrary conclusion. Secondly, in an instrument of comparatively small dispersive power, such as that employed by Father Secchi, in which the widening out of the F line at the base of the chromosphere is not clearly indicated, it is almost impossible to determine, by means of the spectroscope, whether the chromosphere rests on the sun or not, as the chromosphere is an envelope and we are not dealing merely with a section. But an instrument of great dispersive power can at once settle the question; for since the F line widens out with pressure, and as the pressure increases as the sun is approached, the continuous curvature of the F line must indicate really the spectrum of a section; and if the chromosphere were suspended merely at a certain height above the photosphere, we should not get a widening due to pressure: but we always do get such a widening.

"With regard to the second assertion, I would remark that if such a continuous-spectrum-giving envelope existed, I entirely fail to see how it could be regarded as a region of selective absorption. Secondly, my observations have indicated no such stratum, although injections of sodium, magnesium, &c. into the chromosphere not exceeding the limit of the sun's limb by 2″ have been regularly observed for several months past. To-day I have even detected a low level of barium in the chromosphere not 1″ high. This indicates, I think, that my instrument is not lacking in delicacy; and as I have never seen anything approaching to a continuous spectrum when my instrument has been in perfect adjustment, I am inclined to attribute the observation to some instrumental error. Such a phenomenon might arise from a local injection of solid or liquid particles into the chromosphere, if such injection were possible. But I have never seen such an injection. If such an occurrence could be observed, it would at once settle that part of Dr. Frankland's and my own theory, which regards the chromosphere as the last layer of the solar atmosphere; and if it were possible to accept Father Secchi's observation, the point would be settled in our favour.

"The sodium experiments to which I have referred, however, and the widening out of the lines in the spot-spectra, clearly indicate, I think, that the base of the atmosphere is below the spot and not above it. I therefore cannot accept Father Secchi's statement as being final against another part of the theory to which I have referred—a conclusion which Father Secchi himself seems to accept in other communications.

"Father Secchi remarks also that the F line is produced by the absorption of other bodies besides hydrogen, because it never disappears. This conclusion is also negatived by my observations; for it has very often been observed to disappear altogether and to be replaced by a bright line. At times, as I pointed out to the Royal Society some months ago, when a violent storm is going on accompanied by rapid elevations and depressions of the prominences, there is a black line on the less-refrangible side of the bright one; but this is a phenomenon due to a change of wave-length caused by a rapid motion of the hydrogen.

"With regard to the observation of spot-spectra, I find that every increase of dispersive power renders the phenomenon much more clear, and at the same time more simple. The selective absorption I discovered in 1866 comes out in its most intense form, but without any of the more complicated accompaniments described by Father Secchi. I find, however, that by using three prisms this complexity vanishes to a great extent. We get portions of the spectrum here and there abnormally bright, which have given rise doubtless to some of the statements of the distinguished Roman observer; but the bright lines, properly so-called, are as variable as they are in any other part of the disk, but not much more so. I quite agree that the 'interpretation' of sun-spot phenomena to which Father Secchi has referred,* which ascribes the appearances to anything but selective plus general absorption, is erroneous. But as I was not aware that it had ever been propounded, I can only refer to my own prior papers in support of my assertion which were communicated to the Royal Society some three years ago."

"Researches on Gaseous Spectra in relation to the Physical Constitution of the Sun, Stars, and Nebulæ."—Third Note. By E. Frankland, F.R.S., and J. Norman Lockyer, F.R.S.

The authors remark that it has been pointed out by Mr. Lockyer that the vapours of magnesium, iron, &c., are sometimes injected into the sun's chromosphere, and are then rendered sensible by their bright spectral lines. (Proc. Roy. Soc., vol. xvii. p. 351.)

2. It has also been shown (1) that these vapours, for the most part, attain only a very low elevation in the chromosphere, and (2) that on rare occasions the magnesium vapour is observed like a cloud separated from the photosphere.

3. It was further established on the 14th of March, 1869, and a drawing was sent to the Royal Society indicating, that when the magnesium vapour is thus injected, the spectral lines do not all attain the same height.

Thus, of the b lines, b^1 and b^2 are of nearly equal height, but b^4 is much shorter.

4. It has since been discovered that of the 450 iron lines observed by Ångström, only a very few are indicated in the spectrum of the chromosphere when iron vapour is injected into it.

5. The authors' experiments on hydrogen and nitrogen enabled them at once to connect these phenomena, always assuming that the great bulk of the absorption to which the Fraunhofer lines are due takes place in the photosphere itself.

It was only necessary, in fact, to assume that, as in the case of hydrogen and nitrogen, the spectrum became simpler where the density and temperature were less, to account at once for the reduction in the number of lines visible in those regions where, on the authors' theory, the pressure and temperature of the absorbing vapours of the sun are at their minimum.

6. It became important, therefore, to test the truth of this assumption by some laboratory experiments, the preliminary results of which are communicated in this note.

* *Comptes Rendus*, 1869, 1 sem. p. 764.

The spark was taken in air between two magnesium poles, so separated that the magnesium spectrum did not extend from pole to pole, but was visible only for a little distance, indicated by the atmosphere of magnesium vapour round each pole.

The disappearance of the *b* lines was then examined, and it was *found that they behaved exactly as they do on the sun.* Of the three lines, the most refrangible was the shortest; and shorter than this were other lines, *which Mr. Lockyer has not detected in the spectrum of the chromosphere.*

This preliminary experiment, therefore, quite justified the assumption, and must be regarded as strengthening the theory on which the assumption was based, namely, that the bulk of the absorption takes place in the photosphere, and that it and the chromosphere form the true atmosphere of the sun. In fact, had the experiment been made in hydrogen instead of in air, the phenomena indicated by the telescope would have been almost perfectly reproduced; for each increase in the temperature of the spark caused the magnesium vapour to extend further from the pole, and where the lines disappeared a band was observed surmounting them, which is possibly connected with one which at times is observed in the spectrum of the chromosphere itself when the magnesium lines are not visible.

Professor Williamson communicated a paper "On the successive Action of Sodium and Iodide of Ethyl on Acetic Ether," by J. Alfred Wanklyn, F.C.S. The author referred to a paper by Frankland and Duppa, describing the products obtained on treatment with iodide of ethyl of the yellow wax-like mass given by the action of sodium on acetic ether. Besides the description of the compounds, Frankland and Duppa gave four equations expressive of their view of the origin of the wax-like mass: each one of these four equations affirmed the evolution of an equivalent of hydrogen by every equivalent of sodium employed; but according to Mr. Wanklyn neither acetic ether nor any other ether ever evolves hydrogen by reaction with the alkali metals. All equations which assume evolution of hydrogen in these reactions are therefore inadmissible. In the present paper Mr. Wanklyn offers an explanation of Frankland and Duppa's products, which does not involve the assumption of evolution of hydrogen. On reference to Frankland and Duppa's paper just cited, it will be found that the products described by them as obtained from the "wax-like mass" and iodide of ethyl are the following:—

A. $C_8\ H_{14}\ O_3$, liquid boiling at 195° C.,

B. $C_{10}\ H_{18}\ O_3$, liquid boiling at 210° C. to 212° C.,

butyric ether, caproic ether, and also some unacted-upon acetic ether, and a considerable quantity of common ethylic ether. Mr. Wanklyn has already shown that the direct products of the action of sodium on acetic ether are ethylate of sodium and sodium-triacetyl. Nothing else seems to be produced directly. But the excess of acetic ether, which is necessarily taken, acts on some of the ethylate of sodium, producing alcohol and acetate of ethylene-sodium, the extent to which this secondary action takes place being determined by the exact circumstances of the experiment. We have, therefore, in the wax-like mass got by prolonging the action of sodium on acetic ether:—

Ethylate of sodium	$C_2\ H_5\ NaO$
Sodium-triacetyl	$C_6\ H_9\ O_3\ Na$
Acetate of ethylene-sodium . . .	$C_4\ H_7\ Na\ O_2$
Alcohol	$C_2\ H_6\ O$.

On the first three iodide of ethyl acts, giving iodide of sodium and organic liquids. From the ethylate of sodium comes the common ether. From the sodium-triacetyl comes ethyl-triacetyl, which is $A = C_8\ H_{14}\ O_3$, having been got by Geuther from the pure sodium-triacetyl. From isolated acetate of ethylene-sodium and iodide of ethylene Mr. Wanklyn has recently obtained liquid B, $C_{10}\ H_{18}\ O_3$. This liquid boiled at 212° C. and gave carbonate of baryta with baryta-water, and was identical with Frankland and Duppa's liquid B. By the action of liquid A upon ethylate of sodium Geuther has recently shown that butyric ether is produced together with acetate of ethylene-sodium, and Mr. Wanklyn predicts that liquid B will give caproic ether by a similar reaction.

Royal Geographical Society, December 13, Sir R. Murchison in the chair. The President made some comments on the recent letter from Dr. Livingstone, whose return would, he thought, very probably be delayed by the exploration of the waters, which might prove the head waters of the Congo. The paper of the evening was Mr. Hayward's account of his visit to Eastern Turkestan; a large map constructed by Captain George, from the maps and observations sent home by Mr. Hayward, and two views, enlarged from sketches taken by him on the spot, illustrated the paper. Dr. Leitner's collection of Yarkandi manufactures was also exhibited, and the presence of Niaz Muhammed, the native of Yarkand, excited much interest. Mr. Hayward has carefully fixed all the positions in the maps sent home by him, and also sent itineraries, list of names, and plans of towns. He mentioned the valuable pocket artificial horizon invented by Captain George, which enabled him to escape suspicion. Mr. Hayward left Leh Sept. 29, and proceeded by the Chang Chennoo Pass, 18,839 feet high, to Shadula, in lat. N. 36° 21′ 11″, long. E. 78° 18′, 360 miles from Leh, the frontier fort of Eastern Turkestan, 14,745 feet high, which is divided from the dominions of the Maharajah of Kashmir by the Karakorum range. Mr. Shaw had, unknown to Mr. Hayward, arrived a few days before. The travellers were detained while a messenger was sent forward to obtain permission for them to enter the country. The opportunity was taken to explore the sources of the Yarkand Daria, beyond the Khirgiz Pass, 17,095 feet high. From this a view of the Eastern Kuen Luen peaks was obtained, 90 miles away, the course of the river was traced and positions proved. A new pass, called the Yangi Pass, over the Kuen Luen, was observed, and described as practicable for horses, and easily made practicable for carriages, and even for guns. It is at present exposed to the depredations of robbers from Hunza Nagyr, which render it insecure and little used. Twenty days were spent in this exploration, and 300 miles of mountain districts explored. One peak rising to 28,278 feet, was observed from a spur of Kuen Luen Mountains. The source of the Yarkand River, in lat. 35° 37′ 34″ N., long. 77° 50′ E., was reached on December 8th. At a height of 16,654 feet above the sea, the cold experienced was intense. The thermometer the following morning showed the mercury to have sunk to a level with the bulb, or 18° below zero. Having returned to Shadula, he found that permission had come for his advance to Yarkand, and started on December 18th to reach that place by the Sanju Pass. Mr. Hayward described the Khirgizes, the Bedouins of Turkestan, from whom he experienced kindness and hospitality, as throughout the country seems to have been the case. From Shadula yaks were provided, on which the travellers crossed the Sanju Pass. The first village entered was Kibriz. The Turhi villages present a comfortable appearance. The country is well cultivated, and the people well to do. The dress, &c., of the different classes was carefully described. Slaves are still owned by some; but the former slave trade at Yarkand has been suppressed by Yakoob Kushbegi. Between Sanju and Yarkand a sandy steppe was crossed, the commencement of a desert called Tahla Makân Desert, stretching to the east, towards the Gobi Desert. Strange legends of former cities, now buried in the sand, were related by the Panja Bashi. Yarkand was entered on December 27th. It is described as a parallelogram of 2 miles by 1½, containing 40,000 houses, 120 mosques, and 120,000 inhabitants. It is defended by mud walls 45 feet high, with bastions, and an outlying fort. The ruler of Yarkand, Muhammed Yakoob (Kushbegie), "Atalih Ghazee" of Eastern Turkestan, was at his camp near Kashkar. The governor of the city, "a well-informed, pleasant, well-read man," received Mr. Hayward with much courtesy. A house was assigned him, and plentiful supplies furnished him; but he was not allowed, except on visits to the governor, to leave the courtyard of his house during the two months he remained in Yarkand.

February 24th, Mr. Hayward proceeded to Kashkar, which is a strong town of 60,000 to 70,000 people, the central point of all the Central Asia roads. The next day he was received by the ruler, who by his bravery and military talents has raised himself to the chief authority over Eastern Turkestan. His character and abilities impressed Mr. Hayward so much, that he says, were Central Asia undisturbed by foreign pressure, he would be another Zenghis Khan. He received the traveller kindly, and spoke of his desire for visits from Englishmen, who had been hitherto prevented from visiting his country by the Bokhara tragedy. He also alluded to the death of Adolph Schlagintweit, but did not mention that he had himself killed Hullee Khan, the murderer of Schlagintweit, two years ago. Mr. Hayward remained a month in Kashkar, vainly hoping to get permission to proceed to the Pamir Steppe, but was obliged to abandon the attempt. The position of Kashkar was fixed by him at

City . . . . . 39° 19′ 37″ } N. lat.
Fort . . . . . 39° 23′ 9″ }

and 76° 10′ E. long., at an elevation of 4,165 feet. He concluded by some account of the revolt against the Chinese dominion, which, after lasting a hundred years, was overthrown in 1863; after which the present ruler, with his Uzbeg troops, defeated the Tunganis, and successively made himself master of the different places, and is now master of the country. But his tenure is precarious, and his fear of assassination causes him to change his apartment every hour during the night.—In the ensuing discussion, the president stated that, so far from Russia regarding our commercial entrance into Eastern Turkestan with jealousy, the Czar and Prince Gortschakoff had both assured Mr. Forsyth that so long as the Atalih Ghazee confined himself to the country south of the Tian Shan, Russia would not interfere with Eastern Turkestan.—The president also pointed out that Mr. Hayward's discoveries had confirmed A. von Humboldt's theory as to the salient points of the mountain systems of Central Asia. Mr. Hayward was about starting to explore the Pamir Steppe, by way of Ghilghit.—Sir H. Rawlinson mentioned that he was enabled to state that the Indian Government were about to arrange with the Maharajah of Kashmir, to send officers to survey the routes to the frontier of Turkestan; and intended afterwards to enter into negotiations with the Atalih Ghazee for the same purpose, as to the routes in his dominions. It is understood that Russia has not recognised the Atalih Ghazee, regarding him as a rebel against the empire of China—an ally of Russia.

Royal Microscopical Society, December 8.—The Rev. J. B. Reade, M.A., F.R.S., president, in the chair. Prof. Rymer Jones, F.R.S., read a paper on Deep-sea Dredgings from China and Japan. Professor Jones stated that he had recently received from Lieut. Ross, R.N. (grandson of Sir J. Ross), certain specimens of deep-sea dredgings, obtained at a depth of 1,080 fathoms, from the bottom of the sea near Fly Island, in the neighbourhood of Sandal-wood Island. After alluding to the theories which had until a recent period prevailed with respect to the depth at which animal life existed in the ocean, and to the researches and discoveries of Prof. Forbes, Sir. J. Ross, and Dr. Wallich, Prof. Jones proceeded to give a description of the contents of a phial (a small portion of the dredgings sent by Lieut. Ross), from which about a grain and a half of solid matter had been obtained. The first result of the microscopic examination of this matter was the discovery of a considerable quantity of silex, so finely triturated, however, as to be scarcely visible. The next discovery was a large number of sponge *spiculæ*; many of the spicules being sculptured in forms of the greatest beauty. Of these spicules there were 12 genera. Some 800 or 900 specimens of *Foraminifera* were next found, exhibiting nearly every form of the animal hitherto found in the bed of the Atlantic. A still more interesting discovery was that of 600 or 700 *Polycystinæ*; which differed from those found in Barbadoes, in this respect, that whereas the latter were usually brought up fractured and imperfect, the former were perfectly intact in all parts, displaying the most exquisite structures, and hundreds being clothed in thin soft covering. From this fact it might be argued that they had been taken from their ocean home alive, notwithstanding the immense pressure to which they are said to be subjected. There were also many species present which had not as yet received names from naturalists. Besides these, Prof. Jones had found a large number of shields of various shapes, resembling the *Diatomaceæ*; and of these there were not less than 300. Lastly, he had found diatoms themselves, more sparsely distributed, but of larger size than those usually coming under the notice of microscopists; and of these there were over fifty specimens. What larger animals lived at the bottom of the deep sea he could not say, but as there appeared to be abundant food for them, and as both Sir J. Ross and Dr. Wallich had found star-fishes in the respective localities dredged by them, it might be reasonably inferred that they abounded in the ocean bed, and that a most extensive fauna existed there as yet entirely undiscovered. The following papers, for want of time, were taken as read, viz.: "On the Stylet Region of the Ominontoplean Broboscis," by Dr. McIntosh, and "Organisms in Mineral Infusions," by C. Staniland Wake, F.A.S.L. Four gentlemen were elected Fellows, and the Society adjourned to January 12, 1870.

Entomological Society, December 9.—Mr. H. W. Bates, president, in the chair. Seven new members were elected, namely, MM. d'Emerich, De Marseul, and Oberthur (foreign members), Captain Lang, R.E., and Messrs. W. Arnold Lewis, J. Cosmo Melvill, and Howard Vaughan. Exhibitions of *Hymenoptera* were made by Prof. Westwood and Mr. Frederick Smith; of *Lepidoptera*, by Mr. F. Smith and Mr. J. Jenner Weir; of *Coleoptera*, by Prof. Westwood and Mr. Albert Müller. Communications were read from Mr. Robert McLachlan on *Boreus hymenalis* and *B. Westwoodii*; from Mr. Edwin Brown, respecting the locust captured at Burton-on-Trent and exhibited at the previous meeting, which had been identified as *Acridium peregrinum*, a species distributed over a great part of Asia and the North of Africa, but not hitherto detected in Europe.

Ethnological Society, December 7.—Prof. Huxley, LL.D., F.R.S., president, in the chair. At the meeting of the International Congress for Prehistoric Archæology, held last year at Norwich, a committee was formed, under the presidency of Sir John Lubbock, Bart., for the purpose of inquiring into the present condition of the prehistoric remains in the British Isles. Subsequently, the functions of this committee were transferred to the Ethnological Society, and the first-fruits of its labours in this direction have just appeared in the shape of a valuable Report on the Prehistoric Monuments of the Channel Islands, prepared by Lieut. Oliver, R.A. These islands are remarkably rich in megalithic structures of noble proportions, but from their unprotected state they have been subject to the most ruthless destruction. Not only have they been demolished by the "navvy" and the mere treasure-seeker, but they have also suffered considerably from injudicious attempts at restoration. Nevertheless, they are still sufficiently numerous to form the subject of an elaborate Report. Lieut. Oliver pointed out the resemblance between some of these megalithic monuments and those in Madagascar erected at the present day by the hill-tribes of Hovas. The Report was copiously illustrated, and called forth a discussion, in which the chief speakers were the president, Mr. J. Lukis, Mr. J. W. Flower, Dr. Hyde Clarke, and Col. Lane-Fox.—At the same meeting, a note was read from Mr. Acheson on a supposed stone implement, found beneath the bed of a river worked for gold in Co. Wicklow.—A communication was also made, by Maj.-General Lefroy, on the Stature of the North-American Indians of the Chipewyan Tribe; and remarks were made upon it by Dr. Richard King.

Anthropological Society, December 7.—Dr. Beddoe, president, in the chair. Dr. Leitner gave some further details of his visit to Dardistan in 1866, especially referring to the Shina race. He briefly touched upon the main outlines of his journey, mentioning that his experience had modified his views as to the inconvenience resulting from the rarefaction of the air at high altitudes, inasmuch as he and his companions had surmounted passes of 18,000 feet without experiencing any of the usual effects. Although the Dards were at war with the Maharajah of Kashmir, and the towns apparently deserted, he was able to assemble, by sending round a drummer, 150 to a feast, and continued on most friendly terms with them during his abode in Ghilghit. The vocabularies and grammars of the hitherto unwritten Dardoo dialects which he has collected show a probably parental Aryan type. It is to be much regretted that the refusal of the India Office to grant an extension of leave to Dr. Leitner will compel his return to India within a fortnight, and almost deprive him of the opportunity of arranging and comparing these hitherto unknown languages. The Indian Government does not seem desirous of encouraging acquaintance with Central Asia. A traveller desirous of penetrating by Ghilghit to the Panin Steppe had recently been refused mules. Several interesting particulars of the customs among the Chilasis Ghilghites and other Dards were mentioned, which are alien to Mahommedan and Hindu ideas. The place and privileges accorded to women, who receive the visits of their husbands' friends without any suspicion—the custom of courtship, the use of wine, the fondness for dogs,—all seem to point to an independent origin of religion and manners. The value set upon dogs was illustrated by the fact that two men-slaves were given as the price of a good hound. The Sooni ruler of Chitral not merely sold his subjects, but his own mother, as a slave, and when asked how he could sell her whose breasts had suckled him, pointed to a cow, and said that she gave him milk constantly, yet he would sell her! and when a Moollah, who was to be sold, threatened him with vengeance for selling a minister of the Word of God, he replied that everybody sold the Koran—why therefore should he not sell the expounder of it. Dr. Leitner stated that the Kafirs were certainly fairer than the Kashmiris, but his experience hardly bore out the statement of their being exceptionally fair, with blue eyes and light hair. West of Balti the general type of face approximated more to the European. He could discover no religion or rites among them, save that once a year each deposited a stone on a cairn, situated on a high mountain. He found a species of caste division among the

Shinas, but the different castes intermarry and eat together. He narrated a curious Shina legend of a Shinari who fell in with a company of one-eyed demons, and was a witness of a demoniacal wedding. A very numerous and interested assembly listened with marked approval; and in reply to various questions, Dr. Leitner further stated that he had not remarked any megalithic or Druidic remains. The countries were traversed by him rather with a view to linguistic and philological discoveries. The houses were meanly constructed; the food evinced a rough skill in cookery; every Dard family seemed to possess a cavern, the secret of which was known only to them, and they thus had plentiful supplies of food, which they shared with him, while the Maharajah's sepoys were starving. Strong opinions were expressed as to the refusal of extension of leave to Dr. Leitner, and a resolution was unanimously passed calling upon the Government to take measures to aid and encourage travellers to visit these little-known regions of Central Asia. It is to be hoped that some means may be found to prolong the visit of Niar Mahommed, the Yarkandi, and both obtain from him information, and give him lasting impression of our resources and hospitality. We should not omit to mention that Dr. Leitner altogether denied the statement quoted from the *Invalide Russe*, that he had visited Herat or taken part in the battle of Samarcand.

Philological Society, December 3.—Mr. A. J. Ellis, F.R.S., in the chair. Mr. A. Melville Bell read a paper on Pronouncing all Languages. He showed how all the vowels could be produced: first, by placing the tongue in nine different positions, by means of which the extent and form of the neck which unites the front with the back cavity of the mouth was modified; secondly, by increasing or diminishing the whole of the cavities behind this neck; thirdly and fourthly, by altering the form of the cavities in front of the neck in the two former cases, by the action of the lips. The thirty-six vowels thus produced practically covered all known vowel sounds. He also showed how the consonants could be produced by three positions of the tongue and one of the lips, modified in six definite manners, allowing voice or breath to pass through a simple narrow orifice with central aperture, or a compound orifice of the same description, or a double simple or compound orifice, the central passage being stopped, and emission of voice taking place at the sides; or else by stopping breath or voice altogether, or allowing them to pass through the nose. He also explained how these forty-eight consonants could be varied, producing, with the glottal and nasal actions, all the possible varieties of articulation. He illustrated his paper by diagrams and models of his symbols, by which in each case he made the precise position of the organs of speech necessary for producing each sound visible on paper in a single definite and intelligible letter. He informed the Society that these letters had been most effective in teaching little children who had been born deaf and dumb to articulate and distinguish vowel sounds with accuracy; a statement which the chairman confirmed from personal knowledge of Miss Hull's school for deaf and dumb girls, 102, Warwick Gardens, Kensington. The meeting unanimously passed the following resolution: "That this meeting of the Philological Society desires to express its strong sense of the beauty and great value of Mr. A. M. Bell's system of Visible Speech, and its ready applicability to purposes of philological investigation."

Institution of Civil Engineers, December 7.—Mr. C. W. Gregory, president, in the chair. The first paper read was on the Public Works of the Province of Canterbury, New Zealand, by Mr. Edward Dobson, Assoc. Inst. C.E. In this communication a history was given of the Public Works Department of Canterbury, from its establishment, in 1854, to the completion of the railways, in 1868. During that period the survey of the province, commenced under the "Canterbury Association," had been completed by the officers of the Survey Department; the eastern portion of the province had been thrown open to settlement, by the construction of many hundred miles of metalled roads; the western goldfields had been connected with the capital, by a coach-road through the passes of the New Zealand Alps—a road remarkable both for the boldness of its design and the circumstances under which it was executed; and a complete system of railroad had been surveyed, the key to which (a tunnel 129 chains in length through the crater wall of Lyttleton Harbour) had been successfully completed. Extensive harbour works had been constructed, public buildings erected in the principal towns, and telegraph and postal services carried to a fair state of organisation. The total expenditure on public works and surveys during the period referred to had been, in round numbers, 1,800,000*l.*, out of a total Government expenditure of about 8,880,000*l.* The population in 1854 was about 6,000; in 1868 it amounted to 54,000, including the mining population of the county of Westland. The great bulk of the public works of Canterbury possessed but little professional interest—the country being level, and the bridges chiefly of timber of ordinary construction. Many of the rivers run on ridges above the general surface of the plains, and in dealing with them it was essential to leave abundant waterway, as there was little chance of any ordinary embankment standing against such torrents as they sometimes carried. Paradoxical as it might appear, the portions of the proposed railways which were to traverse the level plains would require heavy earthworks, while the lines through the ranges, being contoured on the hill-sides, would be carried for miles on surface gradients with light side-cutting through a mountainous and difficult country. The principal works executed by the Government were: first, the Summer Road from Lyttelton to Christchurch, which was scraped out of the cliffs for a continuous length of several miles; second, the West Coast Road, from Christchurch to Hokitika, which was constructed in nine months, through a hundred miles of rough and difficult country, totally uninhabited, and for the most part densely timbered; third, the Moorhouse Tunnel, on the line of the Lyttelton and Christchurch Railway, 2,861 yards in length, driven through the crater of an extinct volcano under a summit level 1,220 feet above the sea; and fourth, the wharf and jetties at the Lyttelton station, built upon a soft mud-bank which was, in places, 50 feet in depth. In laying out roads on hilly ground, the principle uniformly adopted was to follow the windings of the spurs, contouring the gradients with the spirit-level, so as to minimize both cutting and embankment, and to dispense with culverts as far as possible. In the case of side cuttings, the gradient was contoured with the spirit-level and lock-spitted. The back line of the floor of the cutting was thus ranged out, and the depth of the cutting measured at every half-chain. The width of the slope was then calculated and set off, and the back line of the slope lock-spitted. The work could then be let by contract at any future time when the funds might be voted by the council, no plans or sections being required, or any details, beyond the rate of slope, the total length of the cutting, and its cubic content. A serious difficulty in the conduct of the road works was the want of timber. The expedient adopted was to keep constantly in stock a quantity of planks, 16 feet 8 inches long, and 8 inches by 3 inches in section, and the bridges and culverts were built on standard patterns designed with reference to this unit of material. This plan effected a great saving of office labour, as no drawings were required in ordinary cases; and as three planks made up 100 feet (board measure), any labourer was competent to take an account of the timber used, all that was necessary being to count the number of planks. Amongst the road bridges there were few that presented special interest, with, however, two exceptions. These were: first, a drawbridge over the Waimakariri River, built on the telescope principle, from a simple design, and which worked satisfactorily; and, secondly, a bridge over the Taipo River, on the West Coast Road, presenting several peculiarities of construction. The Harbour Works possessed considerable interest, which was enhanced by their partial failure. It was found that the mud-bank was too soft to support the screws of the screw-pile jetty, and, accordingly, additional lengths of piles were cast, and a solid core of hard wood placed in the bottom of each pile, and driven down to the solid rock, on which the weight of the structure was made to rest; the flanges of the screws simply acting as supports to check lateral vibrations. The diagonal bracing was put in by divers without difficulty, the exact length of each brace being taken from a template applied by the diver to the work after the piles were screwed down to their proper depth. The sea-wall slipped forward in two places during the progress of the work, the total amount of forward movement in each case being between 5 feet and 6 feet. The author did not consider that any advantage would have been gained by carrying the piles down to the solid rock, as, in all probability, the outward movement of the embankment would in that case have overturned the work and destroyed it. He thought that the partial failure of the work might be attributed to two causes: first, that the stone embankment was deficient, both in bulk and weight, for the duty it had to perform; and, secondly, that the tipping of the clay embankment was commenced before the stone embankment had had time to take a solid bearing, so as to form an abutment to resist the pressure of the backing. The work had since been completed, by driving an outer row of piles and putting in fresh capsills, jointing, and planking; and locomotives had been running for twelve months over the embankment without any further slipping, or more than the ordinary amount of settlement. It was worthy of notice, that no effect whatever was produced upon the sea-wall, or the jetties, by the great earthquake wave of August 16th, 1868, although the sea receded so as to lay dry a great portion of the harbour; and it might have been reasonably expected that the removal of the pressure upon the ground in front of the sea-wall would have been accompanied by the subsidence of the station ground. The breakwater was still in progress by prison labour.—The second paper, on Ocean Steam Navigation, with a view to its further Development, by Mr. John Grantham, Memb. Inst. C.E., was read in part, and it was announced that it would be resumed at the next meeting.

EDINBURGH

Naturalists' Field Club, November 30.—Annual Meeting. The retiring president, Mr. Brown, delivered an address on the Education and Ethics of a Naturalist.—The following officers were then elected for the ensuing session:—Mr. R. Scot-Skirving, president; Mr. A. Craig-Christie, vice-president; Mr. Andrew Taylor, Lecturer on Geology, hon. treasurer and secretary; Drs. Black, McBain, R.N., Richardson, and Cameron, and Messrs. Brown, Sadler, Jackson, Panton, C. W. Peach, Herbert (Trinity), Kannemyer, and Archer, council. The club recorded its thanks to Mr. Thomas Edmonston, the late secretary, for his services. Miss Phœbe Blyth, of Abbotsford Park, was admitted without a ballot, and on a ballot the following gentlemen were elected members:—Lieut.-Colonel Rankin (Trinity), Dr. H. W. Nachot, and Messrs. Leitch and Macfie. The annual dinner took place the same evening, the president in the chair.

DUBLIN

Royal Geological Society of Ireland, December 8.—On this date a joint meeting of the fellows of this society and of the fellows of the Royal Zoological Society was held in one of the lecture-rooms of Trinity College, Sir Dominic Corrigan, Bart., in the chair. The Rev. Prof. Haughton read a paper on the Comparative Mechanism of the Flexor Tendons of the Feet and Hands in Mammals, Birds, and Reptiles; Prof. Traquair read a paper on *Griffithides mucronatus*, McCoy.

Institution of Civil Engineers of Ireland, December 8.—Mr. J. Ball Greene, president, in the chair. Mr. J. Price read a paper by Mr. W. Anderson, one of the ex-presidents, entitled "Record of some Experiments on Heating Water and on Condensing Steam by tubular and double-cased vessels."

MANCHESTER.

Literary and Philosophical Society, November 16.—J. P. Joule, LL.D., F.R.S., president, in the chair. Professor Osborne Reynolds, B.A., of Owens College, was elected an ordinary member of the society. A communication by Mr. E. W. Binney, F.R.S., F.G.S., on the Permian Strata of East Cheshire, was read. The author questioned the correctness of the Government map of the district lying between Macclesfield and Stockport, as far as regards the so-called "red rock fault," by which the coal measures are supposed to be bounded on their dip. According to his observations there is no more evidence of a fault between Macclesfield and Stockport, where the trias and permian beds cover the coal measures, than is to be found on the eastern side of the *Pennine* chain between Sandyacre and Sunderland, where carboniferous strata disappear under permian.—Professor Roscoe, Ph.D., F.R.S., communicated a paper on the Combinations of Phosphate of Lime and Sulphurous Acid, by Dr. B. W. Gerland, of Macclesfield. Phosphate of lime, in whatever state it may be, readily dissolves in an aqueous solution of sulphurous acid. The solution can be obtained of great strength: thus, from freshly precipitated tribasic phosphate of lime a liquor was prepared of 1·3 specific gravity, and from bone ash one of 1·708 specific gravity. The former, on analysis, gave results which agree tolerably with the formula $3CaO$, PO_5, $6 SO_2$. The solution of bone ash in sulphurous acid of 1·1708 specific gravity was also found, on analysis, to contain the amount of phosphoric acid required by that formula. The solution of phosphate of lime in sulphurous acid possesses the taste and smell of the acid, but to a much smaller extent than an aqueous solution of the acid containing the same amount of sulphurous acid. Under the influence of boiling heat the phosphate solution is decomposed slowly, sulphurous acid escapes, and a heavy white crystalline precipitate is formed. Under the microscope this appears to be composed of crystals of the hexagonal system, like those of rock-crystal. Washed and dried over sulphuric acid, it gave, on analysis, results agreeing with the formula $3CaO$, PO_5, SO_2, $2HO$. This sulphited phosphate of lime has no smell or taste, and is distinguished from all sulphites by its stability. Heated in an air bath for three hours to 130° C. it lost 0·64 per cent. of water, but the amount of sulphurous acid remained unchanged; neither had a humid atmosphere the slightest effect upon it. The water is held in intimate combination, and is only expelled at a higher temperature when it is accompanied by fumes of sulphuric and sulphurous acids. The residue contains, besides lime and phosphoric acid, sulphate and sulphide of calcium. The sulphite, which withstands the action of the atmosphere indefinitely, is rapidly oxidised when incorporated with soil. In the soil it acts as a soluble phosphate of lime. It has in fact for several seasons been used as manure, and has given great satisfaction. The new sulphite possesses remarkable antiseptic and disinfecting powers, and on this account will command a general interest. The efficacy of sulphurous acid as a disinfectant is well known; it would be more appreciated if it could be conveniently applied. The aqueous solution is expensive by transport, it is very changeable, and in many cases it is unavailable on account of its pungent smell: whilst for medical purposes it can only be used in exceptional cases, in consequence of its irritating action. The sulphites are still more changeable. Exposed to the air they are acted upon by carbonic acid and by oxygen, and when mixed with decaying organic matter for disinfecting purposes they very often increase the mischief, and sometimes cause an abundant escape of sulphuretted hydrogen. The compound of phosphate of lime with sulphurous acid has none of these disadvantages. Acids, as well as ammonia, are neutralised by it. From a sanitary point of view, ammonia is particularly objectionable; being a product of putridity it helps to accelerate it, and also serves as a vehicle for disseminating other products, which, without it, would not be volatile, or only so to a less degree. The sulphited phosphate, when applied to putrid matter, will probably do its first service by neutralising the ammonia present (including compound ammonias), and also prevent its further formation, as the test paper will show. The smell will soon cease, or at least be greatly diminished and altered, and the mass will be safe for a long time, so that it may be removed or dried without danger or inconvenience. Dr. Gerland remarked that large quantities of putrid matter in open spaces are more completely and speedily disinfected by small portions of the phosphate, than samples in glass bottles. The compound recommends itself as a disinfectant by its physical properties. It is a clean white powder, which stains and soils nothing, dusts off garments or carpets, leaving no mark; it is free from smell and taste, and harmless to animal life. The solution of phosphate of lime in sulphurous acid also possesses disinfecting powers, and acts in many cases even with greater energy than the powder. It might be used with advantage as being applicable to places which could not be reached by the other. The neutrality, regularity of composition, utter harmlessness, and freedom from smell and taste recommend the sulphited phosphate of lime for trial in therapeutics. It would be of interest to investigate it in relation to putrid puerperal fevers, pyæmia, &c.

Microscopical and Natural History Section, November 8.—Joseph Baxendell, F.R.A.S., vice-president of the Section, in the chair.—Mr. W. J. Rideout presented the Section with one of the "Diotamaceen Typenplatte" prepared by J. D. Möller, of Holstein.—Mr. J. B. Dancer sent for the inspection of the members a young cuckoo, which had been caught by a cat in his garden, Old Manor House, Tipping Street, on the 19th August.—The following note was read from Mr. Joseph Sidebotham:—"About fifteen years ago, I had a large cabinet made, of forty-five drawers, to contain shells and carpological specimens, the drawers being made of pencil cedar. Very soon I found that the resinous vapour from the wood became deposited on some of the fruits and shells, making them appear as if they had been dipped in varnish. Chloroform appeared to be the only solvent, and the specimens were obliged to be washed with it. This became so bad that I had the whole of the drawers removed, and replaced with drawers of baywood. Some time afterwards, Mr. Carter advised me to have the cedar drawers sized and papered inside, and a new cabinet made to contain them: accordingly he made me one to contain thirty drawers. These drawers were exposed to the air for twelve months, and very well sized inside, and papered, but the resinous vapour is still deposited on the objects in the drawers as before, and so far is a warning to every one never to use pencil cedar for such a purpose. I should not, however, have thought this matter worthy of mention before the Section, had it not been for the very curious and capricious way in which some objects are coated with this resin, while others are left entirely free, and for which I am totally unable to account. In shells the genera *Conus* and *Oliva* are never touched by it, nor are *Cyprea* or *Mitrea*, whilst *Helix*, *Bulimus*, and *Pecten*, are coated over: this is the case when there are specimens of these and other genera in the same drawer. As this deposit is on the genera I have named, and never on the others, it would seem to indicate that the texture of some shells would attract the vapour and not others. But in the case of bird's eggs, the very strange manner in which some species are picked out as it were and others left, is most remarkable. In the owl's eggs, for substance, the barn owl is always free, while the tawny owl is covered with the varnish, although side by side. The song thrush is never attacked, and the missel thrush always." Trays exhibiting these peculiarities were passed round for inspection.—Mr. Sidebotham also sent a living Death's Head Moth, bred from a pupa, which he had obtained at Lytham, and exhibited that the members might hear its curious cry or squeak when touched.—Mr. H. A. Hurst deposited in the Library a copy of a rare botanical work by a Jesuit priest, the Rev. J. Barrelier, which contained upwards of thirteen hundred carefully engraved plates of plants, which he had collected in France, Spain, and Italy. The work was edited by Antonio de Jussieu, and published in Paris in 1714. Mr. Hurst also exhibited some dried plants, recently collected by Mr. Wanklyn in the Southern States of America. Mr. Coward exhibited species of Podostemaceæ, collected by Gardner, in India and Ceylon. The Podostemaceæ, a little-known order of Tropical Aquatics, closely resemble the Liverworts in habit and general appearance, but possess phanerogamous flowers and dicotyledonous seeds. The order was placed by Von Martius amongst Endogens, in the near neighbourhood of the Naiadaceæ, and by Lindley in his Rutal Alliance of Exogens. Gardner considers it to be nearly allied to the pitcher plants, Nepenthaceæ. The difficulties attending the position of the order were well illustrated in the specimens exhibited, which presented a singular resemblance in foliation to Jungermannia and Riccia, and in the first view of the pedicillated ribbed capsule to the fructification of a moss, but in essential characters the true place appeared to be amongst the aquatic Endogens, with the anomaly of possessing a dicotyledonous seed.

November 30.—The Rev. William Gaskell, M.A., vice-president, in the chair. Mr. J. B. Dancer, F.R.A.S., communicated a paper on the Microscopical Examination of Milk under certain conditions, giving the results of observations made with the view of checking those of M. V. Essling, who states that vegetable organisms, like those found in putrefying substances, make their appearance in milk, before the milk gets sour. On examining a sample of unadulterated milk, Mr. Dancer was unable to detect the appearances described by Essling. The smallest oil globules exhibited as usual great molecular activity, but there was no appearance of dotted matter, or any fungoid growth when the milk was examined by powers varying from 200 to 1,500. A bottle was filled with some of this milk and securely corked; other portions of the milk were placed in open cups: one cup was kept in a cabinet which was closed during the day; the milk of the second cup was placed in a closet, the atmosphere of which was known to be favourable to the growth of fungi, the *Mucor Mucedo* being the most abundant and of the same family as that mentioned as having been found in cream by M. V. Essling. The milk in the bottle and that in the cups was examined daily, precautions being taken to close the bottle speedily after a portion was removed. On the third day the milk in the open cups was sour to the smell, but no change appeared visible under the microscrope; the upper portion of the milk in the bottle had become very rich in oil globules by the formation of cream. On the fourth day the casein had coagulated in the milk in the open cups, and the flaky precipitate was visible under the microscope; the pellicle surrounding the oil globules now appeared to be very easily ruptured, and with the slightest pressure some of the globules could be joined together—sometimes a number of globules which had been ranged in line by a current would coalesce by a slight movement of the fluid, and form an elongated mass. Fifth day, no appreciable alteration. Sixth day, the milk which had been placed in the closet had patches of mould visible on its surface: a microscopical examination of this mould showed it to be the *Mucor Mucedo*, such as had been frequently found on fruit which had been left in this closet. The fungus appeared on the surface only, no trace of it could be found in the milk taken from various depths. The milk in the cup kept in the cabinet exhibited no appearance of the *Mucor Mucedo* or any other vegetable or animal organism; it had become thickened into a pasty mass with an intensely sour odour. These observations were continued for eleven days, and the only difference observable was in the oil globules—they began to lose their spherical form, as if the investing pellicle had been weakened in parts and had become expanded. These experiments were repeated with a second supply of milk, and the results were alike in both cases. The range of temperature during the experiments was from 45° to 63° Fahr. These experiments led Mr. Dancer to believe that vegetable organisms do not as a rule make their appearance in pure unadulterated milk unless it is exposed for some time to atmospheric influences; most probably the spores are supplied by the atmosphere. He, however, considered M. V. Essling's suggestion to bottle the milk very good, and thought that cream pans with covers would be a very great improvement on the open ones as at present employed, at the same time having due regard to the cleanliness of the apartment and vessels in which the milk is kept.

Brighton

Brighton and Sussex Natural History Society, December 9.—The president, Mr. T. H. Hennah, in the chair. A paper was read by Mr. C. P. Smith on the Gemmæ of Mosses. Besides the ordinary mode of generation from a spore, which gives rise to a *prothullus*, from which the perfect plant is developed, mosses have another mode of generation, by means of gemmæ or sprouts, which have been defined as loose granular bodies, capable of becoming plants. As yet, none of the *Pleurocarpi* or side-fruiting mosses have, in Britain, been found producing gemmæ, whose situation on the plant varies in different species. Thus, in *Tortula papillus*, which grows on trees in Sussex and elsewhere, and has a thick spongy nerve, the gemmæ are found in the upper parts of the inside of the leaf—the fruit of this moss is unknown except in Australia; *Didymodon gemmascens*, having the nerve excurrent, has the tip crowded with gemmæ; in *Tetraphis pellucida* they are in pedicellate clusters at the ends of separate stems; in *Bryum atropurpureum* they form tubercles or bulbs in the axils of the leaves. On the leaves of *Orthotrichum Lyellii* grow little strings of cells, which, presenting a confervoid appearance, were named *Conferva castanea*: they have, however, been demonstrated to develop into young plants of mosses. *Oncophorus glaucus* has a great number of cells forming a dense mass at the tip of the leaf: these in the damp season give rise to young plants, so that this moss is common in counties where it never fruits. The subject of the growth of gemmæ has not yet been thoroughly worked out: he purposed investigating the phenomena, when he hoped to have some new facts to lay before the society. The paper was illustrated by drawings and microscopical specimens prepared by Mr. Smith, and exhibited by the following gentlemen, the most striking of which were—by Mr. Hennah, *Mnium cuspidatum*, *M. Hornum*, *Polytrichum commune*, and *Neckera oligocarpa*, showing flowers; Mr. Smith, *Ceratodon purpureum* and *Cinclidium stygium*, showing peristomes, and *Ephemerum serratum*, with prothullus and young buds; Mr. Sewell, section of leaf of *Pottia cavifolia* and *Orthotrichum Lyellii*, with confervoid gemmæ on the leaves, the *Conferva castanea* of the early botanists; Mr. Wonfor, *Aulocomnion androgyum*, *Ullota phyllantha*, and *Tetraphis pellucida*, exhibiting gemmæ.

Paris

Academy of Sciences, December 6.—M. Andral communicated a memoir on the relation of the variations of the temperature of the human body to variations in the quantities of some constituent principles of the blood and urine. In this paper the author discussed the proportion to be observed between the temperature of the body taken under the axilla and the amount of fibrin, albumen, and globules contained in the blood, and that of urea eliminated by the kidneys. He treated of the comparative phenomena presented in various diseases.—MM. Bouillard and Becquerel remarked upon this communication. M. Faye communicated extracts from letters from MM. B. A. Gould and L. Respighi upon the solar atmosphere and prominences, with some remarks upon them by himself. Mr. Gould's letter related to the luminous protuberances observed during the last eclipse. He referred them to the chromosphere, which he regarded as the general atmosphere of the sun, and he accepted the notion that they indicate a predominance of hydrogen in that region, but he inclined to ascribe to this a greater elevation than is generally given to it, especially as the Coast Survey Expedition had obtained photographs which show traces of it at an elevation of 7 minutes. Mr. Gould also remarked upon the evidence furnished by the perihelion distance of the comet of 1843.—M. Respighi's note referred to the relation between the protuberances and solar spots, and he stated that in the neighbourhood of the poles of the sun the protuberances are almost constantly wanting, that they are in close relation with the faculæ and spots, and that the faint shadows which appear upon the photosphere are due to the interposition of the materials of eruptions, which may persist for many days together.—M. C. Marignac presented a paper on the influence of water upon saline double decompositions, and upon the thermic effects which accompany them. He described the mode in which he experimented, and gave the following results:—The dilution of a solution causes a variation of temperature in either direction, which usually diminishes with the degree of dilution, but with sulphuric acid the increase of temperature is augmented by dilution. The mixture of solutions of two salts which do not decompose each other, generally gives rise to an evolution of heat less than that produced by the simple dilution of the solutions. When they can form a double salt, there is usually absorption of heat. The mixture of alkaline sulphates with sulphuric acid causes a considerable absorption of heat. With solutions of the alkaline bisulphates, the addition of water produces a considerable and increasing evolution of heat. The mixture of two saline solutions, or of a salt and an acid capable of decomposition without producing an insoluble compound, gives rise to considerable thermic effects, which, in some cases, at least, are increased by dilution. With mixtures, the result appears to be different according as the dilution is effected before or after the mixture of the solutions.—A note by M. H. Resal, on the relative movements of the water in the curved floats of Poncelet's water-wheel was read; as also a note by M. Bosscha in answer to observations made by M. Regnault upon a previous letter of the author's on the measurement of temperatures.—M. Lecoq de Boisbandeau presented a memoir on some points of spectrum analysis, in which he confirmed Secchi's observations on the spectra of different parts of Geissler's tubes, and communicated his own remarks on the spectra of the aureola of the positive pole, of the blue light of the negative pole, and of the spark itself. He also remarked upon differences caused by alterations in the conditions under which the spark is produced. —M. J. L. Soret communicated a note on the illumination of transparent bodies, in which he maintained, in opposition to M. Lallemand, that this is to be ascribed to suspended particles, especially in water. He described some experiments made by him. M. Chevreul in remarking upon this communication, noticed the decomposition of glass by water even at a temperature of 98° C. (= 208, 4° F.), and referred to the action of other bodies upon glass.—M. J. Maumené presented a reply to M. Dubrunfaut's note on inverted sugar, and M. Dubrunfaut a notice of his investigations of the catalytic phenomena presented by the action of acids upon crystallised sugar by the examination of the rotatory properties of its products.—M. A. Petit communicated a note on the sugar normally contained in wine, in which he stated that he had found in all wines a quantity of sugar varying from 0·50–5 grammes per litre. Sugar also occurs in vinegar.—M. Sanson, in a note on the caballine species of the genus *Equus*, endeavoured to show that our domestic horses belong to eight distinct species.—A memoir on the chemical composition of fossil bones by M. Scheurer-Kestner was presented by M. Milne-Edwards. The author remarked upon the conversion, in fossil bones, of a portion of the ordinary osseine into soluble osseine, and showed by analysis that the per centage of the latter is, *cæteris paribus*, equal in bones of the same date, so that its amount may furnish an almost infallible proof of the contemporaneity or otherwise of bones found together in the same cave or deposit. M. Elie de Beaumont made some remarks on this communication.—Notes were communicated by M. Ruffner on the preservation of meat by sulphurous acid, and on various questions of hygiene, and by M. Coffin on the "metaphysics of the differential calculus;" of these the titles only are given.

DIARY

THURSDAY, December 16.

Royal Society, at 8.30—Researches into the Constitution of the Opium Bases. Part III. On the Action of Hydrochloric Acid on Codeia: A. Matthiessen, F.R.S., and C. Wright.—On the Thermodynamic Theory of Waves of Finite Longitudinal Disturbance: Prof. Rankine, F.R.S.—On Approach caused by Vibration: Prof. Guthrie.

Society of Antiquaries, at 8.30.—On the Descent and Arms of the House of Compton: Mr. Evelyn Philip Shirley, F.S.A.

Linnean Society, at 8.—On a species of *Ipomæa* yielding Tampico Jalap: Daniel Hanbury, F.R.S.

Chemical Society, at 8.

Zoological Society, at 4.

Numismatic Society, at 7.

Philosophical Club, at 6.

London Institution, at 7.30—Architecture: Prof. R. Kerr.

Edinburgh Geological Society, at 8.

FRIDAY, December 17.

Philological Society, at 8.15.

Quekett Microscopical Club, at 8.

MONDAY, December 20.

Medical Society, at 8.

Royal Asiatic Society, at 8.

London Institution, at 4.—Elementary Physics: Prof. Guthrie.

Institute of Actuaries, at 7.

Society of Arts, at 8.—The Spectroscope and its Applications: Mr. J. Norman Lockyer, F.R.S.

TUESDAY, December 21.

Institution of Civil Engineers, at 8.—Anniversary Meeting.

Statistical Society, at 8.

Pathological Society, at 8.

Ethnological Society, at 8.—On an Ancient Calvaria, assigned to Confucius: Prof. Busk, F.R.S.—On the Koords and Armenians: Major Millingen, F.R.G.S.—On the Kitai and Kara-kitai: Dr. Gustav Oppert.

WEDNESDAY, December 22.

Society of Arts, at 1.—On Wines—their Origin, Nature, Analyis, and Uses; with special reference to a new Alcoholic Drink made from Tea: Dr. J. L. W. Thudichum.

Geological Society, at 8.—On the Iron-ores associated with the Basalts of the North-east of Ireland: Mr. Ralph Tate, F.G.S., and Dr. J. S. Holden, F.G.S.—Note on the Skull of the Large Kimmeridge Crocodilian, *Dakosaurus maximus*, Buenstedt, *Steneosaurus*, Geoffr. St. Hilaire: Mr. J. W. Hulke, F.R.S.—Note on a fragment of a Jaw with peculiar Teeth from Kimmeridge Bay: Mr. J. W. Hulke, F.R.S.—Notes on the Structure of *Sigillaria*: Principal Dawson, F.R.S. of Montreal.—Notes on some new Animal Remains from the Carboniferous and Devonian of Canada: Principal Dawson, F.R.S.

THURSDAY, December 23.

Society of Antiquaries, at 8.30.

BOOKS RECEIVED

English.—Home Life of Sir David Brewster: By his daughter, Mrs. Gordon (Edinburgh: Edmonston and Douglas):

Foreign.—Histoire de la Création: par H. Burmeister; traduite de l'allemand: E. Maupas.—Monographie des Ligumineuses Cæsalpinées: H. Baillon.—Die Nordamerikanische Zuckerfabrikation aus Sorgo und Imphy: Dr. Karl Löffler und Peter von Papi-Balogh.—Untersuchungen über Bau und Entwicklung der Arthropoden: Dr. Anton Dohrn.—Ueber die Bauweise des Feldspaths: Dr. Fredrich Scharff.—Japanisches Meeres-Conchylien: Dr. C. E. Lischke.—Die Pflanzenstoffe: Dr. Aug. Husemann und Dr. Theod Husemann—Die Lagerstätten der Nutzbauren Mineralien: Johann Grimm.—Archiv fur Mikroskopische Anatomie: Max Schultze.

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Erratum.—Line 26, col. 2, p. 166, should read as follows: "total number about 200. I have identified at least 60"

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THURSDAY, DECEMBER 23, 1869.

TOWN SEWAGE

ONE of the most imperative requirements of social life is some means of dealing with those waste products of the human mechanism which are dirt only while they remain out of their proper place, but are capable of becoming a source of serious inconvenience and injury whenever they are allowed to accumulate in the neighbourhood of dwellings, especially in densely populated places. In the case of isolated dwellings, and where the population is scattered, no great difficulty would be experienced in devising simple measures for disposing of this refuse so as to meet all requirements. But wherever the population is concentrated, the difficulty of dealing with house refuse, so as to prevent its becoming a nuisance, and, at the same time, to make it useful, is greatly increased. Partly on this account, and partly because neglected accumulations of house refuse are in the highest degree detrimental to health, the measures adopted in towns for dealing with house refuse have been subjected to the control of the municipal authorities, instead of being left to the option of the individual occupiers of houses; and in modern times it has come to be regarded as one of the first duties of such bodies to provide for the disposal of house refuse so as to preserve the health and life of the populations under their care. This sanitary axiom has indeed been forced into recognition by the ravages of epidemic disease, such as plague, fever, or cholera, and it may now be deemed unquestionable, except where ignorance overcomes intelligence, or where mistaken notions of economy prevail.

On sanitary grounds it has been decided, or, to say the least, very generally admitted, that the most efficient mode of dealing with house refuse is to remove it at once from dwellings, and by means of a copious use of water to sweep it away through underground channels outside of towns. In this way the domestic nuisances that were familiar during the early part of this century have been done away with, the town nuisance that arose from the use of cesspools has been suppressed, and the sanitary state of towns has generally been improved. But the removal of those nuisances has given rise to another one, affecting not only individual dwellings and towns, but the whole country. The continuous discharge of vast quantities of house refuse, distributed through great volumes of water into rivers and streams that are often sources of water-supply for domestic use, has rendered them so foul that this result of sanitary improvements is acknowledged to be a national nuisance, and one of the very highest importance in regard to public health.

Hence has arisen the question, What is to be done with town drainage? And this question still perplexes the Government, municipal authorities, river conservancies, and legal tribunals. In many instances the sanitary works carried out in towns at vast expense have given rise to serious nuisances at places lower down the streams into which the sewage is discharged; in other cases the execution of such works is prevented by prohibition against the discharge of sewage, and in some cases practices in direct opposition to legal enactment are tolerated because no remedy seems applicable.

So much for the difficulties attending the municipal object for getting rid of house refuse. It is now necessary to consider the subject in another light, and inquire what is the "right place" where house refuse is no longer to be regarded as dirt, but as material of value? How is it not only to be got rid of, but also turned to account and made useful? For this purpose it must be remembered that this waste material consists of the portions of our food which have done their work in the process of nutrition, and those portions of it which were not required in that process. In both cases plants are the source from which the constitutent parts of this material have been derived. Those plants again have abstracted them from the land on which they grew, not accidentally, but as an essential condition of their growth. Here, then, in this fact that the constituents of house refuse are essential for the growth of plants, lies the key to the sewage problem, a possibility for the utilisation of town sewage. Thousands of tons of the same substances that are constituents of house refuse are annually imported into this country for use as manure in agriculture—ammonia in the guano from Peru; phosphates, or bones and phosphatic minerals, from all parts of the world; potash from South America and Germany. Thousands of acres of land lie unproductive from want of these substances, and some of their most important sources are only of limited duration. Meanwhile the aggregate intrinsic value of those constituents in the house refuse of this country amounts to several millions annually.

There are, however, serious difficulties to be overcome before the economic object of utilising town sewage as manure in agriculture can be realised so as to fulfil all requirements involved in the municipal object of getting rid of it, and in the still more important sanitary object of preventing it from becoming a source of injury to the public health. These difficulties arise chiefly from the enormous dilution of the sewage, partly by the use of water for removing house refuse, and partly by the admixture of surface water and subsoil drainage. Generally speaking, the constituents of town sewage which have an intrinsic value as manure are so much diluted that a quantity of them which would be worth one shilling in the state of a dry solid like guano or bones, containing only a small proportion of less valuable admixture, is in sewage mixed with from six to ten tons weight of water. Therefore, in order to give land an ordinary dressing of manure in the form of town sewage, it is necessary to apply a very large bulk of that liquid. This can very often be done without any great trouble, especially when the town from which the sewage is discharged lies high, and is surrounded by cultivated land at a lower level; and even when this is not the case, the cost of pumping the sewage to a sufficient height, and the outlay for pumping works, would not generally be a serious obstacle to the application of town sewage as manure. However, the getting rid of sewage involves its continuous daily application to land; and here the municipal object is at variance with the agricultural object, of using the sewage only when it is wanted. Consequently, it would be necessary, in organising a general system of sewage utilisation, to establish a new system of farming; to grow crops specially suited for the frequent application of very dilute liquid manure, and to have the land laid out for cropping in such a manner that there may always be a sufficient area available for disposing of the sewage day by day. Innovations of such a kind are exceedingly difficult to introduce into an art like agriculture, that is practised so much under the influence of tradition and habit; but, in addition to this impediment, there is the more serious one of cost to be incurred in adapting a farm for sewage irrigation. For the farmer, the value of town sewage is to be estimated, not by the intrinsic worth of the substances it contains, but by the amount of those substances which are effective, or at least likely to be effective, in augmenting the produce of his land after due allowance for the influence of season. If sewage containing in each ton twopence-worth of manure be applied to land in such proportion that only one-fourth of the aggregate quantity of manure constituents remain in the land or become effective, then the sewage so applied cannot be worth more than one-halfpenny per ton to the farmer.

It is therefore futile to estimate by calculation, as has often been done, the value of the sewage discharged from a town, and to anticipate, on such a basis, the possibility of making the sewage a source of considerable revenue to the town. Speculations of this kind have naturally eventuated in disappointment and the disgust of all who have been misled by them, without making due allowance for the drawbacks that influence the value of sewage as manure even more than the intrinsic worth of its constituents.

Another circumstance to be taken into account in this respect is the outlay requisite for conveying sewage from the sewer outlets where it is discharged from a town to the land where it can be utilised as manure. Even under the present system of agriculture, farmers would often be glad to have the command of town sewage for application to their land during dry seasons, when the total failure of a crop might be thus obviated. But it rarely happens that this is practicable, owing to the want of any channel of communication between the sewer outlets and the land where it would be useful. Farmers, and even landowners, would rarely be in a position to incur the expense of making such communications, and municipal authorities refuse to do it as being beyond their province. However, if the importance of preventing the pollution of rivers and watercourses were fully appreciated in regard to its influence on public health, there is much reason to believe that the obligation of getting rid of town sewage appertaining to municipal bodies really extends far beyond merely discharging it into a neighbouring stream, and involves a considerable contribution on their part, according to local conditions, towards the outlay necessary for combining the attainment of their special object with that of the farmer by getting rid of the sewage in such a manner that it may be made useful.

It would, at present, be almost impossible to suggest how this object should be realised; for if town sewage is to be applied on the same principle as manure like guano or bones, only in such proportion as to give the requisite dressing of manure constituents per acre of land, the area over which the sewage of a large town would have to be distributed would be enormous, and the attendant expenses of its distribution would be very large. If, on the other hand, the area of land to which the sewage is applied be limited so as to dispose of the largest possible proportion of sewage and keep the cost of arrangements for distribution within the smallest bounds, there would generally be such a disproportion between the actual quantity of manure constituents applied per acre and the possible effect produced on the produce of the land, that the value of the sewage as manure would be greatly diminished; or, in other words, very much of it would be wasted, and still simply got rid of.

Here again sanitary considerations demand attention, and the possible influence which the application of town sewage to land may have on the public health must be taken into account. It is, for instance, indispensable that the use of town sewage in agriculture should be conducted in such a way as to be an effectual remedy for that pollution of rivers which has become a serious national evil. Moreover, if sewage-irrigated farms are to be distributed throughout the country in the neighbourhood of towns, it is still more imperative to know that the adoption of this course will not be productive of injury to the public health. This point should receive the fullest elucidation before any general measures can be taken with the object of utilising town sewage, and the conditions under which that can be effected without risk should be thoroughly investigated.

Such an inquiry would comprise many questions of detail, requiring varied skill, and considerable time as well as labour, for its prosecution; and the British Association Committee that contemplates carrying it out, impressed with the magnitude and importance of the task, has felt the necessity of much larger means for conducting the inquiry than that small sum which the Association were able to grant for the purpose of meeting the expenses of preliminary work. If municipal bodies and landowners respond to the application of the Committee in a manner commensurate with their interest in this subject, and provide adequate funds for thorough investigation, there is reason to expect some considerable step will have been made towards placing the question of sewage disposition and utilisation in a more satisfactory position than it has yet attained.

Besides the main points already mentioned, of getting rid of sewage and turning it to account, there are yet other questions of moment to be considered. The rapid adoption of reformatory methods, in regard to the sanitary state of towns, which has marked the past quarter of a century, has not always been attended with so much improvement as might have been desired. In some instances, serious anomalies have presented themselves in this respect, and there is much reason to believe that circumstances yet remain to be provided for which affect the sanitary state of towns. Mr. Bailey Denton has recently called attention to this matter by pointing out in his letters to the *Times* the fact that, in some instances, the sewerage works of towns have been constructed in such a way as to admit of the soil surrounding the sewer being permeated by sewage, and he has suggested, as a possibility deserving of inquiry, that in this way an effect may be produced similar to the infiltration of house refuse from cesspools into the surrounding soil. If such be the case, it would perhaps account for the fact that in some towns, where every kind of known sanitary precaution has been taken, the reduction of disease and mortality has been but slight. Such an action, though slower than in the case of infiltration from cesspools, would not be less sure in its influence on the sanitary state of a town, and in that way sewered towns may still be exposed to the evils arising from "excrement-sodden soil" which the Medical Officer of the Privy Council has pronounced to be one of the main causes of cholera and fever.

Another point in which there is reason to believe existing sanitary arrangements are defective is the facility of communication between sewers and the dwellings from which they are intended to convey refuse. Some connection of the kind is indispensable for the use of water as a transporting vehicle for the refuse; but little attention has yet been paid to the fact that the very arrangement which facilitates the water-carriage of refuse also favours the regurgitation of foul gases from the sewers into streets and dwellings. The water traps and syphons commonly attached to the connections between houses and sewers are seldom or never sufficient to prevent the passage of gases; and in this way the inhabitants of sewered towns may be exposed to the unwholesome influence of a constant pollution of the atmosphere as pernicious in its action as the use of water polluted with drainage from cesspools, or living over an excrement-sodden soil, has long been recognised to be.

These are some of the chief points which the limits of the present article will admit of being noticed as being comprised in the inquiry to be carried out by the British Association Committee. BENJAMIN H. PAUL

SCIENCE FOR CHILDREN

THE schoolmasters of the present day may be divided into two categories: those who *teach*, and those who *hear lessons;* the latter class, unfortunately for the next generation, being by far the more numerous. The mischief done to the community generally by the shortcomings of inefficient teachers is too well known to every one who has pierced below the surface of the great question of middle-class education. The difficulties, however, that beset a science teacher in his endeavours to force scientific truths into the unwilling and unprepared minds of boys, who have been subjected to the sway of these same lesson-hearers, can only be realised by those who have gone through the task. The case of a senior science class, which has been under my charge for some months past, will illustrate my meaning most fully. It consists of about a dozen boys, whose ages range between fourteen and seventeen years, and they receive twice a week an hour's instruction on chemistry and physics. The class may be divided into two distinct portions by a perfectly sharp line. Four of the boys have had the advantage of six or seven years' training under the principal of the school, who is not only a ripe scholar, but also an efficient teacher—a very rare collocation in these days. The rest have simply learnt lessons all their lives. The four boys who have been *taught* are as mentally distinct from the others, as if they were different species of the same genus. The first four are bright, attentive, wide-awake—I know of no other term to express exactly what I mean—logical, and clear-headed; they can fairly follow a chain of scientific reasoning, and reproduce it afterwards link by link; they have a certain power of induction and deduction, although of course, being new to science, this power is necessarily only just awakened; they can connect and correlate facts and ideas, they can enumerate a series of phenomena in logical sequence; in a word, although their industry and application are far from colossal, the task of teaching them the truths of natural science is a comparatively easy one. The other boys, as I have said before, almost form a distinct mental species. They cannot understand the possibility of learning anything without the aid of a book, and the idea of finding out anything for themselves has never entered their heads. Still they are far from stupid boys, being all possessed of good average brains; yet their faculties have not merely been allowed to remain undeveloped, but they have been utterly entangled, stunted, and stultified by what Dr. Frankland would call their "previous school contamination." These boys, it must be understood, are the sons of parents belonging to the upper stratum of the middle class, and have mostly been to schools conducted by university men with honourable initials appended to their names—men, in fact, who are scholars but emphatically no teachers. Their great fault is a total want of mental method, without which the greatest brain is as nought. They are at home in Virgil and Horace, some of them are fair Greek scholars; they have "been through" Euclid, and can work moderately difficult algebraical problems in a certain mechanical fashion; they are well acquainted with the leading facts of English history, and know the exact position and population of Adrianople; but as far as real mental power goes, any poor boy, who has been in a National school for three years, would beat them hollow.

These facts surely point out the absolute necessity of beginning scientific training at a very early age; and I fancy this necessity has not been sufficiently dwelt upon in the numberless essays, letters, lectures, and evidence on the subject of scientific education with which we have been deluged during the past decade. There seems to have been a notion abroad, that scientific teaching should not be begun before the age of 12 or 14; but why, I would ask, should boys' minds be allowed to remain fallow during all these years? The minds of boys of 7 and 8 should surely be as carefully developed as those of their seniors, and there is certainly no means of pure mental culture so successful as scientific teaching. A boy of this age should not be taught science so much for the sake of acquiring a certain number of facts, as of developing his powers of observation and reasoning, and giving a proper tone to his mental faculties. A boy of 8 or 9 takes a morning canter of three or four miles on his pony, not for the purpose of getting over some 7,000 yards of ground, but to strengthen his muscles and improve his carriage: his science lesson should be an intellectual canter, taken with the view to strengthening and improving his mental muscles and carriage.

In National and British Schools, and in some few middle-class schools conducted on rational principles, this great want is supplied by what are known as "Object Lessons." A natural object, such as a piece of lead or sugar, is placed before the class, and its physical properties are described by the pupils with the aid of questions from the teacher. Its origin and manufacture are also given in the case of the older children, and the whole is noted down on the black-board in as condensed a manner as possible; the lesson being reproduced in a miniature form either *vivâ voce* or in writing. These lessons are most excellent in their way; but as generally taught, they are too desultory and unsystematic to effect fully their intended purpose. The principal manuals on the subject show a want of arrangement and system, that greatly detracts from their value. One day the children are supposed to learn a lesson on a piece of iron: the next on a flower, the third on a shell, and so on. Too much stress is laid upon cultivating the powers of observation, and too little on connecting the facts observed, and drawing conclusions from them. The lessons, too, are very frequently unconnected with each other, and the facts taught lean almost too much towards the practical and economic side of knowledge, and too little to that of systematic science. Great scientific ignorance is displayed in many cases: for instance, one book informs us that plumbago is an ore of iron; that iron is generally found as an oxide in combination with *sulphuric* and carbonic acid; that fluor spar is composed of fluoric acid and lime; and that lime unites with various proportions of carbonic acid. These mistakes are the result of imperfect scientific knowledge, and may be passed over for the sake of the valuable instruction given to teachers, which cannot fail to produce most excellent results, if applied to systematic scientific teaching.

It may be urged that children of 8 or 9 are too young for systematic science teaching, but facts prove the contrary. An ordinarily intelligent boy or girl of this age is perfectly capable of understanding the broad differences between the animal, vegetable, and mineral kingdoms; that there are more gases than one in the world; that some of them are colourless, while others are brown or green; that some burn and others do not; that some plants grow from the inside, while others grow from the outside; that some animals have jointed backbones, that others have their bones outside their bodies, while others have none at all. Facts such as these are perfectly comprehensible to children even younger than those I have named. During the first two years of a child's school life, after he has learned to read and write, he should be carried through the whole range of physical science in a systematic manner. The fundamental truths of chemistry and physics should be first taught him: all theoretical considerations being left aside. As few definitions as possible should be given, the whole task of the teacher at the commencement being to cultivate the child's powers of observation to the utmost. Gradually the powers of induction and deduction may be developed, facts and phenomena should be compared, and conclusions drawn from them. Order in thought and description should be specially insisted upon, and occasional retracings of the ground already gone over should take place. The objects of this preliminary science teaching should be twofold: first and foremost, to train the mind and form the judgment; and secondly, to give the child a general idea of the object and scope of the natural sciences. At the age mentioned, the faculties are all fresh, and in full process of development; and such is the desire to exercise them in intelligent children, that their thoughts often run wild. There is nothing a child likes so much as investigation, or "finding out all about things," as he himself would phrase it. The boy in the nursery rhyme who cut the bellows open to see where the wind came from, is a type of his class. Unfortunately at the present time, scientific teachers for children are extremely rare, but let the want once arise, and the demand will soon be met. We have plenty of scientific teachers and lecturers for boys and men, but the child has hitherto been left out of consideration. Teachers, in the true sense of the word, are every day on the increase, and even the old-fashioned schoolmasters are beginning to see very plainly that they must alter their system of instruction, and yield to the pressure of the times. But it is not only upon these that I would urge the necessity of beginning science teaching at the earliest possible period, but also upon those who have already adopted science as part of the ordinary school curriculum for the older boys.

CHARLES W. QUIN

THE GOLD FIELDS OF VICTORIA

The Gold Fields and Mineral Districts of Victoria. By R. B. Smyth. (Melbourne: J. Ferres. London: Trübner and Co.)

I.

TWENTY short years ago, the territory of Southern Australia comprised within the colony of Victoria offered comparatively little attraction to the emigrant. Its population had increased but slowly during the half century which had passed away since the discovery of Port Phillip Bay. Graziers, shepherds, and farmers were its chief occupants, and by them the value of its soil was estimated very much according to the number of cattle or of sheep which each acre could maintain. But to-day everything is changed. The land is dotted with hamlets, villages, and towns, and is intersected with roads and railways. The population has increased from 77,000 in 1851, to 660,000 in 1867. In the former year only 57,000 acres were under cultivation, in the latter the area had risen to 631,000. This growth in the population has been accompanied by a corresponding increase in the value of the imports and exports, which are now ten times what they were; while the value of rateable property in town and country districts is estimated at about £42,000,000.

This marvellously rapid rise of the colony is mainly to be ascribed to the discovery of gold there in 1851. Never had the prospects of the colony been gloomier than just before that discovery was made. The able-bodied part of the population was moving off to the gold-fields of New South Wales, glowing accounts of which appeared from week to week in the newspapers. Every kind of property was sinking in value. At last, after small finds of gold had been reported from different parts of Victoria, a public meeting of the citizens of Melbourne was convened, for the purpose of raising funds towards offering a reward to any one who should discover a workable gold mine within twenty miles of that town. The attention of the colonists was now thoroughly roused, and in the course of a few weeks reports came from many of the surrounding districts that gold existed in large quantities. From that time the tide of emigration from the colony was arrested, and the population began to increase with that wonderful rapidity just alluded to.

From the very beginning of the mining operations they were regulated and inspected by the Colonial Government. A mining department was instituted, with a responsible minister at its head. Mining registrars and surveyors, wardens of mining districts, and other officials were appointed with the view of aiding and regulating the labours of the miners, and collecting every variety of information for the use of the Government. More than this, a geological survey was established, under the direction of one of the ablest of the staff of the Geological Survey of the United Kingdom, Mr. Selwyn; and funds were furnished for the production of maps, sections, and other publications necessary for elucidating the geological structure of the colony. That survey has done excellent work, the real value of which may possibly not be understood in the colony for some years to come. We cannot but regret, therefore, that in a spirit of parsimony the colonial Parliament has recently abolished the survey, and deprived the colony of the great advantage of obtaining accurate information as to the mineral tracts which remain yet to be explored. Nevertheless, for what has already been done to develop her mineral resources, and to gather accurate information regarding the structure of the rocks, and the distribution of gold, the colony may be very heartily congratulated.

The handsome volume, whose title heads this article, tells the story of the rapid rise of Victoria. It is a large thick octavo, beautifully printed, and embellished with many woodcuts, sections, and plans of singular excellence, the whole having been prepared and executed in Melbourne. Mr. Brough Smyth, Secretary for Mines to the colony, seeing the want of any trustworthy account of the gold-fields of that region, and having himself peculiar advantages for the task, proposed to himself to compile a narrative of all that was known regarding the mineral districts, the different modes in which the gold occurs, and the various methods in use for obtaining it. He has carried out the project with most commendable patience, and has produced a volume about the Victorian mines which is itself quite a mine of information both to the practical digger and to the geologist.

After a brief introduction, in which the author traces the successive steps which led to the commencement and prosecution of his work, he sketches the general topographical and geological features of the mineral districts. He then briefly describes the circumstances attendant on the first discovery and earliest mining of gold in Victoria, and passes on to treat of the different modes in which the gold occurs. The older or basement rocks are of palæozoic age. They are plicated and denuded very much like our own Silurian strata in Wales, Cumberland, and Scotland. They are, as a whole, but little altered, consisting in large measure of sandstones, mudstones, and shales, which now and then pass into harder and somewhat schistose varieties. Across these strata run thousands of quartz veins, which vary in thickness from one-sixteenth of an inch to 100 and 150ft. Although gold has been found in small quantity disseminated between the planes of bedding of the sandstones, it is in these quartz veins that it chiefly occurs *in situ*. It takes many forms—fine flakes or grains floating, as it were, in the quartz, ramifying threads or moss-like aggregations, spangles, thin plates like gold-leaf, well defined crystals, irregular strings, rough lumps, and large nuggets. How the gold got into the veins is a question on which Mr. Brough Smyth brings forward much argumentation from different writers holding discordant views, but which he does not himself attempt to solve.

Overlying the palæozoic rocks with their quartz veins are "drifts" and alluvial accumulations of different ages. These are very generally auriferous, the gold occurring in detached fragments, varying in shape and size from mere dust up to masses like the "welcome stranger nugget," which weighed upwards of 2280 ounces. There are features of special geological interest in these alluvia, which will be noticed in a second article. The very soil is sometimes full of gold, particularly where it overlies, or slopes from, a quartz-reef. In one place a patch of such soil, about twelve feet square and one foot deep, yielded 30 ounces of gold, even with such rude processes of extraction as were in use in the early days of the gold-fields.

Mr. Smyth arranges the different methods of working gold as follows:—

"(1) *Surfacing*—the washing of the thin covering of earth resting on the tops and sides of the hills in the close neighbourhood of auriferous quartz veins.

(2) *Shallow-sinking*—the obtaining *washdirt* from off the surface of the old claystones, sandstones, and slates, by sinking pits, or making excavations in the valleys and creeks.

(3) *Sluicing and hydraulic mining*—the washing of the auriferous earths, by streams of water, in the gulleys and valleys where recent deposits of auriferous gravels and clays occur.

(4) *Deep sinking*—the obtaining auriferous earths by penetrating the deeper tertiaries.

(5) *Tunnelling*—the obtaining auriferous earths and veinstones by adits.

(6) *Quartz-mining*—the obtaining gold from the mineral veins intersecting the older sedimentary rocks."

The author gives copious details of these different processes as carried on in the various claims and fields. Much of the information so given has necessarily but a local interest, yet its compilation into the present accessible form cannot but prove of much service to those practically engaged in gold-mining in the colony. Some idea of the richness of the Victorian gold-fields may be obtained from the fact that from the first discovery of the precious metal in 1851, up to the end of last year, there had been obtained 36,835,691¾ ounces, estimated as equal to £147,342,767. In the year 1854, just three years after the first discovery of gold, and when the gold-fever was at its height, the number of miners was 65,763. Since that time the numbers have slowly diminished, and in September, 1868, they stood at 63,482. There has been a still more marked diminution in the amount of gold reported. In 1856, the quantity sent out of the colony reached to 2,985,991 ounces, while last year it was only 1,657,498 ounces.

Besides gold, Victoria furnishes other valuable mineral resources. Ores of silver, tin, copper, antimony, zinc, lead, cobalt, bismuth, manganese, and iron occur, some of them in great abundance. Coal, lignite, and bituminous shales are likewise met with; while among the mineral produce of the colony are likewise enumerated the sapphire and the diamond.

The author's official position as Secretary for Mines afforded him excellent opportunities for collecting information regarding the mines in every part of the colony. But such official experience does not necessarily bring with it any practical knowledge of mining, still less any acquaintance with the geological facts which guide mining operations. Mr. Smyth modestly says of himself: "I wish it to be distinctly understood that I am merely a compiler." But his book abundantly proves that he has a thorough knowledge of what practical mining is, and that he is no mere tyro in geology. A tolerably good test of the accuracy of a man's geological knowledge is often furnished by the way in which he draws a section. He is compelled to put down definitely the notion which he has formed of the structure of a district, or of the relations of certain rocks to each other, and the manner in which he does this may be usually regarded as an indication of the extent of his acquaintance, not merely with the locality in question, but with the fundamental laws of geological structure. At the same time, too, he unconsciously betrays whether or not Nature has gifted him with any trace of the artistic faculty. Now Mr. Smyth's sections are singularly excellent. He procured them from miners, mining companies, geologists, and private friends, and no doubt, in many cases, from his own observations. Everybody who has ever tried to collect sections in this way knows that they come in every conceivable style and scale, usually grossly exaggerated either in length or height. Such were doubtless the sections which arrived at the Victorian Office of Mines. But Mr. Smyth has recast them after his own pattern, and they now appear in a uniform kind of drawing, which reminds one of the artistic finish introduced many years ago into geological section-drawing by the late Sir Henry De la Beche.

It is hardly possible to over-estimate the advantages which must accrue to mining interests in the colony when the Government department of Mines possesses a secretary who is evidently most thoroughly in love with his work, and who is endowed with so much sound scientific knowledge and experience. This book is an eminently practical one. Yet it offers every now and then glimpses into geological questions of the highest interest. To some of these reference will be made in a subsequent article.

ARCH. GEIKIE

OUR BOOK SHELF

Terrestrial Physics.—*Probleme der vergleichenden Erdkunde.* By Oscar Peschel. (Leipzig, 1870.)

THE fundamental thesis of the author, involving his conception of the true province of the science of comparative terrestrial physics, appears to be this:—If a series of maps of the globe, or any part of it, drawn at different times during several centuries, be compared, there becomes obvious a radical want of truthfulness in the elder representations; such coast-lines, such mountain-chains, such river-courses are utterly impossible. On the other hand, a modern map convinces us at once of its internal truth. This truth must be founded on some general laws, which must be discoverable by studying the resemblances in the external features of countries; and finally a series of such resemblances distributed over different localities must lead to the discovery of the conditions of their origin.

One example, taken at random, will be sufficient to indicate the author's method of procedure. A comparative study of the localities, where fiords occur, shows—(1) that they are mostly to be found on west coasts, and appear generally associated, rarely single; (2) that they are limited to high latitudes, and excluded from the region confined on both sides of the equator by the isothermal line of 10° C.; (3) that they are all within the region of rainfall during the whole of the year. Hence the general law is deduced, that fiords owe their origin principally to certain climatic conditions, viz. a low temperature, a maximum amount of aqueous deposition, and protection from the drying influence of easterly winds.

Now, we can well admit the possibility, or even probability, that continued actual observations may lead to similar conclusions; but in the mean time we are at a loss to understand how rain or isothermal charts, representing most recent conditions, can be applied to explain phenomena which the author himself thinks must have happened so long ago, that the time would have to be reckoned by hundreds of thousands of years.

M. Peschel, as it appears from his own admissions, has never left his study to observe the phenomena on which he reasons. He has collected, extracted, compiled, compared, and—generalised. This is not the legitimate approach to Nature's secrets, and consequently the author's work, although written in a masterly style, leaves us comparatively in the dark. It is the ingenious pleading of a lawyer for the cause he has undertaken, rather than the transparent and triumphant language with which the genuine student of Nature proclaims his discovery to the world.

B. L.

Cinchona Plantations in Java. *Die Chinacultur auf Java.* Von J. W. Van Gorkom, ans dems Holländischen übertragen von C. Hasskarl. (Leipzig, 1869.)

THE efforts of the English Government to establish the quinine-producing plants of South America in our Indian possessions have excited very general interest. Other European Governments are, however, not less alive than our own to the danger of depending any longer solely upon the chance products of the forests of South America for supplies of the most indispensable of medicines. Our neighbours, the Dutch, have for more than twelve years devoted much attention to the regular cultivation of cinchona trees in Java, and although the results obtained hitherto are not so favourable as we should have hoped, there is good reason to believe that the experience now gained will lead to great success in the future. The scale on which the Dutch experiments are being made will be best indicated by the fact that on the 31st March last there were in Java in nurseries and regular plantations nearly a million cinchona plants under cultivation. Besides these, more than 900,000 have been planted in the jungles, but have, unfortunately, owing to a variety of causes, already mostly disappeared. In the present pamphlet M. von Gorkom gives the experience of the Dutch cultivators, as well as a general review of the literature of the subject. Appended to the pamphlet are tables showing the present state of cinchona-culture in Java, the rate of growths of the plants, and the results of chemical analyses of the various species cultivated. Monsieur van Gorkom has had the advantage of having his work rendered into the more generally accessible German language, by a gentleman who has himself taken so distinguished a part in cinchona-culture as to induce a jury of the French International Exhibition of 1867 to confer a gold medal upon him, while assigning to Markham, McIvor, and others silver medals only.

Transactions of the Bremen Scientific Association.—*Abhandlungen des naturwissenschaftlichen Verens zu Bremen.* Vol. 2. part i. (Bremen, 1869.)

AN article by Dr. Foske on the late Professor Trevirarus points out that in some of his works the fundamental ideas of Darwinianism were clearly expressed, long before the theory was explicitly propounded by Mr. Darwin.

We would direct the attention of biologists to a paper in the same volume, by M. Luerssen, "On the influence of red and blue light on the plasma-stream in the hairs of *Urtica* and *Tradescantia virginica*." It appears that the action of red light is to disturb the molecular structure of the protoplasm, and finally to destroy it entirely, while blue and white light act similarly; the blue, however, with somewhat less energy.

B. L.

SENSATION AND PERCEPTION.—I.

VERY different meanings have been attached to the words sensation and perception by different writers; and this diversity of meaning is to be met with in physiological as well as in more strictly philosophical works. Yet it is most important that we should come to a definite understanding upon the subject, in order to know whether certain physiologists have been warranted in assigning sensation and perception to different parts of the brain, as functions of separate portions of this principal organ of mind.

The distinct issue raised is, Are physiologists justified in assuming that the so-called sensory ganglia, at the base of the brain, are the centres in which mere unconscious nerve impressions are converted into conscious sensations? are these ganglia, in fact, in any sense, seats of Consciousness?

Almost everyone understands that both sensation and perception, however they may be supposed to differ from one another, are nevertheless conscious states, or modes of consciousness in the special and ordinary acceptation of the term. But there is one distinguished writer, at least, who has most strenuously objected to this limitation, in the case of the word sensation. Mr. G. H. Lewes maintains* that what most other people term mere impressions or unconscious nerve actions, should really be regarded as sensations, and should be entitled also to the attribute of consciousness—not in its more special acceptation, but in accordance with the very general meaning which he attaches to this word. For the sensations and perceptions of other writers—those impressions to which our attention is given—he reserves the single term perception, apparently because he considers there is no fundamental distinction between them. With this latter part of his doctrine, as will be seen, we are disposed thoroughly to agree, though we cannot assent to the propriety of so far revolutionising the meanings of the words sensation and consciousness. The fundamental position which Mr. Lewes assumes, and upon the strength of which he considers it desirable to make such an innovation in the meanings of thoroughly accepted terms is:—"that sensibility is the *property inherent in ganglionic tissue*—the one peculiar 'force' belonging to all nerve centres, as neurility belongs to all nerves."† Now Mr. Lewes himself points out, that the only means of upsetting his argument (which must be otherwise logically irrefutable) is to deny that sensibility is a *property* of ganglionic tissue, and to look upon it as a *function* rather of certain nerve centres. And this really seems to us to be the conclusion most strongly supported by obtainable evidence. Instead of believing sensibility to be the property inherent in ganglionic tissue, should we not rather assign to this some more general characteristic, such as molecular instability, conferring upon it a property of mere *impressibility*—of which sensibility and consciousness are the most specialised modes, dependent upon the organisation and molecular instability of certain nerve centres of the cerebral hemispheres? Mr. Herbert Spencer‡ calls a ganglion cell a *libero-motor* element; because in the most general conception of its property it seems to be a portion of extremely unstable matter, in which the molecular movements imparted to it by the afferent nerve-fibre undergo a prodigious multiplication before producing their ulterior effects.

Just as we meet with this notable exception to the generally received meaning of the word sensation, so also has the word perception been endowed with an altogether special meaning, by that school of philosophers known as Natural Realists: some of them have removed it also from the sphere of consciousness as ordinarily understood. Space will not permit of my showing how they differ amongst themselves in minor shades of meaning:

* "Physiology of Common Life." vol. ii. 1859.
† Loc. cit. p. 20.
‡ System of Philosophy, No. 20, 1868.

I will only now quote the views of Dugald Stewart. He says:*—"In order to form an accurate notion of the means by which we acquire our knowledge of things external, it is necessary to attend to the distinct meanings of the words *sensation* and *perception.* The former expresses merely that *change in the state of the mind* which is produced by an impression upon an organ of sense (of which change we can conceive the mind to be conscious without any knowledge of external objects); the latter expresses the *knowledge* we obtain by means of our sensations of the qualities of matter." This is an explanation of perception which to most physiologists would appear absolutely meaningless. It seems itself utterly incomprehensible. Stewart conceived perception to be a distinct mental act by which we obtain a "knowledge" of the properties of matter as existing, and in themselves. But, strange to say, this "knowledge" we "obtain by means of our sensations;" even though by the word *sensation* Stewart understood "merely that change in the state of the mind which is produced by an impression upon an organ of sense." How, through such changes in the state of the mind, we are to arrive at an immediate knowledge of the *things* without which, *ex hypothesi*, the changes are not produced, we are at a loss to understand; and neither do we see how it can be reconciled with Stewart's own theories, seeing that, according to him, consciousness "denotes the immediate knowledge which the mind has of its sensations and thoughts, and, in general, of all its present operations." On the one hand, "knowledge" is made to transcend the sphere of consciousness; whilst on the other, it is said that "of all the present operations of the mind, consciousness is an inseparable concomitant."

With these exceptions, the different acceptations of the words sensation and perception are less divergent, inasmuch as nearly all other writers suppose consciousness, in the ordinary meaning of the word, to be an attribute of both states. And if they are both modes of consciousness, then the only further question to be considered is, whether there is any fundamental difference between them, such as would warrant physiologists in assuming the existence of an organic centre for the realisation of sensations, altogether distinct and apart from that whose functional activity gives rise to perceptions; or whether the two words are applicable only to the extremes of a series between whose terms there are the most innumerable and insensible gradations? If the latter view be the correct one, if the difference is one of degree rather than of kind, then we should be much more consistent in regarding sensations and perceptions as arising from the activity of one and the same organ; and from a consideration of this question we may, therefore, derive some help towards the correct interpretation of the results of operations on the brains of certain lower animals, which have hitherto given rise to much discussion amongst physiologists.

Professor Bain has well shown, in his "Emotions and Will," how sensation in its most strict acceptation does insensibly merge into that which is more usually spoken of as perception. He shows that the more "sensation involves cognitive or intellectual processes, the more liable is it to fall under the title of perception." "Some sensations," he says, "are mere pleasures and pains, and little else; such are the feelings of organic life, and the sweet and bitter tastes and odours. Others stretch away into the region of pure intellect, and are nothing as respects enjoyment or suffering; as, for example, a great number of those of the three higher senses." But it seems to us that Mr. Bain stops short of the truth when he says,† "the lowest or most restricted form of sensation does not contain an element of knowledge." It does not contain knowledge, it is true, in its highest sense, involving affirmation and belief, but as a state of consciousness it is

* Collected works of Dugald Stewart, edited by Hamilton, vol. ii. p. 14.
† Loc. cit. p. 586 (Second Edition).

inseparable from knowledge in its essence, which implies *discrimination of difference or agreement*. We, in common with others, would rather believe that no sensation, not even the simplest, can exist without the elements of cognition being at the same time present in consciousness.

The word perception has, undoubtedly, been used for the most part to signify something which may be termed an intellectualised sensation, and in the purest form of it the amount of mere feeling is reduced to a minimum, whilst the amount of intellectual action involved has undergone a corresponding increase. A perception is a fully elaborated sensation, from which we derive our notion of the nature of an external object—such object being recognised immediately and intuitively, not so much by the mere light of the single present impression, as by the blending of this with revived memories of all other impressions which have, at various times, been related to the one now present. Thus we get a comprehensive notion of the nature of the external object, though a notion which must, to a certain extent, vary with the individual according to the nature of his previous experience. A savage who had never seen gunpowder before, would have a very different notion called up by the sight of it, from that with which a European would be inspired who well knew its composition and properties. To the one it would be a simple black powder, and by him it would be perceived more or less simply as belonging to this category; whilst the other's notion of the same substance would be more complex, containing ideas as to the ingredients of which it is composed, and as to the effects which it is capable of producing by explosion in various ways. But between such states of knowledge, and others which might be regarded as the simplest specimens of mere feelings or sensations, there is not a difference in kind, only one of degree. Any sensation, however simple, can only be recognised as such—can only be revealed in consciousness—inasmuch as it presents a certain quality or qualities, by which it can be differentiated from or classed with previous states of feeling. Therefore even the most simple sensation does necessitate the existence of intellectual activity, since discrimination is the most fundamental mode of intellect. And, in those more complex sensations, generally named perceptions, the only difference, as previously indicated, is that the feeling, as mere feeling, is reduced to its lowest ebb, whilst the amount of intellectual activity, combined in the form of discrimination and memory, has proportionately increased. For by virtue of that association always occurring during the education of the individual between various related sensations, organic and organised relations have been established in the brain, so that a present sense impression rouses simultaneously memories of other past impressions derived from any given object, either by the same or through different avenues of sense; and this blending either actually or potentially of all our past knowledge concerning the same or similar objects with the new impression, goes to constitute our then present perception. "Thus," as we have said elsewhere,* "I see an orange at a distance: this, as an object of visual sense, is simply a rounded yellow area; but past experience has led me to know what are the tactual and muscular sensations usually associated with the sight impressions—how it is really a spherical body with a somewhat rough surface. Then I have learned also that these impressions are usually associated with a certain odour, with a certain taste, a degree of succulence, and certain internal optical characters, including a divisibility into segments, and the possible presence of seeds within. A combination of any of these, or of a host of other revivable impressions, may go to constitute my perception of an orange, and may flash into consciousness more or less simultaneously on the presentation of the object to the visual sense." But as we have previously said, between this comparatively complex resultant, and what would be called a simple sensation, some mere odour or taste, there are other sensations of all intermediate degrees of complexity; and even such simple forms of sensation could not be realised in consciousness without our *knowing* them as sensations possessing such and such characters: to be *known* at all, they must be known qualitatively, and to recognise their qualities is to know them in relation to certain other past impressions which we may have experienced; and thus, in fact, we may look upon it as almost certain, that even the simplest conscious impression can only be known or realised in consciousness so long as intellectual action of some kind is brought to bear upon its recognition.

* "On the Muscular Sense, and on the Physiology of Thinking." (Brit. Med. Journal, May 1869.)

Hence it may be legitimately maintained, that there is the strongest *à priori* objection to the view which has been so generally held amongst physiologists, that there is an inherent difference between a sensation and a perception, and that there are distinct nerve-centres, by the activity of which such states or acts respectively are called into being. And whilst psychological evidence is thus strongly in favour of the supposition that all sensations, whether simple or complex, do reveal themselves in one organ only, we think we shall also be able to show that physiological evidence is, moreover, quite in harmony with the opinion that the cerebral hemispheres themselves are the sole seats of consciousness, whether for simple sensations or for complex sensations; and that there is no lower organ for "mere sensations" only, as they have been termed—no *sensorium commune* as ordinarily understood, in which impressions reveal themselves in consciousness before impinging upon the cortical grey substance of the cerebral hemispheres.

H. CHARLTON BASTIAN

MISTLETOE

WHEN the leaves are rotting on the ground, and the fruit has been converted into cider, the orchards of Herefordshire and Worcestershire still retain something of their verdant hue, and are green with what seems at first to be untimely foliage. But mistletoe cannot be unseasonable at Christmas, and there are those who would be glad to have it in season "all the year round." The supply from the West Midland Counties is practically inexhaustible, for it has been calculated that from 30 to 90 per cent. of the apple-trees are infested by this parasite, two or three boughs of which may sometimes be seen dependent from some old cankered limb. Its presence is at once the cause and the sign of incipient decay. A struggle for life between the tree and its enemy has begun, and, if the pruning-knife or the demands of Christmas do not interfere, the mistletoe will slowly and surely exhaust the branch upon which it grows, penetrating further and further into the wood as the supply of sap recedes, and ever sending forth fresh roots in place of those which were overpowered at first. The severity of the struggle between these seemingly unequal foes may be sometimes seen in the strange fantastic contortions into which the branches twist themselves, and sometimes in the withered aspect which the whole tree wears when, as Shakespeare says, it stands

> Forlorn and lean,
> O'ercome with moss and baleful mistletoe.

The entire existence of this parasite is full of interest, even though the mystery of its birth has been removed. Modern research confirms the accuracy of the old distich which expresses thus its origin:—

> The thrush, when he pollutes the bough,
> Sows for himself the seeds of woe;

and perhaps the increase of mistletoe may be partly attributable to the disuse of its product (bird-lime), and the greater immunity which thrushes in consequence enjoy. But those who desire to do so may easily propagate mistletoe without their intervention. All that is necessary for success is to introduce very carefully a few seeds into a shallow notch made in the bark of an apple-tree, and bind it round delicately with bass or damp moss. The apple-tree is the surest stock, for, though it is found elsewhere, yet there is a certain constancy in the apparent caprice shown by the mistletoe in the selection of its victims. It occurs frequently on the poplar, hawthorn, willow, and lime; never on the beech, holly, cherry, and walnut; rarely on the chestnut and pear, and only in some few known instances upon the oak. Probably the rarity of its occurrence on the oak contributed to the reverence with which, under those circumstances, it was regarded by our British ancestors. To them a mistletoe-oak was a tree beloved of heaven—a symbol of life and death—a promise of renewal of strength to the leafless monarch of the glade. When the New Year's festival came round, the Arch-Druid, clothed in white, mounted the tree, and cut the mistletoe with a golden sickle. As it fell into the white cloth held to receive it, two white bulls also fell to the ground as sacrificial victims; and the prayer went forth from the Druid's lips that God would prosper his gift, and make it a charm potent against poison, and a certain cure for sterility.

It is curious to notice how this traditional connection between the mistletoe and New Year's Day, and a belief in its virtues, have survived among the natives of the Western Marches. In Herefordshire, at any rate, no mistletoe enters into the Christmas decorations of house and church; but on New Year's Eve, many of the old farmers and cottagers still go forth to cut their bough, and hang it up with all solemnity as the clock strikes twelve. Nor are the medical properties of the mistletoe forgotten by them. Before turnips were extensively cultivated, old Tusser's precept was regularly followed:—

> If snowe doe continue, sheepe hardly that fare
> Crave mistle and ivie for them for to spare.

And even now faith in the virtues of the plant (which is in fact a gentle tonic) may here and there be found. "What is mistletoe good for?" asked Dr. Bull of a Herefordshire rustic. "That do depend on what tree it comes from," was the reply. "It be a very fine thing for fits. My father had the 'leptic fits for many years, but nothing never did him no good like mistletoe from the haw, mixed with wood-laurel, and he took nothing else. They do tell me that mistletoe from the maiden ash be a fine thing for convulsives. I know when you get it from the maw-pell it's good for animals. It's capital for sheep as don't go on well at lambing-time, and for cows too. That as comes from the apple-tree and poplins is the best to hang up in the house on New Year's Day for good luck through the year; but a many people use any that comes first. A piece of mistletoe from the haw—*from the haw*, sir—chopped in pieces and given to a cow after calving, will do her more good nor any drench you can give her." Sir Thomas Browne mentions the practice of thus administering it among his "Vulgar Errors," but at least it is one not likely to be attended with evil consequences.

The reason of the exclusion of mistletoe from church decoration may be gathered from what has already been said, and to this we must add, that its appearance there might be likely to suggest something more ardent than "the kiss of peace." But in hall and cottage alike the mistletoe reigns supreme at this season, and in London and other great towns the artisan spends a small portion of his Christmas wages in the purchase of a few sprigs wherewith to decorate his house and bring good luck to its inmates. From Herefordshire and Worcestershire between 200 and 300 tons of mistletoe are annually exported, and during the present week nearly every train from the West Midland district bears with it a truck-load of branches, fraught with we know not what romance, and bright with berries wherein is contained the destiny of the coming year.

THE MIDNIGHT SKY*

SURELY if ever there were an Astronomy made easy, here it is: if ever there were a sensible Christmas present for a boy, here it is. In fact, it is impossible to commend Mr. Dunkin or the Religious Tract Society too highly for the work which they have jointly produced. It is an honest, scientifically sound, beautiful book, with appeals both to the eye and the mind: one in which the magnificence of the heavens and the deep teachings of modern science go hand in hand, until at last the unscientific reader will certainly find himself deeply interested in the discussion of questions, and the following-out of reasonings, which but a few short years ago were generally supposed to furnish day-dreams to solitary astronomers, who dwelt in towers far removed from the ken of their fellows, and still further removed from their pursuits and interests.

That such a state of things is past and gone, and that the glories of the firmament are now eagerly revelled in by thousands, ay, and even tens of thousands, is in the main owing to the publication of such books as the "Midnight Sky," and the many handy series of star-maps which Mr. Proctor and others have produced.

The book contains carefully drawn views of the midnight sky, at London, looking north and south, for every night in the year. These views are accompanied in each case by an index-map giving the names of the principal stars. In order that these maps may be utilised at any other hour than midnight, Mr. Dunkin has provided the observer with a tabular statement which gives at one view the hour and month when each diagram of the series is available for comparison with the sky. The descriptions appended to these maps are clearly written in a style which will not be found beyond the comprehension of the least scientific reader. Mr. Dunkin next gives a description of the midnight sky of the southern hemisphere, in the months of February, May, August, and November. Following these articles and star-maps, we find an interesting account of the constellations, general notes on the milky way, the magnitudes, scintillation and colour of the stars, analysis of solar and stellar light, the observatories in the southern hemisphere, and remarks on nebulæ and clusters. Notes on the sun, moon, and earth, the major and the minor planets, succeed, and the work is concluded by a full account of meteors and shooting stars, a copious index serving to give increased usefulness to the book.

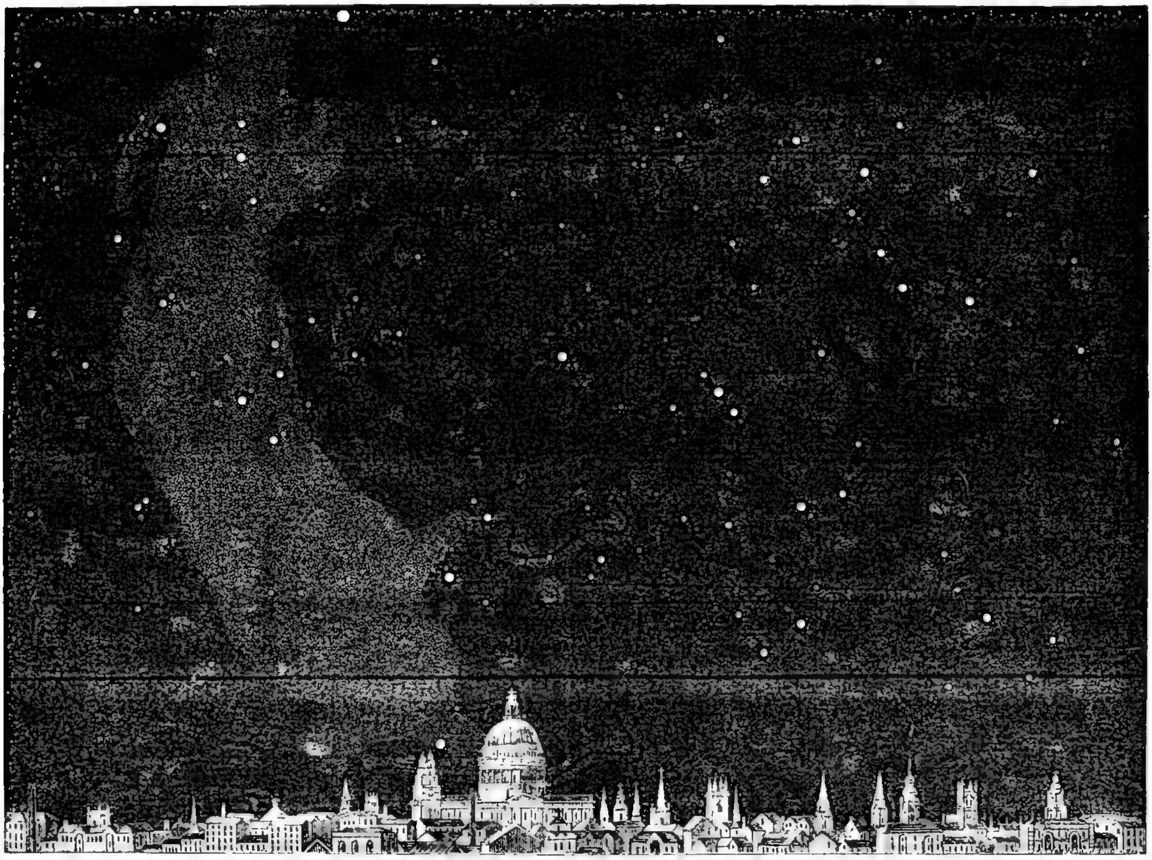
The Religious Tract Society has done wisely in entrusting the writing of these familiar notes to an astronomer of such high ability as Mr. Dunkin. Not only have we at once a guarantee of correctness in the facts themselves, but there is insured that freedom of style which only an intimate acquaintance with a subject can give, and, in the case of such a far-reaching and intricate science as astronomy, this consideration is of high importance—witness the flabby books written by incompetent men.

In the latter part of the work, which forms a sort of treatise on astronomy, Mr. Dunkin dwells among other matters on solar eclipses, and gives several very interesting anecdotes connected with them which we do not remember to have seen in print before. In the notes on the sun we detect a little hasty writing, which the author will do well to correct in subsequent editions. In the first place the hydrogen is the sun's chromosphere, is not in a state of *combustion* but of *incandescence;* and M. Le Verrier gets credit for an assertion he made in 1860, which, had Mr. Dunkin printed the context, would be evidently absurd, according to our present knowledge. Father Secchi is credited too with having proved satisfactorily the hollow

* "The Midnight Sky." Familiar Notes on the Stars and Planets. By Edwin Dunkin, F.R.A.S., Royal Observatory, Greenwich. Thirty-two Star-maps and other Illustrations, pp. 326. Religious Tract Society.

structure of sun spots, the fact being that Father Secchi has only clumsily followed in the footsteps of others, and has contradicted himself in the process. We might have expected also a little notice of the bearing of the recent work on the theories of the constitution of the sun and with the timid, feeble, faith-lacking tone of many of the more modern orthodox.

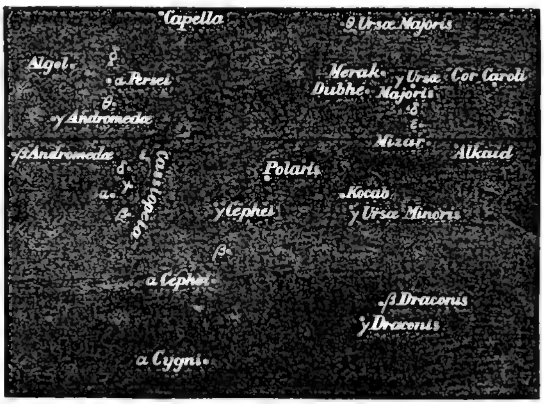
Besides the star-maps and key-maps, specimens of which we give, there are excellent telescopic views of the star-cluster in Perseus, the moon, comets, &c., and drawings of Sir



NORTHERN HEAVENS AS SEEN FROM LONDON JANUARY 15 (MIDNIGHT)

stars, and of the new theory, based on that work, which has been put forward.

But enough of criticism. No; we have a little more. We think the last chapter out of place, or at all events very unhappy in its treatment, and we believe that Bishop Hall would have thought so too, and we commend the following extract from his Contemplations* to the attention of the Religious Tract Society:—"Human learning, well improved, makes us capable of Divine. There is no knowledge whereof God is not the author: He would never have bestowed any, that should lead us away from Himself. *It is an ignorant conceit, that inquiry into nature should make men atheistical.*" This remarkable passage contrasts strongly

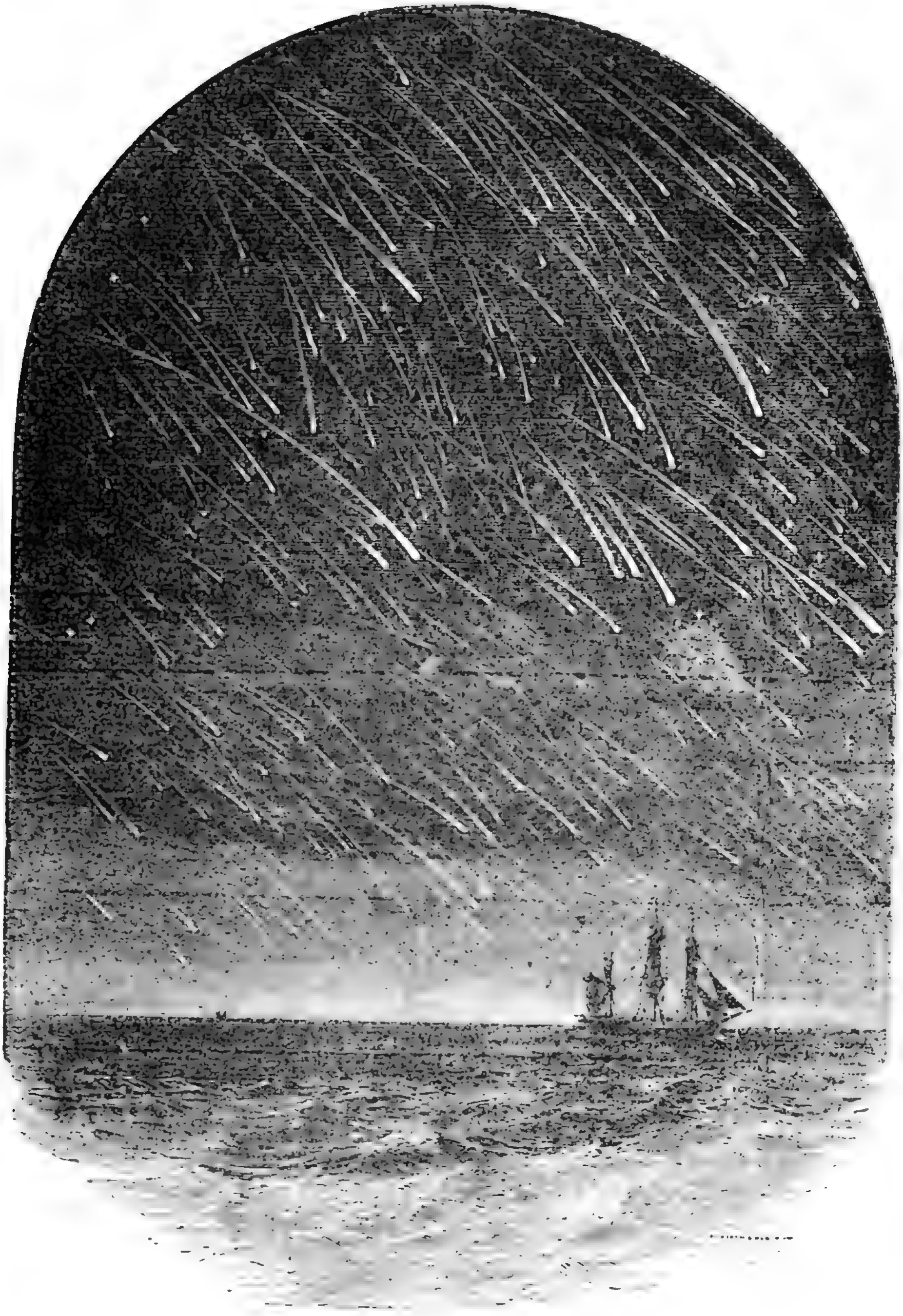


KEY-MAP

W. Herschel's forty-foot reflecting telescope, the Royal Observatory in Flamsteed's time and to-day, the great Equatorial in the Royal Observatory, and of many more interesting subjects either astronomical in themselves or connected in some way with the science. From these we have chosen an exquisite wood-cut representing a meteoric shower as seen off Cape Florida. We know no better way of giving our readers an idea of these splendid phenomena visible so rarely, than by placing this plate before them. With our ordinary experience of meteor showers, even including the brilliant one of 1866, it is almost impossible to believe that such a splendid sight should ever have been realised, but the many published accounts which we have, leave no doubt that here also Nature had beggared description.

F.R.S.

* Vol. ii. Book I. p. 25



METEORIC SHOWER AS SEEN OFF CAPE FLORIDA

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Variety and Species.

IN a recent number of NATURE I noticed an extract from a paper read before the Literary and Philosophical Society at Manchester, on the subject of variety as distinguished from species. The author suggests the question, "where does species end, variety begin?" From experiments, he finds that the colours in different parts of the wings of insects treated with, in some cases become toned down to a more sombre hue, in others become mixed with the adjoining colour, and that they are in every case smaller. May not these differences be attributed to the effects of a confined and unnatural life. I myself well recollect rearing a Drinker Moth when a boy at school, and obtaining a small, dull-coloured specimen, instead of an insect whose rich brown wings rival in colour those of the well-known "oak-egger." But difference of colour does not constitute the only variety which is noticed in *Lepidoptera*, for position of markings and proportions of colour are equally worthy of notice, though not so obvious to the unaccustomed eye. Take, for example, the common six-spot Burnet (*Zygæna filipendula*), of which I know three distinct forms—viz. (1), the ordinary one, with three clear spots; (2), having the spots all connected, forming an ill-defined bar of red down the centre of the upper wings; (3), (a form which I believe to be in general very rarely met with, but of which I have myself captured several specimens), having the red markings of (1) supplied by those of a pale yellow, in both upper and under wings. Now, since these were all captured in one field where the three forms are comparatively common, may it not be more than probable that the difference is not to be denominated a variety, but to be a natural dissimilarity of form; not to be attributed to any physical difference of circumstances, previously to the attainment of the state of "imago," but to a purely natural and unassisted cause? A white horse is not considered a variety because his sire was a bay, nor is the whiteness of a bullock considered a *lusus naturæ* if born from tawny parents. I hope to be able to make experiments during the following year, which may perhaps lead to more conclusive results on this subject.

F.

Cuckow's Eggs

I TRUST that, although some time has elapsed since Professor Newton's very able paper on Cuckows' eggs appeared in NATURE, I am not too late to offer a few observations on it, the more so as I have always taken great interest in the breeding of the cuckow. I cannot quite agree with Professor Newton that cuckows' eggs *as a rule* are subject to great variety. The eggs of the Great Spotted Cuckow (*Oxylophus glandarius*) are certainly not subject to much variety; for in a large series from Africa and Spain I have found them closely resemble each other. Of our common cuckow (*Cuculus canorus*) abnormally coloured eggs have several times come under my observation, but I consider them as of very rare occurrence, and in several large series I have seen, but few have struck me as differing much from the usual type.

Of those I possess in my own collection, the most peculiar variety is a large egg, the ground colour of which is a dirty grey, sparingly spotted and blotched with light brown, and somewhat resembling some varieties of the eggs of the Garden Warbler (*Sylvia hortensis*). This egg was found by the late Mr. E. Seidensacher, of Cilli, Styria, in a nest of the creeper (*Certhia familiaris*), with four eggs of the foster-parent, and was sent to prove that the cuckow must have deposited her egg with her bill, as the nest of the creeper was so placed that she could only have got her head in. A German friend of mine, residing near Coblentz, sent me, for inspection, last year, a most peculiar cuckow's egg, which reminds one of that referred to by Salerne. This egg was rather large for that of a cuckow, and of a uniform bluish green colour. He did not, however, state in what nest it had been found.

My own experience in field natural history leads me to confirm the opinion given by Professor Newton, that the same female produces eggs which closely resemble each other; but at the same time I have not found that the same cuckow generally makes use of the same species of bird as nurse for her offspring, and in this I am borne out by several field naturalists with whom I have worked.

My friend at Coblentz wrote to me some time ago, stating that he had observed that the same female cuckow generally produces similarly coloured eggs, and that he had found in a nest of *Turdus merula* a peculiar and abnormally coloured egg of the common cuckow, closely resembling that of the common bunting (*Emberiza miliaria*), and shortly after found in a nest of the Robin (*Sylvia rubecula*), situated close to the blackbird's nest above referred to, another similar cuckow's egg. He further states that the cuckow is not a common bird there, and that he had good reasons for supposing that the two eggs were produced by the same female; also that in 1867 the same thing occurred, when he found peculiarly coloured cuckows' eggs in nests of the Chiffchaff and Willow-wren.

As far as my own experience goes, I cannot testify to the correctness of Dr. Baldamus's theory, as amongst all the cuckows' eggs I have collected, I find scarcely any that resemble those of the foster-parents. I have now before me eggs of our common cuckow taken with the following species, the eggs of which I have with each cuckow's egg, viz.: *Sylvia arundinacea, S. rubecula, Certhia familiaris, Emberiza hortulana, Sylvia palustris, S. cinerea, Motacilla alba*, and *Accentor modularis*, none of which, excepting that found with the eggs of *Sylvia cinerea*, bear any resemblance to the eggs of the foster-parent. The eggs of the American cow bunting (*Molothrus pecoris*) which, like our cuckow, entrusts its offspring to foster-parents, seldom, I believe, resemble those of the foster-parent, and in the instances that have come under my own observation I have found them to differ very widely from the foster-parent's eggs. On the other hand, the eggs of the Great Spotted Cuckow (*Oxylophus glandarius*) are so strikingly similar to those of the common Magpie, in whose nests they are generally placed, that it is often difficult to distinguish them except by handling them, the texture of the shell being very different from that of the magpie's egg. In Spain they are, however, occasionally found in the nests of the Azure-winged Magpie (*Cyanopica Cookii*,) from the eggs of which bird they differ very much.

H. E. DRESSER

Physical Meteorology

IN Mr. Balfour Stewart's suggestions (NATURE, p. 192) he refers, as an illustration of his method, to a frequently falling barometer in the centre of a cyclone while air is rushing in from every side, and asks, "What can carry off the air if there be not an ascending current in the very heat of the cyclone?" I would therefore ask his consideration of the grounds on which, as I believe, such an "ascending current" *must* there take place on the simple principle that great heat has been evolved.

It is well known—(1) That long-continued and heavy rainfall takes place in any area of low pressure with higher pressure outside of it. (2) That the greater part of the rain which falls, during storms, descends in the front part of the atmospheric depression which attends the storm; and (3) That the rainfall is *proportional* to the suddenness and extent of the fall of the barometer. Now, though mere *sequence* does not *prove* a connection as "Cause and Effect," it certainly *suggests* it if the supposed cause be adequate to produce the effect. Let B represent a certain weight, the latent heat of vapour at (10° Cent.) 50° Fahr. is (Regnault 599°.5 Cent.) = 1079° Fahr. But specific heat of air is to that of water as 0.2375 : 1 (Regnault). Consequently B of vapour condensed would heat B of air $\left(\frac{1079°}{0.2375}\right)$ 4543° of Fahr.

When a warm and very moist equatorial current meets and intermingles with a cold polar current (from the known laws of vapour) the column of air, thus mixed, must deposit a certain amount of moisture. Let us assume the mixed stream to be about 1,000 feet in thickness, and that $\frac{1}{10}$ of an inch of rain falls suddenly on the surface. 1,000 cubic inches of air weigh about 310 grains, and $\frac{1}{10}$ cubic inch of water about $25\frac{1}{4}$ grains. Consequently, the latent heat of this $\frac{1}{10}$ inch of rain would heat the air of the 1,000 feet column $\left(\frac{4543° \times 25\frac{1}{4}}{310}\right)$ 370° of Fahr. which *must* occasion an enormous ascending current of air, thereby producing a sudden diminution of the pressure at the surface, and causing a large influx of air to restore the equilibrium.

We know that "whirlwinds" arise from "local heating" (as in dust-storms or prairie-fires); hence a like effect must result from such local evolution of heat through the condensation of atmospheric vapour, and the heated column of air will ascend (as a whirlwind in the upper strata) *before* the like effects are produced at the surface.[1] In his remarks on the great storm (at Nassau, October 1866), Captain Chatfield observed, "that (during the calm) while the vortex of the storm was passing over the harbour, the atmosphere was most oppressive, and the clouds in the zenith appeared to be revolving rapidly." Under certain modifying circumstances, the same *vera causa* will, I believe, account satisfactorily for the phenomena of "hail-storms," "water-spouts," &c. But I am unwilling to trespass too much on your space.

Glenville, Fermoy HENRY HUDSON, M.D.

A Cyclone in England.

IT is so seldom we get a cyclone so well developed in these latitudes, that I have thought the following observations would interest the readers of NATURE.

Noon.	Barometer,	29.678.	Wind,	S.S.W.	Estimated force,	4
4 P.M.	,,	29.304.	,,	S.W.	,,	9
6 P.M.	,,	29.205.	,,	W.	,,	10
9.40 P.M.	,,	29.342.	,,	W.N.W.	,,	9
11 P.M.	,,	29.391.	,,	N.W.	,,	7

It will be observed the wind began to freshen from the S.S.W. with a falling barometer; it then veered to S.W., W.S.W. to W., the barometer falling the whole time. When the wind arrived at W. the storm was at its height and the barometer a minimum. The wind then veered W. by N., W.N.W. to N.W., gradually becoming less violent, and the barometer rose during that time. The storm lasted about twelve or fourteen hours.

From the above, I deduce that Plymouth must have been in the southern half of the cyclone which travelled eastward; hence, probably, more damage must have been done further north than here.

I should feel obliged by any reader of NATURE living in the North or East of England, giving the results of his observations during the storm. F.R.A.S.

Plymouth, 17th December, 1869.

Lectures to Ladies

I HAVE only just seen the letter in NATURE, signed "M.A.B.," on the subject of the hour chosen for lectures to ladies. I most sincerely hope that the morning hour will be continued. It is certainly to be regretted if this arrangement is inconvenient to ladies engaged in teaching; but to the far larger number who are not so engaged, any other hour would be prohibitory.

In addition to the constant inconvenience entailed on ladies by the necessity (or supposed necessity) of their being "fetched and carried" every time they go out after dark, all ladies living ordinary lives in quiet homes, know very well that it behoves them to get their "occupations" done in the day-time, and that if they began attending courses of lectures in the evening, their fathers, husbands, and brothers would be apt to raise a pretty forcible outcry against the advance of female education.

If I might venture to make a suggestion, it would be that South Kensington is a very long way from everywhere else, and that a more central situation would add very much to the convenience of those who come from a distance. I am sure that no one who attended Professor Huxley's course of lectures just concluded, begrudged the time and trouble it cost them to get there, or thought it anything but well bestowed; at the same time a shorter and more manageable expedition would be a great boon to many. M. T. G.

NOTES

THE Gold Medal of the Royal Astronomical Society has, we are informed, been this year awarded to M. Delaunay, one of the greatest of living mathematicians and astronomers, for his many important investigations. We are sure that English astronomers will hail this award with the liveliest satisfaction.

THE question of Meteorological Standards is, we learn, now occupying the attention of the Royal Society Council. We may hope, therefore, that the revision which has so long been needed will now take place.

THE Lecturers named for the Friday Evening Meetings at the Royal Institution, before Easter, are Prof. Tyndall, F.R.S., Prof. Odling, F.R.S., Prof. Ruskin, Dr. W. B. Carpenter, F.R.S., Mr. W. K. Clifford, Colonel Sir Henry James, F.R.S., Mr. E. J. Reed, C.B., Chief Constructor of the Navy, Prof. Sylvester, F.R.S., Mr. P. W. Barlow, F.R.S, Prof. Rolleston, F.R.S., Prof. Roscoe, F.R.S., and Prof. Huxley, F.R.S. Prof. Tyndall's discourse will be on "Haze and Dust," and will probably be delivered on the 21st of January. Dr. Odling proposes to lecture on "Prof. Graham's Scientific Work;" Dr. Carpenter on "Temperature and Life in the Deep Sea," and Prof. Sylvester on "Chance."

THE Keith Prize of the Royal Society of Edinburgh was awarded on Monday to Professor Tait, for his paper on the rotation of a rigid body about a fixed point.

THE Professorship of Botany in the Royal College of Science, Dublin, is now vacant, Professor Wyville Thomson's resignation having been accepted by the Science and Art Department.

THE following lectures will be given in the course of the present session of the Chemical Society:—On Vanadium, by Dr. Roscoe; on Refraction Equivalents, by Dr. Gladstone; and on the Platinic Ammoniums, by Dr. Odling.

THE subscriptions to the Faraday Monument Fund, received up to Dec. 7, amount to £1,400. The object of the fund is to provide a public memorial to Faraday, and the subscription from one person is not to exceed five guineas.

PROFESSOR CARL VOGT, of Vienna, is actively engaged in the formation of an Anthropological Society for Austria.

DR. S. COULL MACKENZIE has been appointed to the professorship of Hygiene in the Calcutta Medical College.

IN a new quarterly journal devoted to public hygiene, and produced at Brunswick, in Germany, we find a carefully-written article upon English institutions for hygiene, and English factories. There are also contributions upon army hygiene, barrack reform, and drainage. The journal is edited by Prof. Riclam, of Leipzig.

THE Argenteuil Prize has been awarded by the Academy of Medicine of Paris in the following way:—To Mr. Corradi, of Florence, 5,000 francs; to MM. Mallez and Tripier, 2,000 francs; to M. Reliquet, 1,000 francs.

THE General Secretary of the Academy of Vienna has published as a *tirage apart* from the almanack of the Academy, a biographical sketch of Karl Ludwig Freiherr von Reichenbach, who, after a long and distinguished scientific career, died in January last at the advanced age of eighty-one. Dr. Schrötter divides the period of Reichenbach's scientific activity into three parts: the first, that of practical work and exact research, during which he enriched mankind by the discovery of paraffin and creosote; the second, that which he devoted to the study of meteorites, a study in which his enthusiastic mind led him beyond the boundary of accurate science; and, lastly, the time when he gave himself up to the investigation of so-called animal magnetism and the imaginary odic force by which he sought to explain the phenomena he thought he had discovered. Dr. Schrötter rightly concludes, that however far astray Reichenbach may have been led by his odic notions, he earned for himself an honourable place in science, his very errors being those of a highly-gifted man.

WE have received the first part of the volume recording the scientific results of the travels of Baron Claus von der Decken in East Africa, during the years 1857–1865. The materials have been worked up by Peters, Cabanis, Hilgendorf, Ed. von Martens, and Semper, and comprise Mammalia, Birds, Amphibia, Crustacea, Mollusca, and Echinodermata. The part before us is illustrated by thirty-five lithographic plates of great beauty, most of them being carefully and delicately coloured. The second part, which is to contain the Insects and Spiders, has been entrusted to Gerstäcker.

DR. OLDHAM, the president, has communicated to the Proceedings of the Asiatic Society of Bengal some interesting notes on remains found in a Cromlech at Coorg. This Cromlech was opened out by the order of the Chief Commissioner of Mysore, on the Moory Betta Hill, in North Coorg. The relics consist of small earthenware vessels, as well as several beads and tubes bored through, and evidently portions of necklaces. These last are of the colour of agate, and have circles in white around them, with zigzag pattern in white in the centre.

IN the early part of last year Dr. Francis Day, F.L.S., F.Z.S., was commissioned to examine the important subject of the Indian River Fisheries. The result is the publication of an interesting and comprehensive report. Dr. Day's observations were at first directed to the fresh-water fisheries south of Madras. He personally inspected the Coleroon anicuts, and then extended his researches to the places lying between these anicuts and the sea. Dr. Day commenced his examinations with the Cauvery river, which runs a course of a hundred miles in the Tanjore district, where it gives off four large branches. At the island of Serungum, the Coleroon becomes the main channel. At this point an anicut was erected in order to raise the water to a height of six feet by means of a wall or barrier, to which the native name of anicutta or anicut was applied. It was subsequently found necessary to erect a regulating dam upon the head of the Cauvery. This dam consisted of a flooring across the stream, with a slip at each extremity 76 feet long, 2·4 feet above the low or middle portion. On the northern waterway of this anicut there are sluices with vents 8 feet in width. It is stated that when, during the freshets, the fish cannot surmount the dam, they make their way up the river through these vents. During the last few years the decrease of fish in the Coleroon is said to be considerable, though Dr. Day does not entirely endorse this assertion. The most valuable fish in the Coleroon was formerly the oolum, or sable fish, culpea (alausa), palasah, C. and V.; but since the erection of the anicut they have seldom been found. It is asserted that in 1836 the value of the sable fish captured in the river near Trindinopoly was equal annually to about two lacs (£200,000). They were principally taken for their roe; but when in condition they are described as splendid eating. Unless something is done, this fine fish, and others of value, will become extinct in the Coleroon. Dr. Day points out how necessary it is that some means may be tried to enable the fish to ascend the river above the anicut, that the ova may be deposited in sufficiently deep water.

ACCORDING to the *Boston Advertiser*, an upheaval is taking place in the harbour at Machias port, Maine. Vast quantities of water, mud, and stones are being thrown up to the distance of many feet with a loud rushing noise. During last summer this occurrence was frequently noticed.

A GERMAN translation of Mr. Wallace's work on the Malay Archipelago, by Dr. Adolf Bernard Meyer, has just been published by Westermann of Brunswick.

Mr. M. J. Barrington Ward, B.A., F.L.S., Scholar of Magdalen Hall, Oxford, has been appointed Natural History Master at Clifton College.

WE have to record the appearance of the sixth, seventh, and eighth supplementary volumes of the Annals of the Munich Observatory. The first contains the meteorological observations from 1857 to 1866; the second a similar series taken on the Hohenfreissenberg from 1851 to 1864; and the last, a catalogue of 6,323 telescopic stars between + 3° and + 9° declination which occur in the Munich zone observations, reduced to the commencement of the year 1850, together with comparison of the observations of Lalande, Bessel, Rünker, and Schiellerur.

THE second part of the results of the Geological Survey of the West Indies has just been issued under the title "Reports on the Geology of Jamaica." Pending a complete notice of this important volume, we may mention that it contains in its first thirty-seven pages a general description of the physical geography of the island, with outlines of the different formations. The body of the book consists of the details of the lithological structure of the various districts. Appended to the volume is a report by Mr. Etheridge, Palæologist of the British Survey, on the organic remains. He has not only examined and classified these remains, but has also referred them to their equivalents in the cretaceous and tertiary deposits of Europe. Sir Roderick Murchison, in his preface, calls special attention to the interesting results of Mr. Etheridge's work.

THE Royal Irish Academy have voted the following sums of money out of their special parliamentary grant for scientific purposes:—30*l.* to the Rev. Eugene O'Meara, A.M., to enable him to continue his researches on the Irish Diatomaceæ; 30*l.* to H. Hennessy, F.R.S., to determine the molecular condition of fluids and their motion, when in rotation and in contact with solids; 20*l.* to J. Bailey, to carry out experiments on "Flitch Beams;" 20*l.* to B. B. Stoney, to try experiments on riveted joints. All the reports on these subjects will appear from time to time in the "Transactions and Proceedings of the Academy."

A SERIES of very beautiful photographic negatives has been taken of all the more important antiquities in the Museum of the Royal Irish Academy. The Council of the Academy intend to have these printed from, and the prints to be sold both separately and in series.

WE hope shortly to give an article on a new artificial light suitable for the production of photographic enlargements, by Dr. Van Monckhoven.

THE following is the result of the National Sciences Tripos, at Cambridge, in which the examiners were—J. Hooker, LL.D., W. H. Miller, M.A., O. Fisher, M.A., C. Trotter, M.A., and J. B. Bradbury, M.D. Class I. Ds. Watson, Queen's.—Class II. Ds. Kilner, St. John's; Maxwell, King's; Lupton, Trinity; Lees, Trinity; Stirling, Trinity; Simpson, Caius; Calliphronas, Caius.—Class III. Ds. Alliot, Pembroke; Johnson, Jesus; Banham, St. John's; and Colvin, Trinity—equal; Young, Caius. A prize offered by the Professor of Botany has been adjudged to M. J. Barrington-Ward, B.A., Scholar of Magdalen Hall.

WE have received the following note with regard to the Holborn Viaduct:—"The Report of the Engineers, published in the daily papers, entirely endorses the opinion expressed in the note I previously sent you. The only difference between it and my explanation arises from the fact of the insertion in the joints of lead-packing near the outer edge of the stone, which of course exaggerates the evil of a 'concave face.' The variation of temperature which has been dwelt upon as the chief cause of failure is evidently in the opinion of the engineers quite inadequate to account for it."

MR. MELDRUM has kindly forwarded us the following note:—"A strict watch was kept at the Mauritius for meteors during the nights of the 12th, 13th, and 14th November, and the expected shower was seen on the morning of the 14th. Between midnight of the 13th, and 4·40 a.m. of the 14th, 439 meteors were counted at the Observatory, Port Louis, by three observers. Of that number, 427 were seen between 3·20 and 4·40 a.m. Sir Henry Barkly, at his country residence, 7 miles from Port Louis, counted 192 between 3·15 and 4·15 a.m. At my residence, 5 miles from Port Louis, 434 were counted between midnight and 4·40 a.m., by two observers up to 4 a.m., and then by four observers. Between 3·14 and 4·24 we counted 370, and between 3·55 and 4·13, 215. The greatest number seen by Sir Henry Barkly in an interval of five minutes was 33 between 3·55 and 4·0, but he saw only a small portion of the heavens. I have not had time to analyse the observations carefully, but the time of maximum intensity was about 4·09 a.m. The only source of doubt in this subject arises from the circumstance that after 4·15 daylight was setting in. I have no doubt that the radiant point was somewhere within the sickle of Leo, but I am not sure as to its exact position. Most of the meteors shot westward along the ecliptic, through Gemini and Taurus, but others in all directions. The trains of light and the nuclei were generally white, with a slight tinge of green, but all the prismatic colours were seen. The time of duration of the flight was from the fraction of a second up to 6 seconds, and the longest trains about 40°. At one time gleams of light of various forms appeared in Leo. I had a small hand-spectroscope, but the times of duration were too short for using it."

SCIENTIFIC SERIALS

The *Moniteur Scientifique* for December 1 contains a translation of Dr. Williamson's memoir of the late Professor Graham, which appeared in the first number of NATURE, a review of contemporary physics and astronomy, a long notice of M. Paul Champion's work on the ancient and modern industry of China, and the usual accounts of new patents and meetings of scientific societies. The number for December 15 completes the volume for 1869, and gives elaborate tables of contents. The remaining space is devoted to reports of the proceedings of the Academy of Sciences, abstracts of papers, notices of new publications, and an account of the new development of the trade in false autographs.

The *Revue des Cours Scientifiques* for December 11 contains a translation of an essay by Helmholtz on Goethe as a naturalist and a physicist, an article on the boring of Mont Cenis by M. A. Cazin, and a translation of Professor Williamson's memoir of Graham, contributed to our first number. The greater portion of the number for December 18 is occupied by a translation of a paper on the Centenary of Humboldt, read before the Boston Natural History Society by Professor Agassiz. It also contains lectures on Palæontology by M. A. Gaudry, and an important paper on the Mortality of Women in Labour, by Professor Lorain.

In the *Philosophical Magazine* for this month, Mr. C. Tomlinson, F.R.S., gives an account of Van der Meusbrugghe's important treatise on the Superficial Tension of Liquids, in which the movements of camphor on the surface of water are shown to form a particular case of a general theory. Mr. W. H. Preece contributes a proof of the Parallelogram of Forces, and Dr. Odling a note on Condensed Ammonia Compounds. Professor Kengott's Microscopical Investigation of the Knyahynia Meteorite, and M. Abich's paper on Hailstorms in Russian Georgia (both of which are accompanied by plates), are well deserving of attention.

In the *Chemical News* for December 17, Mr. Edwin Smith describes an interesting series of experiments on the Electrical Phenomena of Plants, suggested by a chapter in Becquerel's treatise. A paper read before the Glasgow Philosophical Society by Mr. R. R. Tatlock, F.C.S., on the Estimation of Iodine and Bromine, with special reference to the Analysis of Kelp, is reproduced. Mr. W. T. Suffolk, F.R.M.S., continues his useful articles on Microscopical Manipulation; and Mr. H. C. Sorby, F.R.S., describes the application of the Spectrum Microscope to the Valuation of Wines. In a paper on the Constitution of the Compounds of Sodium, Mr. J. A. Wanklyn, F.C.S., adduces new arguments in support of his opinion that the metal sodium had a polyvalent character. The books noticed in this number are Dr. Bence Jones's Memoir of Faraday, and a treatise on the Leclanché Battery. Correspondence from Dr. Mennier and Dr. J. H. Gladstone, and Chemical Notices from Foreign Journals, make up the rest of the number.

A Paper by M. Felix Plateau, on the Flight of the Coleoptera, read before the Physical and Natural History Society of Geneva, in September last, has just been published in the *Bibliothèque Universelle et Revue Suisse*. The conclusions arrived at are as follows:—(1), The difference of flexibility between the two edges of the wing are not sufficient to account completely for the phenomena of flight. (2), The wing makes a wide angle with the plane in which it moves. (3), It is deflected more rapidly than it is elevated. (4), The extent of surface of the wing is greater in the movement of deflection than in the movement of elevation. The influence of the elytra, their form and mode of action, as well as some other considerations, are reserved for a memoir which the author hopes to publish shortly.

ASTRONOMY

Oppolzer communicates to the *Astronomische Nachrichten* the following elements of Comet II., 1869:—

$$\tau = \text{Oct. } 9{\cdot}266 \text{ Berlin mean time.}$$

$$\left.\begin{aligned}\pi &= 139^\circ\ 1'\ 13''\\ \Omega &= 311^\circ\ 27'\ 51''\\ \iota &= 111^\circ\ 26'\ 40''\end{aligned}\right\}\text{Mean Eq. 1869–70.}$$

$$\log.\ q = 0{\cdot}09014^\circ$$

Professor C. H. F. Peters, of Clinton, N.Y., has discovered still another new planet, 9·7 mag., the elements of which are as follows:—

$$\tau = 1869, \text{ Oct. } 0{\cdot}0 \text{ Berlin mean time.}$$

$$\begin{aligned}M &= 338^\circ\ 1'\ 47{\cdot}7''\\ \pi &= 53^\circ\ 8'\ 20{\cdot}8''\\ \Omega &= 5^\circ\ 3'\ 52{\cdot}2''\\ \iota &= 8^\circ\ 9'\ 59{\cdot}4''\\ \phi &= 16^\circ\ 43'\ 30{\cdot}2''\\ \mu &= 808''32\\ \log.\ a &\ \ 0{\cdot}428281\end{aligned}$$

SOCIETIES AND ACADEMIES

LONDON

Royal Astronomical Society, December 10. — Second Meeting of Session. Admiral Manners, president, in the chair during the early part of the meeting; afterwards (the president finding his health not sufficiently restored to enable him to remain), Mr. De la Rue, F.R.S., vice-president, took the chair. The minutes of the last meeting were read and confirmed, and thirty-two presents announced, including a magnificent representation of the solar spectrum from France (showing the part beyond the violet end), presented by Mr. Ladd. Mr. Williams, the assistant secretary, then read a series of extracts from an elaborate work on Chinese Astronomy, upon which he has been engaged during the last three years. He exhibited in a very complete and lucid manner the Chinese mode of reckoning time by cycles of sixty years, the several years of each cycle being indicated by certain characters called Kea Tsze. He then showed how any year in ordinary chronology, whether B.C. or A.D., can be represented in the proper cycle, and in its right place in that cycle. He described the division of the heavens into thirty-one parts; three, called "Yuen," of large size; the remainder, called "Suh," representing lunar houses, and very irregular in extent, both from east to west and from north to south. While one, for instance, extended north and south from Perseus to Canopus, another consisted mainly of a few stars in the head of Orion. Other extracts exhibited the correctness of the positions assigned by the Chinese to the equinoxes and the solstices, and the evidence their estimates give respecting the date at which their observations were made. He mentioned *inter alia* that the Metonic Cycle had been known to the Chinese astronomers 2,000 years before Meton's day. The occurrence of the names of our modern asterisms in Chinese records must not be held to indicate the antiquity of our constellation-figures, because it cannot be doubted that the Jesuits taught the Chinese these new names. In fact, the Chinese were led to remodel their system of astronomy according to the instructions of the Jesuits—a misfortune, perhaps, since, al hough the old system of astronomy had had the disadvantage of being inexact and scarcely intelligible, the change destroyed many of the clues by which we might have found clearer ideas as to what the Chinese astronomers really meant to record.—The Astronomer Royal indicated his high opinion of the value of such researches as those in which Mr. Williams had been engaged. Astronomy is the science which of all others brings most together the past, the present, and the future, and, therefore, all studies of long past eras, even though the astronomical observations then made were comparatively inexact, cannot but have a high value. Mr. Stone, F.R.S., called attention to the general value of the matter brought before the society's notice by Mr. Williams, but expressed his regret that the Chinese records named only the day on which any phenomenon was observed. Mr. De la Rue then mentioned that the greater part, if not all, of Mr. Williams's work, would be printed in the Society's Memoirs.—The Astronomer Royal described an arrangement for correcting atmospheric chromatic dispersion, even simpler than those he had before devised. It had occurred simultaneously to himself and to Mr. Simms, the optician, and consists simply in giving the eye-glass of an eye-piece such a motion that while the face towards the field-glass presents an unchanged curvature, the other face (plane) is slightly inclined. This is clearly equivalent to the addition of a prism to the eye-glass, only there is no loss of light, as there would be were a separate prism added. The new eye-piece will serve also to correct errors in the centreing of an object-glass.—Professor Cayley discussed certain geometrical relations connected with the problem of determining the place of a body revolving round the sun, from three observations. He remarked that each observation shows that the body lies on a known line. If we take these three lines in space, what the problem really requires is, that we should determine the position of a plane passing through the sun, and intersecting these lines so that a conic through the points of intersection should have the sun in its focus, and the areas between vectorial radii to the points proportional to the two observed time-intervals. He then considered the locus of the orbit-pole, (1) for an assumed eccentricity, (2) for an assumed period, on a stereographic projection of a portion of the sphere—equal in extent to one half, but not actually a hemisphere. The *loci* for poles to *real* orbits—that is, orbits having all three points on one branch—exhibit a singular figure, the true locus having *points d'arrêt* on the bounding-lines of the half-sphere of projection. In answer to questions by the Astronomer Royal, Mr. De la Rue, and Mr. Stone, Professor Cayley indicated that his paper was intended rather as a contribution to the geometry of the problem than to its practical solution.—Dr. Balfour Stewart then read a paper on terrestrial magnetism. After referring to the views he has already published respecting the earth's magnetic character, he indicated his belief that the zodiacal light is a phenomenon of terrestrial magnetism, owing its existence to the magnetic effects produced by the upper air-currents (the counter-trades); these effects not being recognisable, of course, in ordinary observations. He suggested also that the motion of the tidal wave might account for the magnetic variations, whose period corresponds to the lunar diurnal motion. The Astronomer Royal remarked on the complexity of the whole problem of terrestrial magnetism, which he characterised as hardly belonging to the class of subjects usually dealt with by the Society.—Mr. Proctor gave a brief sketch of a new theory of the Milky Way. He regards the galaxy as neither a cloven disc, as Sir W. Herschel opined, nor a flat ring as Sir J. Herschel has suggested, but a spiral of a figure which he indicated as serving to explain all the most striking peculiarities of the Milky Way, as seen upon the heavens.—Another paper by Mr. Proctor, on Great Circle Sailing, and a letter from Lieut. Tupman about the November meteors as seen in Egypt, remained unread owing to the lateness of the hour.

Geological Society, December 8.—Professor T. H. Huxley, LL.D., F.R.S., president, in the chair. The following communications were read:—1. "Notes on the Brachiopoda hitherto obtained from the Pebble-bed at Budleigh Salterton, near Exmouth, in Devonshire," by Thomas Davidson, Esq., F.R.S., F.G.S., &c. The author first described the general characters, and discussed the opinions that have been put forward as to the origin of the pebbles forming this bed. Nearly forty species of Brachiopoda have been obtained from them. The fossils contained in the pebbles have been regarded as of Lower Silurian age; the author considered the great majority of the Brachiopoda to be Devonian. The species identified with Silurian fossils are:—*Lingula Lesueuri* (Rouault), *L. Rouaulti* (Salter), and *L. Hawkei* (Rouault). The species regarded by the author as undoubtedly Devonian (*i.e.* either previously described from Devonian deposits or associated with such species in the same pebble) are twelve in number, namely:—*Spirifer Verneuilii* (Murch), *S. macroptera* (Goldf.) *Athyris budleighensis* (sp. n.), *Atrypa* (*reticularis?*), *Rhynchonella inaurita* (Sandb.), *R. elliptica* (Schnurr.), *R. Vicaryi* (sp. n.), and two undetermined species of *Rhynchonella*, *Streptorhynchus crenistria* (Phil.) *Productus Vicaryi* (Salt.), and an undetermined *Chonetes*. Eight species occurring in the same rock, three of which have been doubtfully identified, are considered by the author to be probably Devonian. The species supposed to be determined are:—*Orthis redux* (Barr.) and *O. Berthosi* (Rouault), Silurian; and *Spirifer octoplicatus* (Sow.), Devonian and Carboniferous, but possibly identical with the Silurian *S. elevatus* (Dalm.) The others are two new species of *Orthis*, and a new *Rhynchonella* (?), and an undetermined species of *Terebratula* (?) and *Strophomena* (?). Finally, the author noticed fourteen species (all new, except *Orchis pulvinata*, Salt.) only known from these pebbles, but which were stated to possess a Devonian *facies*.—Mr. Etheridge agreed with Mr. Davidson as to his determination of the species. He had, however, examined the extensive collection of Mr. Vicary, and, from their general *facies*, he was inclined to assign them to the Middle Devonian and Carboniferous beds. The attribution of the fossils to Upper Llandovery beds was founded on the presence of *Lingula crumena*; but he thought he could give some clue to the locality from which the pebbles had been derived. It had first, from the lithological character of the pebbles, as well as from the fossils, been thought that they were of Lower Caradoc age. He himself assigned the position of the rocks from which the pebbles had been derived to the Hangman group of North Devon. At Anstis Cove, Mr. Tawney had found a series of the same class of fossils in a matrix exactly like that of the pebbles. He had examined the spot, and there recognised an extension of the sandstones of North Devon (the Hangman Grits) on the south coast, and certainly, so far as lithological character is concerned, the rocks are the same as the pebbles. It did not, however, follow that the pebbles came from that particular district, but probably from the denudation of the large tract of country of Devonian age to the north. There are, however, Silurian species in the pebbles, and these he would refer to the denudation of rocks in an area mainly to the south of what is now the Devon coast. The fauna at Budleigh Salterton is essentially British, and not French, though some few species are common to both areas. The bivalves, indeed, were hardly known in France. On the whole, he concluded that the fossils in the pebbles were Devonian, with a slight admixture of Silurian and probably Carboniferous forms, derived from rocks at no great distance from the spot where the pebbles are found.—Professor Ramsay pointed out that in conglomerates it might be expected to find pebbles of rocks of various ages. He commented on the difficulty palæontologists seemed to labour under in determining a fossil if it came out of a pebble instead of from a rock the position of which was definitely known. He adverted to the statement that the beds containing the pebbles had been deposited in the New Red Sandstone sea, whereas Mr. Godwin-Austen had regarded the New Red deposits as formed in large inland lakes; and the local character of the beds supported this latter view.—Mr. Prestwich was glad that some other source had been suggested for the quartzite pebbles. He had found somewhat similar quartzites between Lisieux and Cherbourg, in France.—The President observed that he would like to see the rise of a new race of palæontologists, relying simply on zoological characteristics, and not on geological position. A considerable simplification of our classification would probably result.—Mr. Etheridge briefly replied.

2. "On the relation of the Boulder-clay without Chalk of the North of England to the Great Chalky Boulder-clay of the South," by Searles V. Wood, jun., Esq., F.G.S. The author described the Yorkshire glacial clays as of two kinds—the lower, containing chalk debris, and belonging to the uppermost member of the glacial series in eastern and east-central England; the upper containing chalk sparingly in its lower part, and gradually losing this upwards. On the coast the latter occurs only north of Flambro'. He stated that, palæontologically, the lower and middle glacial deposits closely agree with the crag, and are quite distinct from the deposits at Bridlington, which he placed immediately above the "Great Chalky Clay." The absence of chalk debris in the deposit north of Flambro' has been regarded as evidence of a drift from north to south; but the author stated that the purple clay without chalk extends over much of the north-eastern part of the Wolds, from the sea-level to an elevation of 450 feet, and that outliers of it occur at intervals along the Holderness coast-section as far as Dimlington, forty-two miles south of the northern limit of the Wolds. In the direction of Flambro' and York the clay was said to be destitute of chalk, which would not be the case had the Wolds formed a sea-shore causing a drift from the north to pass either to south-east or south-west. The author described the characters of the great chalky boulder-clay in the eastern and central counties of England, and maintained that the chalk found in it (equal, according to him, to a layer of at least 200 feet over the entire Wold) could only have been detached by the agency of moving ice, which he believed to have covered nearly the whole Wold for a long period. The author stated that boulders of Shap Fell granite are confined to the deposit of clay without chalk; and discussed the means by which they could have been distributed. He ascribed their dispersion to the agency of floating ice during an adequate sub-

mergence of the district. He supposed them to have passed from Shap Fell by what is now the pass of Stainmoor. Thus he ascribed the formation of the "great chalky clay" to the extrusion from the sea-foot of a great sheet of ice, of materials abraded by the latter, the land being depressed 600 to 700 feet below its present level; and that of the clay without chalk and with boulders of Shap Fell granite to deposition during a period of much greater depression (about 1,500 feet), throughout which the sea bore much floating ice. He considered that the "great chalky clay" indicated a long period during which the land, with its enveloping ice, remained stationary, and that during this period, when intense cold prevailed, the arctic fauna of Bridlington became established. He thought that the recommencement of subsidence was indicated by the reddish-brown or brownish-purple sediments of Holderness, in which some chalk occurs. He then indicated the species of mollusca which have occurred in the purple clay without chalk about Scarbro' and Whitby, all of which were said to belong to existing forms, and thus be in accordance with the date assigned by him to that deposit. The molluscan fauna of Moël Tryfane was referred to by the author, who stated that he regarded it as belonging to the period of emergence from the deepest depression during which the clay without chalk was assumed to have been deposited, *i.e.*, to the earliest part of the post-glacial period, to which the stratified drifts of Scotland are referred by Mr. A. Geikie. Mr. Gwyn Jeffreys had found the shells of Kelsea and elsewhere in Yorkshire to be mainly arctic; and Mr. Prestwich, in his paper on the boulder-clay near Hull, had first pointed out their glacial character. In the late dredgings in H.M.S. *Porcupine* several of the species before known as fossil at Bridlington, but not as existing in the British seas, had been discovered. In fact, he believed that the Bridlington species, with but few exceptions, had now been found in the British seas. Similar species had also been found in the boulder-clay in Scotland. Prof. Ramsay was pleased to find the author's views so closely correspond with his own published some years ago as to the glacial phenomena of North Wales, though based on another part of the country. He thought that shells might be found by careful search in the low-lying boulder-clay in other places than those enumerated, as they had been discovered in the western part of England. Mr. Prestwich, though inclined to accept the divisions of the boulder-clay in Yorkshire as suggested by the author, was not so clear as to his divisions in the south. He thought the presence of chalk in the clay might be traced to the contiguity of the outcrop of the chalk stratum. The shells being to a very great extent recent, the grouping might be due to accidental or local circumstances. The Chillesford clays, in his opinion, mark the commencement of the great glacial period. Mr. Etheridge suggested that *Nucula Cobboldiæ*, *Cardita similis*, and some other shells not found in the British seas, proved the arctic character of the Bridlington fauna. Sir Charles Lyell remarked that if the fauna of the lower and middle glacial really corresponded so closely with that of the crag, it afforded a strong argument against their being of the same age as the Bridlington beds. Perhaps, eventually, some palæontological connection might be traced throughout the series, and a chronological scale established. The President suggested a difficulty in the marine transport of ice from Shap Fell to Bridlington, not only from the wind blowing rarely in the necessary direction, but from the current caused by the great submerged ridge also tending to carry any bergs in another direction. He thought the transport by sheet-ice more probable. The Rev. J. L. Rome had traced the Shap granites over the valley of the Eden, across Stainmoor, to the Yorkshire side. There might have been difficulties in their transport, but there they are. Though they were found in Teesdale, yet the intervening ridge of millstone-grit, 2,000 feet, had prevented them finding their way into Swale Dale. Mr. Searles V. Wood, jun., stated that he had relied on Mr. Gwyn Jeffreys's works for his classification of the shells as being arctic or otherwise. He regarded the succession of the various members of the glacial series as well established, and as borne out also by the molluscan remains. He utterly repudiated the notion that the Chillesford, Bridlington, and Kelsea Hill beds were on the same horizon. He believed the whole of the Scotch beds to be newer than those of England. He quoted Professor Phillips as suggesting a change in the elevation around Shap Fell since the dispersion of the boulders, and offered as his own explanation of the hypothesis, that the passes by which the boulders travelled were those which, though at the higher levels, were the soonest freed from ice. He thought that the direction of the current was influenced by other causes than the general trend of the rocky dividing ridge.

The following specimens were exhibited to the meeting:—Fossiliferous Pebbles from Budleigh Salterton, exhibited by Professor Tennant and R. Etheridge, Esq.

Zoological Society, December 9.—Dr. E. Hamilton, V.P., in the chair. The Secretary read a list of the more remarkable of the recent additions to the Society's menagerie, amongst which were particularly noticed two gibbons (*Hylobates lar*), deposited by G. S. Roden, Esq. An extract was read from a letter addressed to the Secretary by Capt. G. E. Bulger, C.M.Z.S., correcting an error in a former paper by him on the birds observed at Wellington, in the Neilgherry Hills, published in the Society's Proceedings. Professor W. H. Flower, F.R.S., gave some account of the external characters of the fin-whale, recently stranded in Langston Harbour, near Portsmouth, which he considered referable to the species usually called *Balænoptera musculus*. Mr. Flower concluded his remarks with a sketch of the species of the Balænoid, or whalebone-producing, whales, which occur in the British seas. These, according to our present knowledge of them, appear to be six in number, namely:—*Balæna biscayensis*, *Megaptera longimana*, and *Balænopteræ musculus*, *Sibbaldii*, *laticeps*, and *rostrata*. A communication was read from Surgeon Francis Day, F.Z.S., on the fresh-water fishes of Burmah, being an account of the specimens of this class of animals obtained during a recent inspection of the fisheries of Pegu, and during a short visit paid to the capital of Upper Burmah. A second communication was read from Surgeon Francis Day containing the third part of his critical notes on the fishes of the Calcutta Museum. Mr. G. French Angas gave descriptions of twelve new species of land-shells belonging to different subdivisions of the family *Helicidæ*, from the Western Pacific Islands. Mr. P. L. Sclater read a list of the birds that had bred in the Gardens of the Society during the past twenty years. The total number of species enumerated in this list was 108. Mr. R. B. Sharpe pointed out the characters of a new kingfisher belonging to the genus *Tanysiptera*, which he proposed to call *T. Ellioti*. A communication was read from Mr. Harper Pease on the classification of the molluscs of the genus *Helicter*. A paper was read by Messrs. P. L. Sclater and O. Salvin on birds collected by Mr. W. H. Hudson at Conchitas, near Buenos Ayres, being their third communication to the Society upon this subject. Mr. Sclater exhibited and pointed out the characters of two new species of birds of the sub-family *Synallaxinæ*, proposed to be called *Synallaxis curtata* and *Leptasthenura andicola*. A communication was read from Capt. G. E. Bulger, entitled Notes on Two Animals observed near Wind-Vogel-berg, South Africa. Mr. R. Swinhoe, F.Z.S., read a paper on the Cervine Animals of the Island of Hainan, Southern China, which he stated to be referable to three species, namely:—*Cervulus vaginalis*, *Cervus* (*Panolia*) *Eldi*, and a Rusine Deer allied to *Cervus hippelaphus*. A communication was read from Mr. W. T. Blanford on the species of *Hyrax* inhabiting Abyssinia and the neighbouring countries, which he believed to be four in number. Dr. J. E. Gray communicated the description of a new species of *Emys*, living in the Society's Gardens, which he proposed to call *E. flavipes*, from an unknown locality.

Mathematical Society, December 9.—Professor Cayley, president, in the chair. Professor H. J. S. Smith communicated a note on the Focal Properties of two Correlative Figures. This paper was an appendix to a former paper by the same author, on the Focal Properties of Homographic Figures. By the term "focal properties" are intended those properties which arise from considering the imaginary circular points at an infinite distance in either figure, and the points corresponding to them in the other figure. These properties appear to be much less varied in their character in the case of two correlative figures than in the case of two homographic figures; and the two following theorems (of which the first is well known) will suffice to give an idea of the general nature of the results:—1. In two correlative figures in space there are always two corresponding tetrahedra, such that three adjacent edges of each are rectangular; the three edges opposite to these being at an infinite distance, and the edges at a finite distance in either figure corresponding to the edges at an infinite distance in the other. 2. If we consider any point in either figure, and its correlative plane in the other, we have two definite planes passing through the point, and two corresponding points upon the plane, which may be called respectively the cyclic planes of the point and the foci of the plane. If we take any third point in the plane, the angles which its focal radii vectores make with the line joining the foci are equal to the angles which the traces of the corresponding planes upon the cyclic planes make with the line of intersection of those two planes. These theorems suppose only that in the two correlative figures the plane at an infinite distance in either figure answers to a point at a finite distance in the other. Mr. Tucker (Hon. Sec.) read a proof (by Mr. M. W. Crofton, F.R.S.) of Gauss' Theorems and Napier's Analogies. The proof, a purely geometrical one, was extremely neat and simple. The perpendicular bisector of the base is produced to meet the external bisector of the vertical angle, and from the point of intersection (P) arcs are drawn perpendicular to the sides containing the said vertical angle. This point (P) is also connected by arcs with the extremities of the base; the results readily follow from the equality of certain triangles.—Mr. S. Roberts, M.A., gave an account of a short paper On the Order of the Discriminant of a Ternary Form. The main theorems, the author states, have been geometrically obtained by, and are due to, Professor Cremona (Mr. Roberts' paper contains an analytical proof of them), and relate to the influence of common multiple points on the number of double points of a pencil or involution of curves. The method employed was applied to the determination of the discriminant of a ternary form when certain of the terms are wanting, viz. the form (x, y) P(x, z)1. The communication also had reference to a paper on Discriminants, by Dr. Henrici, published in the Society's Proceedings, in which the result had been arrived at *indirectly*, and Mr. Roberts' aim was to clear up an apparent discrepancy in the results obtained by Professor Cremona and Dr. Henrici. The latter gentleman joined in a discussion on the subject.—The President gave an account of his investigations on the cen ro-surface of an ellipsoid (locus of the centres of curvature of the ellipsoid). The surface has been studied by Dr. Salmon, and also by Professor Clebsch, but in particular the theory of the nodal curve on the surface admits of further development. The principal sections of the surface (as is known) consist each of them of an ellipse counting three times, and of an evolute of an ellipse: the evolute and ellipse have four contacts (twofold intersections) and four simple intersections, but the contacts and intersections respectively are in the different sections real or imaginary. The form of the principal sections then is: a real contact at P in the plane of xz, and a real intersection at Q in the plane of xy; and thus there are an exterior and an interior sheet, but (instead of meeting in a conical point, as in the wave surface) these intersect in a nodal curve QP. The curve has a cusp at Q, and a node at P, thus extending beyond P, but from that point is acnodal, or without any real branch of the surface passing through it. Several simple relations were established, but the reductions were of some complexity.

Syro-Egyptian Society, December 7th.—W. H. Black, Esq. in the chair. Mr. Bonomi read a paper on the defacement of the name and figure of the god Amon on all Egyptian temples, obelisks, and statues, during the reign of the successor of Amnnohph III., and the subsequent restoration of both during the reign of Rameses II. Mr. Bonomi conjectures that the amount of skilled labour and expenses of scaffolding necessary to effect these changes prove that they were considered of great importance in a religious point of view; and he stated that there was scarcely a public or private collection of Egyptian antiquities in Europe that could not furnish examples of it. The beautiful drawings and photographs exhibited by Mr. Bonomi, to illustrate the subject, enhanced the interest of his able paper.

Institution of Civil Engineers, December 14.—Mr. Chas. Hutton Gregory, president, in the chair. The paper on Ocean Steam Navigation, with a view to its future development, by Mr John Grantham, M. Inst. C.E., partly read at the meeting on the 7th inst., was concluded; and a brief abstract of the whole is now given. The author contended that steam-ships could be employed more extensively on routes partially occupied by them, and on others where regular steam-lines had not yet been established. Rapid and regular voyages both for passengers and goods were now fully appreciated, while the greatly-increasing intercourse of all nations furnished freights which would support lines of expensive steam-vessels. He traced the rise of ocean steam navigation, and showed that the route from Liverpool to New York was the principal field on which it was first fully developed. He described the efforts made by the Americans to maintain by steam the prestige so long secured by their sailing ships; gave the reason for the great change that had taken place; and stated that not one American steamer was now running between Europe and America. Some of the causes of this were to be found in the fact, that iron ships, worked by the screw propeller, could alone be employed successfully, and that such ships in America were too expensive, both in their construction and in their working, to enable them to compete with English vessels. The form of, and various improvements in, the boilers and the engines were described, showing that a much higher pressure of steam was now employed, that the expansive system and surface condensation were at present considered essential to success in economising fuel, and that the amount of coals consumed had in the best vessels been reduced to 2¼lb. per indicated horse-power per hour, but it was anticipated that a reduction to 2lb. might soon be attained. A map on Mercator's projection was exhibited, indicating the principal ocean routes in connection with the trades between Great Britain and the rest of the world; and the improved system by great circle sailing, as recommended by Mr. Towson, of Liverpool, was described. A table was also exhibited of the relative distances between London and Liverpool, and the various ports shown on the map, both by long sea, and by the Suez Canal and the Pacific Railroad; from which it appeared that, as regarded the Northern Hemisphere, a great saving of distance and time would be effected. The number of ocean steam-ships now working in connection with this country was stated to be 364. The performances of the best ships of various companies were then alluded to, and the result showed that on the North American lines the highest average rate of speed was maintained, but by a large expenditure of fuel; that the Pacific and Colonial Companies' ships gave excellent results, as regarded economy of fuel; and that some new vessels, lately built for the Royal West India Mail Company, seemed to promise the best performances with respect to speed and economy combined. A table taken from the Board of Trade Returns for 1868 showed that, with North America, the tonnage of steam-ships nearly equalled that of sailing ships; but in the Mediterranean trade steam-ships largely exceeded sailing ships. On the other hand, in the regular trades with India, China, and Australia, steam tonnage, by long sea, comprised only about 1 per cent. of the whole. A calculation was then made to show what might be expected if the trade with the East was in future carried through the Suez Canal, and of the number of large steam-fleets which would be required to work it. Some facts were also recorded relative to the effect of the Pacific Railroad, and the probability of letters and passengers from China, Japan, and Western Australia going by that route. It was shown that several days' saving in time would be effected. The author considered that the voyage to Melbourne could be best performed by long sea, as there would be no saving either in distance or in time by way of Suez. The paper held out great prospects of advantage to England and to British shipbuilders, from the immense changes that were apparently about to take place.

Anthropological Society, December 14.—Dr. Charnock, V.P., in the chair. Mr. Wake read a paper on the Race Affinities of the Madecasses. The agreement of the *Hovas* with the other inhabitants of Madagascar in language and customs forbids us to refer the former to a Malayan origin. Moreover, the division into dark and light tribes is found in the Malayan Archipelago, and also in South Africa. Comparison of physical and mental characters, and of customs and superstitions, shows that the dark Madecasses, the Kafirs, and the Papuans, all belong to the same race. By a similar comparison, an analogous affinity between the Hovas, the Hottentots, and the Malays (as representative of whom the paper took the Siamese), can be established. The South African relationship of the Madecasses is supported by the verbal and grammatical affinity of the Malagasy to the Kafir and Hottentot dialects, which are shown to be related between themselves, and also to the Polynesian dialects. The arrangement of peoples on the African area is opposed to the idea of a continental origin of the Madecasses, while their numerous African affinities prevent their being traced to a Malayan source. The Madecasses are more really *autochthonous* than any other race except the aborigines of Australia, and probably Madagascar was connected with both the African Continent and the Malay Archipelago when it was first inhabited by man. The inhabitants of Madagascar possess the domestic ox, sheep, and fowl, and are skilled in the smelting and working of iron. This island was probably (according to the author) the seat of man's primitive civilisation.

DUBLIN

Royal Irish Academy, December 13.—The Rev. Professor Jellett, president, in the chair. Professor Sullivan, Ph.D., read a paper on the Beds of Thenardite of the Valley of Jarama, in connection with climatal effects supposed to be due to the variation of the eecentricity of the earth's orbit, according to the calculations of Messrs. Croll and Moore. The author remarked that M. Adhémar endeavoured to account for change of climate in geological time by the precession of the equinoxes, and the change of position of perihelion. These effects are modified by another astronomical movement—the change in the eccentricity of the earth's orbit. At the instance of Sir C. Lyell, Mr. Stone made some calculations to determine the eccentricity of the orbit in former periods, which Mr. Croll, by the aid of Leverrier's formula, has completed for one million years before 1800 in parts of a unit equal to the mean distance of the earth from the sun. These calculations are given by Sir C. Lyell in the last edition of his "Geology," with the addition of some calculations made by Mr. John Carrick Moore, of the mean temperature of the hottest and coldest months in the latitude of London, supposing other causes which may influence the distribution of heat to remain the same as at present. According to these tables, several periods of extreme temperature should have occurred within the million of years. The most marked of them should occur at 200,000, 210,000, and 750,000 years before 1800, when the mean temperature of the hottest month should be 113° Fahr., and of the coldest 1°·9, 0°·7, and 0°·6 respectively. Professor Tyndall has well pointed out that glaciers require heat as well as cold to produce them, so that extreme temperatures appear to represent the conditions required. These views appear to receive an unexpected support from a phenomenon which, being purely physical, gives more definite results than can in general be obtained from biological ones. In the Valley of the Jarama, a branch of the Tagus which receives the waters of the Manzanares, which flows through Madrid, occurs a series of beds,—thenardite, glauberite, gypsum, and clay,—having a variable thickness of from 16 to 19 metres. Through this the alluvial plain of the river has been cut. The formation of anhydrous sulphate of soda requires that the solution from which the salt separates should be above 35° Cent. or 95° Fahr. This is a temperature which even a shallow lake could only attain if the temperature of the air were considerably above that point. On the other hand, the conditions under which the sulphate of soda could be formed in the first instance requires a low temperature. So that, like glaciers, these beds require great heat and cold, the limits of which are, however, fixed in this case. If the temperature of the hottest month in the latitude of London were 113°, it would be still higher on the plain of Madrid, where even 120° Fahr. in the shade is sometimes even now attained in the locality of these beds. The circumstance which should exist at either of the glacial periods indicated by Mr. Croll's and Mr. Carrick Moore's calculations, would be sufficient to account for those beds; it would be difficult to account for them on the supposition of a period of intense cold. These beds were fully described in a paper by Professors Sullivan and O'Reilly, published in 1863 in Vol. iv. of the *Atlantis*, and afterwards in "Notes on the Geology and Mineralogy of the Spanish Provinces of Santander and Madrid." (London: Williams and Norgate. 1863.) Professors Apjohn and Hennessy took part in the discussion of the paper. J. R. Garstin, A.M., was elected a member of council in the room of Professor Jellett.

PARIS

Academy of Sciences, December 13.—M. H. Sainte-Claire Deville brought under the notice of the Academy a siderostat constructed by the late M. Léon Foucault, and communicated a note upon it by M. C. Wolf. Its action depends upon the production of a perfectly plane mirror, the mode of obtaining which was described in a posthumous paper by M. Léon Foucault, read to the Academy at a recent meeting (see NATURE, p. 177), and its object is to furnish the observer with a perfectly reflected image of any sidereal body for examination by the telescope. A figure of the instrument, which is provided with a clockwork movement, is given in illustration of M. Wolf's note.—M. Laugier remarked upon the employment of the plane mirror, and noticed that Arago had called attention twenty years ago to the advantages which might be derived from it. M. P. A. Favre presented some remarks upon the electric explorer described by M. Trouvé (see NATURE, p. 177), for the detection of metallic substances in wounds, and claimed for himself the invention, in 1862, of an electrical sound for the same purpose.—Marshal Vaillant announced that M. Pasteur was engaged at Trieste in completing a work upon sericulture, and in organising a silk-worm cultivation on a large scale, to be carried on in accordance with his system.—M. Haton de la Goupillière presented a memoir on the system of metallic floodgates which require the minimum of attraction.—A memoir on the dispersion of light, by M. M. Ricour, was communicated by M. Combes. General Morin presented a note by M. H. Morton, on the origin of the luminous band which is observed in contact with the margin of the moon's disc in the photographic pictures of various eclipses. In preparing negative photographs of eclipses, a slight band surrounds the border of the moon's shadow, in which the deposit of silver is more dense than elsewhere, producing a light band in that positive. The author has produced a similar effect by substituting a disc of dark paper for the moon's shadow, and he comes to the conclusion that the phenomenon is simply chemical, and due to the extension, during the development of the plate, of the nitrate of silver from the part protected by the shadow, to a short distance beyond the latter.—A note by M. Hugo Schiff, on the constitution of amygdaline and phloridzine, was communicated by M. Wurtz. The author describes and formulates these substances and their derivatives.—M. E. J. Maumené communicated another memoir on inverted sugar, in reply to M. Dubrunfant, in which he states that none of the latter's assertions are in accordance with experiment. He says that inverted sugar, properly prepared, is a mixture of three optically neutral bodies, which are neither glucose, nor levulose, nor any of the sugars possessing a rotatory power. The fermentation of inverted sugar is accompanied by no elective phenomena.—M. Dubrunfant presented a communication on spectrum analysis applied to the investigation of simple gases, and of their mixtures, in which he described the phenomena presented by various gases and gaseous mixtures under different conditions of pressure, and indicated that the supposed multiple spectra of certain gases are probably due to admixture. Thus it appears to be impossible to obtain hydrogen free from nitrogen, and under a low pressure the spectrum of the latter alone appears.—M. Jos. Boussingault communicated an analysis of the "morallon" emeralds from the mines of Muso, in New Granada.—A memoir was presented by M. Martin de Brettes on the determination of one or more of the following quantities, the others being given: The diameter of an oblong projectile, its weight, its initial velocity, the curve of its trajectory, and the weight of the gun from which it is fired. He gives the formulæ for working out these questions, and indicates their applications to artillery and small arms.—Of two zoological papers, one, by M. Lacaze Duthiers, calls the attention of naturalists to the Harbour of Roscoff, on the north coast of France, as a locality where the so-called *Pentacrinus europæus*, the young form of *Antedon rosaceus*, is to be found in abundance. From his description, the Bay of Roscoff is a paradise for the student of marine zoology.—The second memoir, by M. F. Lenormant, discusses the question of the antiquity of the ass and the horse as domestic animals in Syria and Egypt; and the author states, in opposition to Professor Owen, that the ass is represented very frequently upon the earliest known monuments. The horse, on the contrary, remained unknown in the countries south-west of the Euphrates until the time of the shepherd kings, or about the nineteenth century B.C. M. Milne-Edwards remarked upon this communication that it agreed with the conclusions of zoologists as to the distribution of the species of the genus *Equus*; the ass is to be regarded as an essentially African species, whilst the horse is a native of central Asia and part of Europe. He added that if the shepherd peoples introduced the horse into Egypt, this might throw some light upon their origin. M. Elie de Beaumont remarked that these facts were favourable to the opinion that the existing state of things on the surface of the globe was not of very ancient date.—M. J. Reboux communicated the results of some Prehistoric Archæological researches upon the quarternary beds of Paris, in which he indicated the character of numerous worked flints obtained by him from these beds (from a depth of twelve metres upwards), and gave a long list of animals, the remains of which were found intermixed with the flints.—M. Guérin-Méneville remarked upon the conditions of production of truffles.—A note was presented from M. Namias, describing his employment of hydrate of chloral with beneficial effects at the Hospital of Venice; and another from M. Thuau on a process for the instantaneous lighting and extinction of gas-lamps by means of electricity.

BRUSSELS

Royal Academy of Sciences, November 6.—Various meteorological reports were presented to the Academy, namely: On the Aurora Borealis of the 6th of October, 1869, by MM. A. Quételet and F. Terby; and on storms observed in various parts of Belgium, by MM. A. Quételet, Brauch, Malaise, Dewalque, and Leclercq, the last giving an account of the storm phenomena of the neighbourhood of Liége for the year 1869.—M. C. Montigny communicated a note on the phenomena of coloration of the edges of the sun's disc when near the horizon, in which he referred especially to the appearance of rose-coloured undulations upon the blue arch of the upper margin of the sun, remarked upon certain facts which seem to indicate that these are not produced by atmospheric dispersion or interference, and suggested that they may be due to the protuberances of the chromosphere.—M. E. Morren presented a paper on the contagion of the variegation of plants by means of grafting, both from the stock to the graft, and from the graft to the stock. His observations relate to *Abutilon Thompsoni*, and other species of the same genus.—A note on the wax of straw, by Dr. B. Radziszewski, was communicated by M. L. Henry. This substance, which is analogous to the wax obtained from the sugar-cane, was first observed in a paper-factory at Willebroeck; it is solid, white, insoluble in water, soluble in alcohol and ether, and crystallises from its alcoholic solution in small nacreous scales.—An important memoir, by M. E. Van Beneden, on a new and very large species of *Gregarina* was read; to this we shall revert elsewhere.

BERLIN

German Chemical Society, December 11.—On this date there was a general meeting for the purpose of electing its officers for the year 1870. The following gentlemen were elected:—President: Professor Rammelaberg, with 34 votes against 25 given to Professor Baeyer. Vice-presidents: Professors Baeyer, Hoffmann, Magnus, and Rose. Secretaries and Vice-Secretaries: Dr. Eichermann, Dr. Martius, Dr. Oppenheim, and Dr. Wichelhaus. Treasurer: Mr. Scherinn. Librarian: Dr. Scheibler. Resident Committee: Professor Finkener, Dr. Jacobser, Dr. Kunheim, Dr. Schultzen, and Dr. Vogel. Non-resident Committee: Professors Illasiwetz of Vienna, Hoppe-Scyler of Tuebingen, Kékulé of Bonn, Wislicenus in Zurich, and Wagner in Wurtzburg. Obituary notices of the late honorary member, Professor Graham, and the late member Mr. Beyrick in Berlin, were then read by the President.

December 13.—The following papers were read:—Riebermann and Gräbe on Anturacene-monocarbonic Acid. Baeyer and Emmerling: Synthesis of Indole. Ascher: The Transformation of Angelic into Valerianic Acid. Hofmann and Gentz on Brominated Derivatives of Xylidine and on Dixylyle-guanidine or Meloxylidine. Hofmann on an Isomeric diphenylated Guanidine; and on Sulphocyanate of Xylyle. Hobreller on the Action of Sulphuret of Carbon on Sulphuretted Urea. Naumann: The Law of Avogadro considered as a consequence of the laws by which the movement of gases are regulated. Bel-Trederi on a Third Monochlorinated Phenelo-sulphurous Acid. Cossa on the Constitution of Native Carbonates. Thomsen on the Inaccuracy caused by the use of Favre and Silbermann's Mercury-calorimeter. Rathke on Molecular Combinations. Ladenburg on the Molecular Weight of certain Protoxides and Protochlorides. Fleury on the Action of Pentachloride of Phosphorus on Phenolic Ethers.

VIENNA

Imperial Academy of Sciences, December 2.—Professor Zepharovich presented a fourth instalment of his mineralogical communications, in which he referred to crystals of ullmanite and pyrite, and to the fine twin-crystals of sphene which were found in 1863 on the Rothenkopf. A telegram was communicated from M. Tempel announcing the discovery of a comet at Marseilles on the 27th November. This comet was, in consequence, observed at Vienna by Professor Weiss on the 29th November, and subsequently by Dr. Theodor Oppolzer, who communicated the elements of its orbit and its ephemeris up to the 6th January, 1870, deduced from the observations at Marseilles, Vienna, Leipzig, and Carlsruhe. A memoir entitled "Development of the tetratosymmetrical division of the hexagonal crystal-system, with remarks upon the occurrence of circular polarisation," by M. Aristides Brezina, was communicated by Professor Lang.—Professor von Hochstetter communicated a third paper on the earthquake-wave in the Pacific Ocean, in August 1868, containing observations made in Australia.—M. Schrauf presented the first part of his investigations of Labradorite, containing a description of the mineral and a microscopical examination of its enclosures, and an account of the phenomenon of avanturinisation as presented by it.

DUBLIN

Royal Dublin Society, December 20.—G. J. Stoney, A.M., F.R.S., in the chair. Mr. John Adair read a paper on the Acclimatisation of Plants as a help to the advance of civilisation. The author treated this interesting subject from a practical point of view, leaning rather to the possibility of plants being acclimatised—at least sufficiently so to bear the ordinary winter climate of this country. Dr. Moore, Professor E. Perceval Wright, and others, took part in the discussion of the paper. Mr. A. G. More exhibited from the museum of the society three fine specimens, probably the only three known, of the Blue Mountain Duck of Jamaica (*Pterodroma Caribbœa* Carte) also a large specimen of the Grey Seal (*Halichœrus griseus* Nils), which he had shot during the last summer on the coast of Galway. Dr. Emerson Reynolds exhibited a collection of flint arrowheads found in Ireland, and a photograph of a portion of the Giant's Causeway. He mentioned having obtained for the museum a series of the Causeway basaltic columns, consisting of a central column and six encircling ones.

[This abstract reached us too late to be inserted in its proper place.—ED.]

DIARY

THURSDAY, DECEMBER 23.

SOCIETY OF ANTIQUARIES, at 8.30.—Confessionals in the Middle Ages: Abbé Cochet.

THURSDAY, DECEMBER 30.

ROYAL INSTITUTION, at 3—Light: Prof. Tyndall, F.R.S. (Juvenile Lectures.)

BOOKS RECEIVED

ENGLISH.—Catechism of the Decimal, Albert, and Metric Systems: A.W. Bonn (published by the author).—Madam How and Lady Why: Rev. C. Kingsley (Bell and Daldy).—Reptiles and Birds: L. Figuier, edited and adapted by Parker Gillmore (Chapman and Hall).—The Sun: Amedée Guillemin, translated from the French by Dr. Phipson (Bentley).—The Snakes of Australia: Gerard Krefft (Sydney: T. Richards).—Meteorological and Magnetical Observations made at Flagstaff Observatory, Melbourne: Geo. Neumayer. (Through Trübner & Co.)

AMERICAN.—The Trapper's Guide: S. Newhouse.—The New West: Charles Loring Brace.—Agricultural, Qualitative, and Quantitative Analysis: G. C. Caldwell.—Sorghum and its Products: F. L. Stewart.—Elements of Astronomy: C. J. White.—Annual of Scientific Discovery: Dr. J. Knuland.—The Mines of the West: Rossiter W. Raymond.—Report on the Machinery and Processes of the Industrial Arts, &c., at the Paris Exposition of 1867: F. A. B. Barnard.—The Myths of the New World: Dr. Daniel G. Brinton. (Through Trübner and Co.)—An Abstract of Measurements and Examinations of the Solar Eclipse of August 7, 1869. Lecture Notes on Physics. The Total Eclipse of August 7, 1869: all by Prof. Alfred M. Mayer, Ph.D. (From the author.)

FOREIGN.—De la Fécondation Artificielle: Jules Gautar (published by the author).—De l'Abus des Boissons Alcooliques: L. F. E. Bergent.—Die Spectralanalyse: Dr. H. Schellen.—Rapport sur le Progrès de la Chimie Organique pure: L. Micé.—Dictionnaire Botanique: E. G. de St. Pierre.—Die Physiologie: Dr. J. W. Czermak.—Stellung des Menschen: Ludwig Büchner. (Through Williams and Norgate.)

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THURSDAY, DECEMBER 30, 1869

A DEDUCTION FROM DARWIN'S THEORY

THERE is one important consequence deducible from Darwin's profound theory which has not yet been noticed so far as I am aware. The theory is capable under certain reasonable conditions of accounting for the fact that the highest forms of civilisation have appeared in temperate climates.

Although some apparent exceptions might be adduced, it is no doubt true that man displays his utmost vigour and perfection, both of mind and body, in the regions intermediate between extreme heat and extreme cold, allowance being made for the reduced temperature of elevated mountain districts. The explanations hitherto given of this fact are of a purely hypothetical and shallow character. It is said, for instance, that the prolific character of the tropical climate too easily furnishes man with subsistence, so that his powers are never properly called into action. On the other hand in the Arctic regions nature is too sterile and no exertions can lead to the accumulation of much wealth. This explanation obviously involves the gratuitous hypothesis that man has been created with powers exactly suited to be called forth by just that degree of difficulty experienced in a temperate climate. There are those even who maintain our peculiar British climate to be the very best possible, because it taxes our powers of endurance to the last point which they can bear, and thus calls forth the greatest amount of energy. But here again is the assumption that the British people and the British climate were specially created to suit each other.

The theory of natural selection, on the other hand, represents that great method by which infinitely numerous adaptations will always be produced throughout time. Whatever happens in this material world must happen in consequence of the properties originally impressed upon matter, and our notions of the wisdom embodied in the Creation must be infinitely raised when we understand, however imperfectly, its true method. The continual resort to special inventions and adaptations must surely be below the greatness of a Power which could so design and create matter from the first that it must go on thenceforth inventing and adapting forms of life without apparent limit, in pursuance of one uniform principle.

I conceive it to be the essential consequence of Darwin's views that no form of life is to be regarded as a fixed form; but that all living beings, including man, are in a continual process of adjustment to the conditions in which they live. If this be so, it will of necessity follow that the longer any race dwells in given circumstances, the more perfectly will it become adapted to those circumstances. A migratory race, on the contrary, will always be liable to enter climates unsuited to it, and less favourable to the development of the greatest amount of energy. Negroes can bear a tropical heat simply because the race has grown more accustomed to it than Europeans, who bring with them indeed a superior degree of energy and intellect, but soon sicken and fail to reproduce themselves in equal perfection.

The intellect of man renders him far more migratory than most other animals, and when we look over long periods of time we must regard him as in a constant state of oscillation between the equator and the borders of perpetual snow. It will of necessity follow that the race, as a whole, will be better adapted to a medium than to an extreme climate. Not only may the same race have passed alternately through colder and hotter climates, but it is obvious that the tribes which intermix and intermarry in temperate regions will have come, some from a hotter and some from a colder region. The amalgamated race will therefore be precisely adapted to a medium climate. The inhabitants of the Arctic regions, on the contrary, must have come entirely from a warmer climate, and those of a tropical region from a colder climate, so that ages must pass before either re-adapts itself perfectly to its new circumstances.

It is hardly to be expected that history can afford complete corroboration of this theory; but I do not think that historical facts can be adduced in serious opposition to it. The progress of archæological and linguistic inquiry shows more and more clearly that the civilised parts of the earth have been inhabited by a succession of different races. A really aboriginal and indigenous people, growing upon a single island or spot of ground without kinship with other races, is not known to exist; and it is almost certain that all races have descended from a few stocks, if not from a single one. The evidences of extensive and frequent migrations are thus most complete, even if we had not distinct historical facts concerning the rapid and extensive movements of the Goths, Huns, Moors, Scandinavians, and many other races.

If the historical evidence disagrees with the theory in any point, it is that the migrations from temperate to extreme climates greatly over-balance any opposite movement. It would hardly, perhaps, be too much to represent the temperate regions of the Old World as the birthplace of successive races, which have diverged and died away more or less rapidly in distant and extreme climates. But if such be the conclusion from historical periods, it would only indicate that the human race had already acquired, in prehistoric times, a constitution displaying its greatest vitality in temperate regions. There can be no doubt that, were the rest of the world uninhabited by man, a very inferior race, such as the negroes of tropical Africa, would gradually re-people it; but they cannot do so in the present state of things, because they come into conflict with races of superior intellect and energy.

I would add in conclusion that the utmost result of speculations of this kind, supposing them to be valid, would consist in establishing a *general tendency*, so that the probabilities will be in favour of a great display of civilisation occurring in temperate climates rather than elsewhere. I do not for a moment suppose that any common physical cause, such as soil, climate, mineral wealth, or geographical position, or any combination of such causes, can alone account for the rise and growth of civilisation in Assyria, Egypt, Greece, Italy, or England. Material resources are nothing without the mind which knows how to use them. No physiology of protoplasm, no science that yet has a name, or perhaps ever will have a name, can account for the evolution of intellect in all its endless developments. The vanity of the Comtists leads them to suppose that their philosophy can compass the bounds of existence and account for the evolution of history; but the scientific man remembers that however complicated the facts which he reduces under the grasp of his laws, yet beyond all doubt there remain other groups of facts of surpassing complication. Science may ever advance, but, like an improved telescope in the hands of an astronomer, it only discloses the unsuspected extent and difficulty of the phenomena yet unreduced to law.

W. STANLEY JEVONS

THE STATE TELEGRAPHS

OUR Government—always the last among European Governments to endow the nation with any benefit resulting from the advance of science—has at length awakened to the fact that the electric current is the scientific modern equivalent for the ancient post-boy, and we are to have a State Telegraph as we have a State Postal system.

As early as 1854, Mr. Thomas Allan, the electrician, published a paper entitled "Reasons for the Government Annexing an Electric Telegraph System to the General Post Office," in which he recommended the adoption of a shilling rate, for messages of twenty words, throughout the United Kingdom. This paper was published a second time in 1863. In 1856, Mr. Baines, an officer in the General Post Office, submitted to the Lords of the Treasury a plan for the annexation of the telegraphs, and a general charge of sixpence for messages of twenty words. In 1861, a memorandum by Mr. Ricardo, chairman of the Electric and International Telegraph Company, recommending the transfer of the telegraphs to the Government, was forwarded to the Chancellor of the Exchequer. Late in the year 1865 the proposition was again brought forward in the report of a committee appointed by the Edinburgh Chamber of Commerce "to consider the present condition of telegraphic communication in the United Kingdom, with a view to its improvement." In June 1866, Mr. Edwin Chadwick also forwarded a like scheme to the Chancellor of the Exchequer. The substance of all these papers was to the effect that the existing charges were too high, that the rapidity of transmission of messages was bad, that improvements are slow where they have to be made by competing companies fighting for high dividends, and that telegraphing in consequence was in a more backward state in the United Kingdom than in Switzerland and Belgium.

In September 1865, Mr. Scudamore was requested by the Postmaster-General to take the whole subject into consideration, and to report thereon. His first report was presented in July 1866, followed by a second in February 1868. These reports set forth that before December 1862 messages of twenty words were transmitted for fifteen pence to or from any part of Belgium, in which country the telegraphs are under the control of the State. At the end of 1862 the charge was reduced to tenpence, and in December 1865 the charge was still further reduced to fivepence. The hours of business in the telegraphic offices in Belgium are much the same as those adopted in England. The clerks have the power, which they use largely, of altering the wording of messages so as to make them read clearer, and to prevent mistakes—a plan which manifestly would not work in England, and which would lead to many legal and other difficulties. The result of the reductions in charges was, that in 1860 one telegram was transmitted in Belgium to every 218 letters passing through the post; in 1863, one message was transmitted to every 114 letters; and in 1866, the proportion was one telegram to every 37 letters. He also reported that the charge for the transmission of messages of twenty words between any two towns in Switzerland was tenpence. In 1860, one telegram was transmitted in Switzerland to every 84 letters; in 1863, one telegram to every 74 letters; and in 1866, one telegram to every 69 letters. In the United Kingdom the proportion of telegrams to letters was, in 1860, one to 296; in 1863, one to 197; and in 1866, one to 121. At the close of the year, the telegraphic systems of Belgium and Switzerland had been in operation about fifteen years, and the working expenses during that period had amounted in the case of Switzerland to about 68 per cent., and Belgium 62½ per cent. of the total revenue during the period. At the end of the year 1866, both Governments had a good surplus on hand from the telegraphic departments. The post offices of Switzerland and Belgium have less work than that of the United Kingdom, as shown by the following table, giving national statistics for the year 1865:—

Nation.	Number of Inland Telegrams.	Number of Inland Letters.
Belgium . . .	332,718	24,530,688
Switzerland . .	364,118	25,183,136
United Kingdom	4,662,687	706,057,667

From these figures, Mr. Scudamore concluded that the use of the telegraphs was in a more backward state in the United Kingdom than in Switzerland or Belgium; and he recommended their transference to the Government. One principal reason urged by him to prove that the Government could better afford to send messages at a lower rate than the companies was, that the post offices could spare for the use of the telegraph 12,000 offices rent-free, and a large staff of officials at present engaged, but not all of them fully employed throughout the whole of their hours of duty.

He therefore recommended the purchase of the telegraphs by the State. In August last an Act of Parliament was passed by the late Government sanctioning the plan, and authority was given to buy up the telegraphs by paying the companies £5,715,048 8*s.* 11*d.* (The odd elevenpence shows the extreme nicety of the calculation.) The Electric International Telegraph Company will receive £2,938,826 9*s.* 0*d.*; the British and Irish Magnetic, £1,243,536; Reuter's Telegram Company, Limited, £726,000; the Universal Private Telegraph Company, £184,421 10*s.*; the London and Provincial Telegraph Company, Limited, £60,000; and the United Kingdom Telegraph Company, Limited, £562,264 9*s.* 11*d.*

At the present time everything relating to the transfer of the telegraphs to the Government is in a transition state, very many of the arrangements not having as yet been completed. It is intended, if possible, to effect the transfer on the 1st of January next; but so much preliminary work remains to be done, that it is doubtful whether all will be ready by that date. A large room has been fitted up in the General Post Office, with telegraphic instruments, in order that the clerks on the premises may learn to work them; and "dummy" instruments for the use of learners have been sent to the post offices in the provinces. The apparatus for common use will be the Morse printing telegraph and the single needle instrument; a wise selection, for long experience has proved them to be the best to place in the hands of unscientific clerks. They are not very liable to get out of order, and are very certain in their indications.

The following are among the changes that will be gradually made, some of them, however, at so distant a date that even the preliminaries have not been arranged as yet. The nine large district post offices in London will be made central stations, and each one will be connected by wire with the subordinate offices in its district. The chief post office in each of the largest provincial towns will be made a central telegraphic station, and the chief provincial towns will be placed in direct communication with three of the largest central London offices, namely, those in the West Central, Western, and South-western districts, in addition to the chief office in the East Central district. Suborbinate offices will be opened throughout the kingdom at the money-order offices in all places having a population of 2,000 persons and upwards. Messages will be received at all post offices for transmission by hand in the ordinary way to stations in connection with the telegraphic lines; pillar boxes will be places of deposit for messages written on stamped paper; and, as a rule, all messages will have to be paid for in stamps. The charge for transmission of a message of twenty words from any one part of the United Kingdom to any other part will be one shilling; but when it has to be delivered at a considerable distance from the nearest terminal station, it will be forwarded from that station by post for a penny, or by special messenger at sixpence per mile. Facilities will be given for the transmission of money-orders by telegraph, and as soon as possible the charges for messages to foreign parts will be reduced. Such are the plans which will be carried out, some of which will be in a very forward state in a few weeks' time.

THE GOLD FIELDS OF VICTORIA

The Gold Fields and Mineral Districts of Victoria. By R. Brough Smyth. (Melbourne: J. Ferres; London: Trübner and Co.)

II.

ALTHOUGH large quantities of gold are obtained from the detrital accumulations which overlie the palæozoic rocks of Victoria, there can be no doubt that they have come originally from the decomposition and removal of the auriferous quartz veins by which these rocks are traversed. The gold is simply a part of the detritus, in the same way that the fragments of quartz, sandstone, and slate are. Each nugget and bit of gold is only a more or less water-worn pebble, its edges being, as a rule, less worn, and its size larger, the nearer it is found to its parent reef. Yet some writers have endeavoured to show that the nuggets really grow by a kind of accretion, each fragment of gold becoming larger by successive depositions of the metal held in solution in the water percolating through the gravels. Mr. Brough Smyth, in discussing these and other disputed questions, usually avoids the expression of any decided opinion of his own. He treats them very much as a judge treats the evidence at a trial, and he leaves the decision to the jurymen, his readers. Yet we can very commonly guess what his opinions are, though he may not expressly state them. He gives us a tolerably copious account of opinions which have been published relative to the origin of quartz veins, and among these a valuable series of notes and sections specially made for him by a mining engineer of repute in the colony. The whole of this subject is, he says, involved in obscurity; "and though it is not possible for any one who has given attention to it to attach equal weight to the several theories which have been proposed, he would do wrong rashly to dismiss any of them as altogether improbable." Perhaps a judicial summing-up of this kind was, in the circumstances, better than the keen advocacy of any one theory. What is of value to the engineer in the colony is, to know what has really been written about the veins; and this he can learn with ease and satisfaction from Mr. Smyth's pages.

Allusion was made, in the previous notice of this volume, to the excellence of the geological and mining sections. It is rare to meet with such sections, so clearly conceived, so tastefully drawn, and carrying with them such conviction of their truth. The plate illustrative of the Ballarat gold fields is quite a model of clearness and clever drawing. No colour is used, but the various rocks are sharply defined, while, by the kind of drawing given to each, the internal structure of the mass is felicitously rendered. In the way of illustrations, the book seems to have only one failing, but it is a serious one: there is no geological map of the colony. The map at the end does not supply the want. A little coloured sketch-map, giving a general outline of the distribution of the geological formations, would have been an invaluable addition to the book, and would have certainly been worth a whole chapter of description.

One of the most striking facts brought out by the data compiled by Mr. Smyth is the high geological antiquity of the present land-surface of Victoria, or, in other words, the immense period during which that surface has remained above the sea. The palæozoic strata form the framework out of which the contour of the land has been moulded. These strata have been curved and folded, thrown on end, inverted, fractured, and upheaved. But the surface outlines are not found to bear any close relation to the direction of the subterranean movements. "There is scarcely one range in the colony which is not due to denudation, and those following lines of upheaval have been so modified by the action of water, through countless ages, as to make it difficult to determine where and how the elevating forces have operated." The palæozoic rocks were carved out into systems of valleys by the descent of rain-water from the watersheds to the lower grounds. Along these valleys river-gravels were laid down. In later times many volcanoes broke out, and thick streams of basalt rolled into the valleys and buried the ancient river-courses. Thus, in many places, the surface and the drainage of wide areas were wholly changed. New streams began to flow and to excavate new channels, which often flowed across the trend of the older valleys lying buried beneath them. By slow degrees these later valleys sank deeper into the framework of the country, often cutting down through the older water-courses. Speaking of Gippsland, the author remarks that the streams "have scooped out deep valleys. The lofty hills have not been upheaved in isolated masses, but are the remains of formations which have been swept away by the slow action of water. If all the rock-formations could be restored and placed in the positions which they once occupied, Gippsland would be an immense nearly level plateau. As a familiar illustration, we may liken the mountains formed of palæozoic rocks to the humps of earth left by the navvy when he digs a cutting The grass on the surface of the hump shows what was once the height of the ground which has been removed; and the recent tertiary formations on the tops of the hills in Gippsland are evidence of the original height of the whole area. The rocks which once occupied the intervening spaces have been eroded by water; and the height of the hills above the valleys affords some hint as to the vertical extent which has been cut away." The author believes that Victorian surface-geology affords "an answer to those geologists who have urged that the greater amount of erosion everywhere has been effected by marine agency, and not by rivers, rains, and the wasting action of the atmosphere." And, indeed, no one can study the maps and sections in this volume without being convinced that the erosion of the present and of the old valley-system has been wholly a sub-aërial process.

Mining operations have done a good deal towards elucidating the older system of water-courses which were overflowed and buried beneath basalt. These water-courses or "leads," as the miners call them, contain richly auriferous "drifts," and they are accordingly explored and ransacked by shafts and adits. Thus, at Ballarat, the river Yarrowee must have had its course shifted considerably eastward by the overflow of basalt. Its old winding channel has been explored under the overlying basalt, and the channels of its tributary rivulets from the east have been followed under the bed of the present river.

From the shafts and the natural sections along the sides of the valleys, we learn that the volcanic phenomena continued to manifest themselves for a prolonged period. Showers of ashes and streams of basalt were thrown out at long intervals, during which gravel and sand were accumulated in the water-courses above the last erupted materials. Hence we now find sections where sheets of basalt alternate with stream-gravel and with layers of clay and ancient soil. As in Auvergne, the lapse of time which separated the oldest from the most recent volcanic rocks cannot but have been great. On the one hand, some of the basalt plateaux have been trenched by valleys several hundred feet deep, and fragments of the plateaux have been left isolated; on the other hand, there occur craters and cones of ash so fresh that not many centuries may have passed away since they ceased to be in eruption.

But the changes of level effected by the outpouring of volcanic rocks at the surface have not been the only causes at work in greatly modifying the drainage of the country. In comparing the water-courses with the quantity of water flowing in them, still more in examining the endless lines of water-course in which there is no water at all, we are forced to conclude that the rainfall must be much less now than it was in a very recent geological period. Over a large part of Victoria the ground is low and sandy; and there the streams which come down from the hills, after wandering hopelessly about among pools and scrub, disappear altogether, being partly evaporated and partly absorbed into the parched soil. Mr. Smyth mentions an interesting fact when he says that the old drainage system of the country can often be traced only by the vegetation. "The Murray pine, in the midst of small Eucalypti, marks distinctly the line of the ancient water-courses." "The beds of old lakes and tributary creeks can now be discovered in some places only by the timber which they bear." This general desiccation of the country points to some wide-spread geological cause. Possibly it may be due—in part at least—to a comparatively recent elevation of the northern part of Australia, whereby the northerly winds, having a broad belt of land to pass over, lose much of their moisture before they reach the high lands of Victoria and New South Wales. The want of an abundant and constant supply of water is in some parts of the colony a serious obstacle to improvement. In particular, it operates most prejudicially upon gold-mining: no pains ought to be spared, therefore, to prevent the destruction of timber, and to take every opportunity of planting it where it is likely to be of service.

In conclusion, the volume which Mr. Smyth has produced, though too bulky and too detailed for general readers, is a storehouse of information on the subject of which it treats, and will undoubtedly take its place as one of the standard works of reference for all that relates to the occurrence and the mining of gold. ARCH. GEIKIE

OLIVER'S INDIAN BOTANY

First Book of Indian Botany. By Daniel Oliver, F.R.S., F.L.S., Keeper of the Herbarium and Library of the Royal Gardens, Kew, and Professor of Botany in University College, London. With numerous Illustrations. Small 8vo. pp. xii. and 394. (London: Macmillan and Co. 1869.)

THE want of special works introductory to the study of the botany of the principal tropical and southern countries of the globe has long been felt. The medical man, the student, and the amateur resident or travelling in India and our principal colonies, find it hard work to keep up or get up their botany by introductions and class-books founded on British plants, whilst the schoolmaster would find himself very much abroad who should attempt to teach his pupils Australian Botany by Henfrey's or Balfour's Introductions, or by Oliver's Elements. Hence the need of a series of works devoted to the teaching of botany with a special reference to the wants of the sojourners in foreign parts, and illustrated by the common plants to be found therein. With the exception of the admirable text-books of American Botany, of Asa Gray, we know of no work of the nature indicated, illustrative of any extra-European Flora. There was, indeed, some talk a few years ago of a series of such works, embracing all departments of Natural History, being authorised by the local governments of India,—but nothing has come from that quarter: and much as we then regretted the supineness of the Indian authorities in the matter, we no longer do so; for India could assuredly never have produced a work of so high an order as that whose title stands at the head of this notice, for a better considered and better executed work of the kind it has never been our good fortune to meet with, and it at once places its author first in the rank of English writers of Botanical Class-books.

Professor Oliver states in the preface that his book is in substance his "Lessons on Elementary Botany," adapted for use in India: but we find that it is this and a great deal more; for after following that excellent model in the part that relates to the structure of plants and the functions of their organs, a larger portion of the book is taken up with concise descriptions of 116 principal natural orders of India, illustrated by a clear analysis of the parts of a very common Indian flower, insomuch that, if we were asked what is the best text-book for a student in this country who wishes to acquire more knowledge of botany than is needful for a mere pass examination, without at all setting aside

Vertical Section of flower of *Nelumbium*, showing the hypogynous stamen and carpels singly immersed in a turbinate receptacle

the former work just mentioned, we do not know any to which we could so conscientiously direct attention, as almost all the plants in question may be easily found in any good botanic garden. Attached to each of the descriptions is a schedule of the floral characters on Henslow's plan, and a brief sketch of the principal matters of interest, structural, physiological, and economic, to be observed in Indian plants of the order, whilst the greater part are further accompanied by beautiful and original drawings and diagrams by Fitch, which delineate the floral organs graphically and naturally. We may add, too, that the more advanced and inquiring student has his attention occasionally directed to matters on which additional information is desired; as, for example, in the genus Drosera, where our author writes: "Some species exhibit a low sensibility or irritability in the leaves, which curl upon particles placed on their glandular hairs. Is this the case with Indian species? and do they appear to discriminate between organic and inorganic matter offered to them?"

Or, again, in Campanulaceæ: "Two small flowered Campanulas of Northern India exhibit the curious phenomenon of dimorphic flowers. Besides the flowers of usual form, there are smaller ones about the size of coriander seeds, which never open, but which nevertheless mature abundant seed. The latter must necessarily be self-fertilised, while the flowers of ordinary form are often, if not always, crossed by the pollen of other flowers of the same species. The part which these hermetically-sealed flowers play in the economy of plants is not yet well made out. They are found in isolated species and genera belonging to widely different natural orders, and it would be worth while to look for fresh examples amongst Indian weeds."

We consider such suggestions of extreme importance, as some stimulus of this kind is wanted to urge students to something more than the requirements of the passing time. It is notorious that though great acuteness is often shown amongst the higher proficients in botany who come before public examiners, not one in a hundred goes a step beyond what is wanted to secure a certain class or scholarship. There must, we imagine, be something in the style of public teaching on such subjects which seems to check all real interest, much less to excite a spirit of love or enthusiasm for science itself, without which it is quite certain that we shall have no new fellow-workers.

Sacred Lotus (*Nelumbium speciosum*), about one-tenth to one-fifteenth natural size

In conclusion, we would recommend a close study of the precision of our author's descriptions, and the clearness and terseness of his diction, to the writers of botanical text-books, as worthy of their imitation. These are qualities which improve the mind of the pupil more

Screw Pine (*Pandanus*), showing aërial adventitious roots than is usually supposed. They are conspicuously present in French class-books, but their absence is too often as conspicuous in English ones.

The author states in his preface that his chief difficulty has been in the selection of suitable plants to illustrate the natural orders, especially as types which are common in some parts of India, are absent in others. We think, however, that he has been extremely judicious in his selection, which certainly required no little local knowledge, and he has very properly recorded his obligations in this respect to our two great authorities on Indian botany, Dr. Hooker and Dr. Thomson.

If we were required to point out the especial part of the volume in which we think the author's tact has been more peculiarly developed, we would instance that in which he might be supposed to be least familiar. We have read with pleasure the observations on the cryptogamic orders, in admiration of the immense mass of information which is condensed within a short compass, and of its intrinsic value. We are glad to observe that some definitions are to be found in the very copious index, which did not come within the author's views in the text, and it would add greatly to their value if in a future edition little illustrations of such matters could be added in the margin. We have selected some woodcuts which are fair specimens of the 240 engravings in the book.

M. J. BERKELEY

OUR BOOK SHELF

Literature of Natural History.—*Bericht über die wissenschaftlichen Leistungen in der Naturgeschichte der niederen Thiere während der Jahre* 1866 *und* 1867. Von Dr. Rudolph Leuckart. (Berlin, 1869. London: Williams and Norgate.)

NOW that original observers in every branch of natural history are to be found in all civilised countries, it is only by means of such reports as this that the working naturalist can keep himself acquainted with the actual state even of that department of his science which he himself more particularly cultivates. When, as in the present case, a man of real eminence as a naturalist has at his command all the chief languages of Europe, and gives us year by year no mere dry list of papers but full analyses accompanied by critical remarks, we feel that it is not easy to exaggerate the importance of his labours as affecting the general progress of zoology. For the sake of any worker who may be unacquainted with Prof. Leuckart's reports, we may mention that they embrace the groups Vermes, Echinodermata, Cœlenterata, and Protozoa, as defined by German writers. The Rotiferi and Bryozoa are included under the Vermes.

Parsons on the Rose. *A Treatise on the Propagation, Culture, and History of the Rose.* By Samuel B. Parsons. Pp. 215. Illustrated. (New York. London: Trübner and Co.)

THE horticultural portion of this work, occupying its first nine chapters, is a digest of some of our best English authors on the subject. Chapter IX., on the Diseases and Insects attacking the Rose, is confessedly little more than a reproduction of the writings of Harris on the same topic, and of use *only* to the American cultivator.

The historical part, contained in Chapters X. to XV., exhibits a remarkable collation of gleanings from history—ancient, mediæval, or modern—of legends, fables, ceremonies, &c., all having some connection (although in some instances rather remote) with the rose. R. C. K.

The Romance of Natural History. By Philip Henry Gosse, F.R.S. 1st and 2d series. (London: James Nisbet and Co.)

THE popularity of these well-known volumes may be looked upon as a standing protest against the common opinion that the exact study of natural objects is inimical to a poetic conception and romantic love of nature. We know of no more delightful New Year's gift for an intelligent boy than Dr. Gosse's eloquent and well-illustrated work.

Our Dumb Neighbours; or, Conversations of a Father with his Children on Domestic and other Animals. By the Rev. T. Jackson. (London: S. W. Partridge and Co.)

THIS is a first-rate picture-book of animals for children. The text is not up to the level of the woodcuts.

Gedächtnisrede auf Alexander von Humboldt. Von H. W. Dove. (Berlin: Harrwitz und Gossman, 1869.)

Alexander von Humboldt. Festrede von Dr. A. Bastian. (Berlin: Wiegandt and Hemfel, 1869.)

THESE are addresses delivered, on the occasion of the recent Humboldt Centenary, before the Prussian Academy of Sciences, and the joint meeting of the scientific societies of Berlin. The memoir of Professor Dove records many interesting personal characteristics of the great German *savant*.

Monthly Bulletin of the Imperial Society of Acclimatation Second Series, January to November 1869.

THE Acclimatation (or, as we term it, Acclimatisation) Society of Paris, was founded in 1854, and appears to be in a most flourishing and active condition. The beautiful gardens of the society in the Bois de Boulogne are known to every visitor of Paris; but the work done by the society can be best judged of by glancing at its "Bulletins." An important part of the operations of the society consists in the distribution of animals and plants to its members, who may wish to experiment in endeavouring to acclimatise such useful species as the society may obtain. Pisciculture of all kinds, marine and fresh-water, occupies a large share of the attention of the society: ostreo-culture also and the coral-fisheries—which the French Government has most anxiously fostered on the coast of Algeria—are noticed in articles giving account of recent progress in these departments of industry. The cultivation of the silkworm, however, calls forth the most notable exertions of the society. Large districts in the south of France are given up to this employment. On some of the limestone plateaux north of Nimes—which are bare for miles and present no soil—holes are excavated, and the necessary earth in which to place the mulberry-trees which are to feed the crops of silkworms reared by the inhabitants of this district is fetched from thirty miles' distance—so valuable is the crop of silk when obtained. To these "Bulletins" we shall return as they make their monthly appearance. At present, on glancing through the year's accumulation, we find, amongst other facts of more than economical interest, an account of the introduction of the salmon of the Rhine into the Lake of Geneva. It has always been held doubtful as to whether salmon could thrive when access to the sea was impossible. The great length of the Rhone, and the overpowering force of its waters at the spot near Bellegarde, called *la perte du Rhône*, renders the Lake of Geneva practically closed from communication with the sea for all icthyological purposes. Hence it is exceedingly interesting to find that success has attended the efforts of Dr. Chavannes and others to introduce the Rhine salmon to this area. Specimens, put in among many thousand others in 1857, have been recaptured, weighing over four pounds, and with roe; whilst others, evidently the offspring of these, have been also taken. Further experiments are being made on an *actually* closed lake.

A PLEA FOR THE MATHEMATICIAN

[At the request of the Editor, Professor Sylvester has furnished the following abridgment of his opening address to the Mathematical and Physical Section of the British Association at Exeter, with some supplemental notes appended in the course of its passing through the press.—ED.]

I.

IT is said of a great party leader and orator in the House of Lords that, when lately requested to make a speech at some religious or charitable meeting, he declined to do so on the ground that he could not speak unless he saw an adversary before him—somebody to attack or reply to. In obedience to a somewhat similar combative instinct, I set to myself the task of considering certain recent utterances of a most distinguished member of this Association, one whom I no less respect for his honesty and public spirit than I admire him for his genius and eloquence, but from whose opinions on a subject which he has not studied I feel constrained to differ. Göthe has said—

> " Verständige Leute kannst du irren sehn
> In Sachen nämlich, die sie nicht verstehn."

Understanding people you may see erring—in those things, to wit, which they do not understand.

I have no doubt that had my distinguished friend, the probable President-elect of the next Meeting of the Association, applied his uncommon powers of reasoning, induction, comparison, observation, and invention to the study of mathematical science, he would have become as great a mathematician as he is now a biologist; indeed he has given public evidence of his ability to grapple with the practical side of certain mathematical questions; but he has not made a study of mathematical science as such: and the eminence of his position and the weight justly attaching to his name, render it only the more imperative that any assertions proceeding from such a quarter, which may appear to be erroneous, or so expressed as to be conducive to error, should not remain unchallenged or be passed over in silence.

He says "mathematical training is almost purely deductive. The mathematician starts with a few simple propositions, the proof of which is so obvious that they are called self-evident, and the rest of his work consists of subtle deductions from them. The teaching of languages, at any rate as ordinarily practised, is of the same general nature—authority and tradition furnish the data, and the mental operations are deductive." It would seem from this that, according to Prof. Huxley, the business of the mathematical student is from a limited number of propositions (bottled up and labelled ready for future use) to declare any required result by a process of the same general nature as a student of language employs in declining and conjugating his nouns and verbs: that to make out a mathematical proposition and to construe or parse a sentence are equivalent or identical mental operations. Such an opinion scarcely seems to need serious refutation. The passage is taken from an article in *Macmillan's Magazine* for June last, entitled "Scientific Education—Notes of an After-dinner Speech," and I cannot but think would have been couched in more guarded terms by my distinguished friend had his speech been made before dinner instead of after.

The notion that mathematical truth rests on the narrow basis of a limited number of elementary propositions, from which all others are to be derived by a process of logical inference and verbal deduction, has been stated still more strongly and explicitly by the same eminent writer in an article of even date with the preceding, in the *Fortnightly Review*, where we are told that "Mathematics is that study which knows nothing of observation, nothing of experiment, nothing of induction, nothing of causation." I think no statement could have been made more opposite to the facts of the case: that mathematical analysis is constantly invoking the aid of new principles, new ideas, and new methods, not capable of being defined by any form of words, but springing direct from the inherent powers and activity of the human mind, and from continually renewed introspection of that inner world of thought of which the phenomena are as varied and require as close attention to discern as those of the outer physical world—to which the inner one in each individual man may, I think, be conceived to stand in somewhat the same general relation of correspondence as a shadow to the object from which it is projected, or as the hollow palm of one hand to the close fist which it grasps of the other: that it is unceasingly calling forth the faculties of observation and comparison, that one of its principal weapons is induction, that it has frequent recourse to experimental trial and verification, and that it affords a boundless scope for the exercise of the highest efforts of imagination and invention.*

Lagrange, than whom no greater authority could be quoted, has expressed emphatically his belief in the importance to the mathematician of the faculty of observation :† Gauss has called mathematics a science of the

* The annexed instance of Mathematical Euristic is, I think, from its intrinsic interest, worthy of being put on record. The so-called canonical representation of a binary quartic of the eighth degree I found to be a quartic multiplied by itself, together with a sum of powers of its linear factors, just as for the fourth degree it was known to be a quadric into itself, together with a sum of powers of its factors: but for a sextic a cubic multiplied into itself, with a tail of powers as before, was not found to answer. To find the true representation was like looking out into universal space for a planet desiderated according to Bode's or any other empirical law. I found my *desideratum* as follows: I invented a catena of morphological processes which, applied to a quadric or to a quartic, causes each to reproduce itself: I then considered the two quadrics and two quartics to be noumenally distinguishable (one as an auto-morphic derivative of the other), although phenomenally identical. The same catena of processes applied to the cubic gave no longer an identical but a distinct derivative, and the product of the two I regarded as the analogue of the before-mentioned square of the quadric or of the quartic. This product of a cubic by its derivative so obtained together with a sum of powers of linear factors of the original cubic, I found by actual trial to my great satisfaction satisfied the conditions of canonicity, and it was thus I was led up to the desired representation which will be found reproduced in one of Prof. Cayley's memoirs on Quantics and in Dr. Salmon's lectures on Modern Algebra. Here certainly induction, observation, invention, and experimental verification all played their part in contributing to the solution of the problem. I discovered and developed the whole theory of canonical binary forms for odd degrees, and, as far as yet made out, for even degrees too, at one evening sitting, with a decanter of port wine to sustain nature's flagging energies, in a back office in Lincoln's-Inn-Fields. The work was done, and well done, but at the usual cost of racking thought—a brain on fire, and feet feeling, or feelingless, as if plunged in an ice pail. *That night we slept no more.* The canonisant of the quartic (its cubic covariant) was the first thing to offer itself in the inquiry. I had but to think the words "Resultant of Quintic and its Canonisant," and the octodecadic skew invariant would have fallen spontaneously into my lap. By quite another mode of consideration M. Hermite subsequently was led to the discovery of this, the key to the innermost sanctuary of Invariants—so hard is it in Euristic to see what lies immediately before one's eyes. The disappointment weighed deeply, far too deeply, on my mind, and caused me to relinquish for long years a cherished field of meditation: but the whirligig of time brings about its revenges. Ten years later this same canonisant gave me the upper hand of my honoured predecessor and guide, M. Hermite, in the inquiry (referred to at the end of this address) concerning the invariantive criteria of the constitution of a quintic with regard to the real and imaginary. By its aid I discovered the essential character of the famous amphigenous surface of the ninth order, and its bicuspidal universal section of the fourth order (otherwise termed the Bicorn), as may be seen in the third part of my Triology, printed in the Philosophical Transactions.

† I was under the conviction that a passage to that effect from Lagrange had been cited to me some years ago by M. Hermite of the Institute of France; on applying to him on the subject, I received the following reply:—

"Relativement à l'opinion que suivant vous j'aurais attribuée à Lagrange, je m'empresse de vous informer qu'il ne faut aucunement, à ma connaissance, l'en rendre responsable. Nous nous sommes entretenus du rôle de la *faculté d'observation dans les études que nous avons poursuivies de concert pendant bien des années*, et c'est alors, sans doute, que je vous aurai conté une anecdote que je tiens de M. Chevreul. M. Chevreul, allant à l'Institut dans la voiture de Lagrange, a été vivement frappé du sentiment de plaisir avec lequel ce grand géomètre lui faisait voir, dans un travail manuscrit, la beauté extérieure et artistique, si je peux dire, des nombreuses formules qui y figuraient. Ce sentiment nous l'avons tous éprouvé en faisant, avec sincérité, abstraction de l'idée analytique dont les formules sont l'expression écrite. Il y a là, n'est-il point vrai, un imperceptible lien qui rattache au monde de l'art le monde abstrait de l'algèbre et de l'analyse, et j'oserai même vous dire que je crois a des sympathies réelles, qui vous font trouver un charme, dans les notations d'un auteur, et dans les répulsions qui éloignent d'un autre, par l'apparence seule des formules."

I am, however, none the less persuaded that on one or more than one occasion, M. Hermite, speaking of Lagrange, expressed to me, if not as I supposed on Lagrange's, then certainly on his own high authority, "that the faculty of observation was no less necessary for the successful cultivation of the pure mathematical than of the natural sciences."

eye, and in conformity with this view always paid the most punctilious attention to preserve his text free from typographical errors: the ever to be lamented Riemann has written a thesis to show that the basis of our conception of space is purely empirical, and our knowledge of its laws the result of observation; that other kinds of space might be conceived to exist, subject to laws different from those which govern the actual space in which we are immersed; and that there is no evidence of these laws extending to the ultimate infinitesimal elements of which space is composed. Like his master Gauss, Riemann refuses to accept Kant's doctrine of space being a form of intuition,* and regards it as possessed of physical and objective reality. I may mention that Baron Sartorius von Waltershausen (a member of this Association), in his biography of Gauss ("Gauss zu gedächtniss"), published shortly after his death, relates that this great man was used to say that he had laid aside several questions which he had treated analytically, and hoped to apply to them geometrical methods in a future state of existence, when his conceptions of space should have become amplified and extended; for as we can conceive beings (like infinitely attenuated book-worms in an infinitely thin sheet of paper) which possess only the notion of space of two dimensions, so we may imagine beings capable of realising space of four or a greater number of dimensions.† Our Cayley, the central luminary, the Darwin of the English school of mathematicians, started and elaborated at an early age, and with happy consequences, the same bold hypothesis.

Most, if not all, of the great ideas of modern mathematics have had their origin in observation. Take, for instance, the arithmetical theory of forms, of which the foundation was laid in the diophantine theorems of Fermat, left without proof by their author, which resisted all the efforts of the myriad-minded Euler to reduce to demonstration, and only yielded up their cause of being when turned over in the blowpipe flame of Gauss's transcendent genius; or the doctrine of double periodicity, which resulted from the observation by Jacobi of a purely analytical fact of transformation; or Legendre's law of reciprocity; or Sturm's theorem about the roots of equations, which, as he informed me with his own lips, stared him in the face in the midst of some mechanical investigations connected (if my memory serves me right) with the motion of compound pendulums; or Huyghen's method of continued fractions, characterised by Lagrange as one of the principal discoveries of "that great mathematician, and to which he appears to have been led by the construction of his 'Planetary Automaton;'" or the new algebra, speaking of which one of my predecessors (Mr. Spottiswoode) has said, not without just reason and authority, from this chair, "that it reaches out and indissolubly connects itself each year with fresh branches of mathematics, that the theory of equations has almost become new through it, algebraic geometry transfigured in its light, that the calculus of variations, molecular physics, and mechanics" (he might, if speaking at the present moment, go on to add the theory of elasticity and the developments of the integral calculus) "have all felt its influence."

Now this gigantic outcome of modern analytical thought, itself, too, only the precursor and progenitor of a future still more heaven-reaching theory, which will comprise a complete study of the interoperation, the actions and reactions, of algebraic forms (Analytical Morphology in its absolute sense), how did this originate? In the accidental observation by Eisenstein, some twenty or more years ago, of a single invariant (the Quadrinvariant of a Binary Quartic) which he met with in the course of certain researches just as accidentally and unexpectedly as M. Du Chaillu might meet a Gorilla in the country of the Fantees, or any one of us in London a White Polar Bear escaped from the Zoological Gardens. Fortunately, he pounced down upon his prey and preserved it for the contemplation and study of future mathematicians. It occupies only part of a page in his collected posthumous works. This single result of observation (as well entitled to be so called as the discovery of Globigerinæ in chalk

* It is very common, not to say universal, with English writers, even such authorised ones as Whewell, Lewes, or Herbert Spencer, to refer to Kant's doctrine as affirming space "to be a form of thought," or "of the understanding." This is putting into Kant's mouth (as pointed out to me by Dr. C. M. Ingleby), words which he would have been the first to disclaim, and is as inaccurate a form of expression as to speak of "the plane of a sphere," meaning its surface or a superficial layer, as not long ago I heard a famous naturalist do at a meeting of the Royal Society. Whoever wishes to gain a notion of Kant's leading doctrines in a succinct form, weighty with thought, and free from all impertinent comment, should study Schwegler's Handbook of Philosophy, translated by Stirling. He will find in the same book a most lucid account of Aristotle's doctrine of matter and form, showing how matter passes unceasingly upwards into form, and form downwards into matter; which will remind many of the readers of NATURE of the chain of depolarisations and repolarisations which are supposed to explain the decomposition of water under galvanic action, eventuating in oxygen being thrown off at one pole and hydrogen at the other (it recalls also the high algebraical theories in which the same symbols play the part of operands to their antecedents and operators to their consequents): at one end of the Aristotelian chain comes out πρώτη ὕλη, at the other, πρῶτον εἶδος. We have, then, only to accept and apply the familiar mathematical principle of the two ends of infinity being one and the same point, and the otherwise immoveable stumblingblock of duality is done away with, and the universe reintegrated in the wished-for unity. For this corollary, which to many will appear fanciful, neither Aristotle nor Schwegler is responsible. We perfectly understand how in perspective the latent polarities of any point in a closed curve (taken as the object) may be developed into and displayed in the form of a duad of *quasi* points at an infinite distance from each other in the picture. In like manner we conceive how *actuality* and *potentiality* which exist indistinguishably as one in the *absolute* may be projected into seemingly separate elements or moments on the plane of the human understanding. Whatever may be the merits of the theory in itself, this view seems to me to give it a completeness which its author could not have anticipated, and to accomplish what Aristotle attempted but avowedly failed to effect, viz. the complete subversion of the "Platonic Duality," and the reintegration of matter and mind into one.

† It is well known to those who have gone into these views, that the laws of motion accepted as a fact suffice to prove in a general way that the space we live in is a flat or level space (a "homaloid"), our existence therein being assimilable to the life of the bookworm in a flat page: but what if the page should be undergoing a process of gradual bending into a curved form? Mr. W. K. Clifford has indulged in some remarkable speculations as to the possibility of our being able to infer, from certain unexplained phenomena of light and magnetism, the fact of our level space of three dimensions being in the act of undergoing in space of four dimensions (space as inconceivable to us as our space to the supposititious bookworm) a distortion analogous to the rumpling of the page. I know there are many, who, like my honoured and deeply lamented friend the late eminent Prof. Donkin, regard the alleged notion of generalised space as only a disguised form of algebraical formulisation; but the same might be said with equal truth of our notion of infinity in algebra, or of impossible lines, or lines making a zero angle in geometry, the utility of dealing with which as positive substantiated notions no one will be found to dispute. Dr. Salmon, in his extensions of Chasles' theory of characteristics to surfaces, Mr. Clifford, in a question of probability (published in the *Educational Times*), and myself in my theory of partitions, and also in my paper on Barycentric Projection in the *Philosophical Magazine*, have all felt and given evidence of the practical utility of handling space of four dimensions, as if it were conceivable space. Moreover, it should be borne in mind that every perspective representation of figured space of four dimensions is a figure in real space, and that the properties of figures admit of being studied to a great extent, if not completely, in their perspective representations. In philosophy, as in æsthetic, the highest knowledge comes by faith. I know (from personal experience of the fact) that Mr. Linnell can distinguish purple tints in clouds where my untutored eye and unpurged vision can perceive only confused grey. If an Aristotle, or Descartes, or Kant assures me that he recognises God in the conscience, I accuse my own blindness if I fail to see with him. If Gauss, Cayley, Riemann, Schalfli, Salmon, Clifford, Krönecker, have an inner assurance of the reality of transcendental space, I strive to bring my faculties of mental vision into accordance with theirs. The positive evidence in such cases is more worthy than the negative, and actuality is not cancelled or balanced by privation, as matter plus space is none the less matter. I acknowledge two separate sources of authority—the collective sense of mankind, and the illumination of privileged intellects. As a parallel case, I would ask whether it is by demonstrative processes that the doctrine of limits and of infinitely greats and smalls, has found its way to the ready acceptance of the multitude; or whether, after deducting whatever may be due to modified hereditary cerebral organisation, it is not a consequence rather of the insensible moulding of the ideas under the influence of language which has become permeated with the notions originating in the minds of a few great thinkers? I am assured that Germans even of the non-literary classes, such as ladies of fashion and novel readers, are often appalled by the habitude of their English friends in muddling up together, as if they were nearly or quite the same thing, the reason and the understanding in doing into English the words Vernunft and Verstand, thereby confounding distinctions now become familiar (such is the force of language) to the very milkmaids of Fatherland.

As a public teacher of mere striplings, I am often amazed by the facility and absence of resistance with which the principles of the infinitesimal calculus are accepted and assimilated by the present race of learners. When I was young, a boy of sixteen or seventeen who knew his infinitesimal calculus would have been almost pointed at in the streets as a prodigy, like Dante, as a man who had seen hell. Now-a-days, our Woolwich cadets at the same age talk with glee of asymptotes and points of contrary flexure, and discuss questions of double maxima and minima, or ballistic pendulums, or motion in a resisting medium, under the familiar and ignoble name of *sums*.

of of the Confoco-ellipsoidal structure of the shells of the Foraminifera), which remained infructuous in the hands of its distinguished author, has served to set in motion a train of thought and propagated an impulse which have led to a complete revolution in the whole aspect of modern analysis, and will continue to be felt until Mathematics are forgotten and British Associations meet no more.

J. J. SYLVESTER

TECHNICAL EDUCATION

MANCHESTER at all events is beginning to be alive to the present situation, and at a meeting on the 18th inst., the following document, expressing the views of the Council of the Society of Arts, was read.

1. The Council of the Society of Arts have received a communication from Owens College Extension Committee, Manchester, asking their co-operation in the extension of technical education, or, more properly, Scientific Instruction; and it affords them much pleasure to do whatever lies in their power to advance this important national object. With this view, the Council have invited the members of the Society, and especially those resident in the locality, as well as the authorities of Owens College, to meet them in conference on the subject, to discuss the best means by which scientific instruction may be promoted, and to establish an organisation which will keep an influence at work to accomplish what is so urgently needed.

2. The necessity and importance of improved scientific instruction for the people of the United Kingdom, in order that they may be placed in a favourable position in the race of industrial competition with other nations, has, for some time past, been forced upon the notice of the Society of Arts, whose chartered objects are the Promotion of Arts, Manufactures, and Commerce.

3. The great international displays of industry in 1851, 1855, 1862, and 1867, have shown unmistakeably that, if this country is to maintain her position as a commercial and manufacturing power, the people (and in this term are comprehended not only artisans, but also persons of higher position in the social scale) must have at their command the means of education improved in its general character, and embracing, if not based upon, science to a far greater extent than has hitherto been the case. The official jury reports at all the exhibitions abound in declarations of this character, and the country can no longer afford to ignore the fact, but must earnestly set to work to bring about a change. These reports, as well as those of the artisans who were sent to the Paris Exhibition of 1867 by the Society, one and all point out the great educational facilities which are available for all classes, and especially the artisan class, upon the Continent.

4. The Council are of opinion that existing schools and colleges, where science has hitherto been all but excluded, should adopt some means for its being taught; and that where such teaching already exists, measures should be taken for extending the usefulness of the institutions, and rendering them more easy of access to the great body of the people; whilst in localities where no such facilities exist, means should be taken to secure their foundation. The localities must themselves stir in this reform, and their efforts should be aided by pecuniary assistance and countenance by the State.

5. The nation must set itself earnestly to work to bring about the sought-for change in the education of the people. The evils have been so often pointed out, that it is unnecessary to enter into detail; our duty is to supply the remedy. This the Council believe to be by the localities setting themselves heartily to work, and when they have shown themselves in earnest by raising funds and organising establishments for the teaching of science, they should be entitled, as of right, to aid from the State.

6. In order, however, that such establishments, colleges, or schools should be of value to the mass of the people, so that they can take advantage of the facilities which would then be offered to them, it is absolutely necessary that elementary education, commonly known as primary education, should be extended far more widely than at present. To an ignorant population the establishment of colleges and schools for the teaching of science will be of little avail, and unless the blessings of an ordinary elementary education, *i.e.*, reading, writing, and arithmetic, at least, can be more diffused, so as to place our people on a par with those of Switzerland, Prussia, Saxony, &c., the attempt to extend the teaching of science will be in vain. Again, not only must we have improved elementary education, but these elements must themselves be taught by improved methods and organisation, so that less time may be occupied in acquiring them, thus leaving free for the learning of elementary science some of those years which are now unnecessarily taken up in mastering the mere rudiments of knowledge. Abroad it is the custom of the State only to deal with this and many other matters of public concern, but such is not the case here. The Council do not recommend State interference as of choice, but of necessity. This work of education must be done, and will have to be done, wholly by Government, if not otherwise. Experience proves that it can be done by a combination of voluntary efforts with Government aid, as in the existing system of primary education, and in the instruction aided by the Science and Art Department. The Council think that the work is to be done in part nationally, in part voluntarily, but not upon a haphazard system.

7. Adam Smith, the earliest, and, perhaps, the first English writer on political economy, as well as Mr. J. Stuart Mill, its present most able exponent, recommend scientific instruction as profitable to the nation. Her Majesty's Government must not plead economy as an excuse, for the highest and wisest economy comes out of wise expenditure.

8. The Council believe that this is the feeling of the country, which the Government will regard with respectful attention. Government must be urged to co-operate with Owens College and other bodies, either existing or to be established. Parliamentary grants are now made to the old universities of England and Scotland, and to the Queen's Colleges in Ireland, and there is no reason why the same principle should not be extended, and grants made to modern educational establishments in the great centres of industry. The Council are of opinion that a Government resulting from a wide representation of the whole people ought adequately to represent the highest intelligence and aspirations of that people for improvement, and not limit its responsibility and its labours to matters of police. There can be no more profitable investment of national capital drawn from taxes paid by the whole nation, than in promoting the best education among all classes of the people, and the widest extension of sound knowledge, on which the Arts, Manufactures, and Commerce of a kingdom rest.

At the meeting, the following resolution, proposed by Professor Jack, was carried unanimously:—

"That the best interests of the country demand the establishment of a complete system of primary education, the extension of the system of science classes under a responsible department of the Government, and under a definite plan, and especially the establishment of Science Colleges in the principal industrial centres of the United Kingdom: and such colleges ought to be established and maintained partly by local efforts, and partly by liberal assistance from the State; and existing institutions such as Owens College ought to be made available for the purpose."

For the present, we content ourselves with chronicling these facts, and calling upon other centres of industry, such as Birmingham, to help to bring the pressure of public opinion to bear upon the members of the Government, who, perhaps, more than anyone else, require to be taught the vital importance of technical education to the future national life.

WHENCE COME METEORITES?

IN examining a mass of meteoric iron found in the Cordillera of Deesa (Chili), M. Stanislas Meunier, of the Museum of Natural History in Paris, has discovered evidences of an unexpected relationship between this iron and two meteorites fallen at a great distance from Chili; viz. a mass of iron found at Caille (Alpes Maritimes), and a stone which fell at Sétif (Algeria) June 9, 1867.

The meteorite of Deesa is a mixture of these two rocks: it is composed of iron which is identical with that of Caille, injected in a state of fusion into a stone which is identical with that of Sétif. The iron of Deesa is thus evidently an eruptive rock, and it is the first hitherto observed among meteorites. Besides this, it is asserted that the iron resembling that found at Caille, and the stone resembling that of Sétif, have been mutually connected by stratification upon an unknown globe, and it is the first time that such a connection has been materially demonstrated.

M. Meunier remarks that the meteorites which now arrive upon the earth are not of the same mineralogical nature as those which fell in past ages. Formerly iron fell; now stones fall. During the last 118 years there have been in Europe but three falls of iron, whereas there have been, annually, on an average, three falls of stones. The greater number of meteoric irons, which exist in the Paris collection, have fallen on the earth at undetermined epochs; all the meteoric stones are of comparatively recent date. Perhaps we are even justified in saying that stones of a new kind are beginning to arrive, for falls of *carbonaceous meteorites* were unknown before the year 1803, and four have been observed since then.

From this assemblage of facts, M. Stanislas Meunier concludes that meteorites are the fragments of one or more heavenly bodies which, at a period relatively recent (for these waifs are never found except in superficial strata), revolved round the earth, or perhaps round the moon. Having, in the course of ages, lost their own proper heat and become penetrated by the cold of space, they have arrived, much sooner than the moon, by reason of their inferior volume, at the last term of the molecular actions which are operating upon our satellite, and which are rendered evident to our eyes by the enormous crevices, the deep fissures with which it is furrowed. Split in all directions, they have fallen to ruin, and their fragments, remaining scattered along the orbit, so as to form a circle more or less complete, have at the same time become arranged, according to their density, in zones concentric with the focus of attraction towards which they are constantly impelled by the resistance of the ethereal medium through which they move. The masses nearest to the centre, and which were principally composed of iron, were the first to fall; afterwards came the stones, in which period we now are. Hereafter, perhaps, will arrive meteorites analogous to our crystallised formations, and perhaps even to our stratified beds.

Thus meteorites, the veritable products of demolition, represent, according to M. Meunier, the last period of the evolution of planetary bodies. The incandescent orb, the sun, figures at the present day in our system as the sole representative of the primitive state through which the earth, and all the other bodies which revolve around it, have passed; the moon representing the future which awaits the terrestrial sphere, now in all the plenitude of life; and, finally, meteorites show us what becomes of the dead stars, how they are decomposed, and how their materials return into the vortex of life.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Dr. Livingstone's Explorations.

It certainly is to be regretted that the information received from Dr. Livingstone should be so imperfect. Still, though insufficient in itself, perhaps, to warrant our arriving at any positive conclusion respecting his claim to have discovered the chief sources of the Nile, the information furnished by him affords material aid towards the solution of that great problem of African geography, and is generally of much greater value, in my estimation, than it would appear to be in that of your learned correspondent "F.R.G.S."

Before adverting to the main subject, I desire to point out, in the first place, that Dr. Livingstone has definitively settled that the Chambeze—the New Zambesi of some of our maps—is not an affluent of the well-known river Zambesi, which flows eastward into the Indian Ocean, but is a distinct stream, of which the course is to the west and north-west. On this point it is due to Mr. Cooley to say, that, although he was mistaken respecting the upper course of the Zambesi itself, he has long contended for the separate existence of the "New Zambesi," or Chambeze.

Secondly, Dr. Livingstone has ascertained that the Chambeze, in its lower course beyond the capital of the Cazembe, is joined by another large river, the Lufira, coming from the south and south-west, which drains the western side of the country south of Tanganyika, as the Chambeze drains the east side. The Lufira was not seen by the traveller; but when he was at some place, not named by him, in 11° S. lat., that river was pointed out to him as being at some distance west of that spot, and was described as being so large there as always to require canoes; for so I read his words:—"I have not seen the Lufira, but, pointed out west of 11° S., it is there asserted always to require canoes;"—which shows that it must come from a considerable distance south of that parallel.

In the next place, Dr. Livingstone informs us that the Chambeze enters Lake Bangweolo, and then changes its name to Luapula; that this river flowing north enters Moero Lake, and "on leaving Moero at its northern end by a rent in the mountains of Rua it takes the name of Lualaba, and passing on N.N.W. forms Ulenge in the country west of Tanganyika." This, it must be remarked, is not native information, but the result of the traveller's own personal observation on the spot. His letters are dated "near Lake Bangweolo;" and in speaking of the Lualaba he says, "I have seen it only where it leaves Moero, and where it comes out of the crack in the mountains of Rua."

To make it more certain that he is speaking of the Lua*laba*, and not of the Lua*pula*, the traveller expresses his intention "to follow down the Lua*laba* and see whether, as the natives assert, it passes Tanganyika to the west, or enters it and finds an exit by the river called Locunda [or Loanda] into Lake Chowambe;" which lake, he says, "I conjecture to be that discovered by Mr. Baker;"—adding, "I shall not follow Lua*laba* by canoes," &c.

Nothing could well be more explicit than this. And yet your correspondent represents Dr. Livingstone as saying that "he saw the Lua*pula* only at this gap in the mountains," and describes the Lua*laba* as being a month's journey further west, and as falling into the Lulua and so joining the Zaire, or great river of Congo, on the west coast of Africa. There must clearly be some mistake here.

I think, too, there must be some misapprehension respecting "the great salt marshes, which chiefly supply the interior of Africa," described by "F.R.G.S." as situated on the banks of the Lualaba, a great running stream of fresh water. Is it not more likely that those salt marshes lie in some extensive depression in the interior of the continent, having no outlet, but in which the rivers that may flow into it are absorbed and lost?

Further, according to Dr. Livingstone, the Lualaba, after leaving Moero beyond the town of the Cazembe to the north, forms Ulenge, either a lake with many islands or a division into several branches, which are taken up by the Lufira. This I understand to mean, that the junction of the Lualaba and the Lufira is in Ulenge, *north* of the Cazembe's residence. "F.R.G.S." says, on the contrary, that the Lufira "flows into the Luapula from the west about 100 miles S.W., or S.S.W., from the Cazembe." How are these two statements to be reconciled?

Then "F.R.G.S." says, "When our author speaks of the Luviri (Lufira) entering Tanganyika at Uvira, he evidently casts the dimly discerned views of the natives into his own preconceived mould, and clothes them in his own language." But Dr. Livingstone could scarcely have had any "preconceived" notions on the subject, unless he took with him Mr. Cooley's map of 1852, in which the Chambeze, under the name of the New Zambesi, is laid down as joining the Luviri and then, under the name of Luapula, falling into the lake of "Zangañika" on its west side in about 8° S. lat. And this opinion Mr. Cooley would seem to regard still as the correct one; for in a letter which appeared in the *Daily Telegraph* of the 27th August last, with his initials "W.D.C.," he expressly states that "the drainage of the Cazembe's country is all into the Nyanza on the east." Though why this name should be applied to the Lake of Tanganyika is not patent. We know the "Victoria Nyanza" of Speke, the "Albert Nyanza" of Baker, the "Lake Tanganyika" of Burton, and the "Lake Nyassa" of Livingstone. We also know that in Mr. Cooley's maps of 1845 and 1852, Tanganyika and the more southerly Lake Nyassa are made to form one continuous body of water under the name of "Nyassa, or the Sea." But the present seems to be the first time that the designation of "Nyanza" has been applied, without any qualification, to the separate Lake Tanganyika. I perceive that "F.R.G.S." associates Captain Burton with this "Nyanza;" but such a name was never given to it by its discoverer, neither is it generally known by any other designation than that of "Lake Tanganyika:" whether or not it should properly be called the "Lake *of* Tanganyika" is of no moment.

I come now to the consideration of Dr. Livingstone's claim to the discovery of the sources of the Nile, which will be best given in his own words: "I think that I may safely assert that the chief sources of the Nile rise between 10° and 12° south latitude, or nearly in the position attributed to them by Ptolemy, whose river Rhaptus is probably the Rovuma." On this "F.R.G.S." acutely remarks: "Here two different problems are attempted to be solved at once—the one touching the sources of the White Nile, and the other those of Ptolemy's Nile;" in which remark he is no doubt substantially correct. Into the question of Ptolemy's sources of the Nile, on which subject "F.R.G.S." and I differ widely, I need not now enter: what I have here to do with, is the question of the chief sources of the Nile. And in order to decide whether Dr. Livingstone has really discovered these sources, it is, in the first instance, requisite to define the limits of the basin of the Nile, so as absolutely to determine where the sources of the river can or can not be situated. As those limits were approximatively determined in a paper "On the Nile and its Tributaries," communicated to the Royal Geographical Society in 1846, and published in the seventeenth volume of the Society's Journal, I cannot do better than reproduce the portion of it relating to this particular subject.

After describing the physical character of the table-land of Eastern Africa, of which Abyssinia forms the northern extremity, and its rivers as far as they were then known,—on which subject I need not dilate, as the substantial correctness of my views is now established,—I proceeded in these terms:—

"All the streams of the plateau or western counter-slope of the Abyssinian chain are affluents of the Nile, and their easternmost branches take their rise at the extreme eastern edge of the table-land, which is the limit of the basin of the Nile, and the watershed between its tributaries and the rivers flowing E. and S.E. towards the Indian Ocean. On the seaward side of this watershed, the declivity being much more abrupt and its extent much more limited, the rivers must necessarily be of secondary importance. Thus, proceeding from the N., we do not meet with a stream deserving of name until we come to the Hawash; and even that river is, near Aussa, lost in Lake Abhebbad before reaching the ocean. The river Haines of Lieutenant Christopher, which is the next in succession, appears, in like manner, not to have sufficient power to reach the sea, at least not at all times of the year. Further to the S. we find the river Gowin (*i.e.* Wabbi-Giweyna) or Jubb, possessing a substantive character as an ocean stream; but this river, during the dry season, has at its mouth a depth of only two feet. At a short distance to the S. of the equator is the Ozay, which river, though said to be of great extent, has very little water at the entrance. Further S. the same law appears to prevail, as is exemplified in the Lufiji or Kwavi (Quavi), the Livuma [Rovuma] and the Kwama (Quama) or Kilimane (Quilimane), which rivers rise on the eastern edge of the elevated plain in which Lake Zambre or N'yassi is situate, and flow into the Indian Ocean. *Here, however, the southern extremity of the basin of the Nile having been passed*, the larger streams of the counter-slope no longer join that river, but take their course westwards into the Atlantic, belonging in fact to a distinct hydrographical basin."

What I thus wrote three-and-twenty years ago requires now but little modification. The erroneous identification of Lake Zambre with N'yassi was simply adopted from Mr. Cooley's learned and valuable paper in the fifteenth volume of the Society's Journal, which was then our only authority on the subject. I also followed him in his alteration of the spelling of the name "Zambre," which in my paper was printed "Zambeze," with the explanatory note, "This name is usually printed Zembere, Zembre, or Zambre. It is the Lake *Maravi* of the maps." Though even this was wrong; for Nyassa is properly Lake Maravi, and Tanganyika is the Great Lake, or Zambre. The blending of the two together by Delille and D'Anville was the primary cause of the long-existing misapprehension of the subject.

In my paper from which the foregoing extract is taken, when speaking of the lakes and swamps of the Upper Nile as then known, I added in a note, "May not Lake Zambre ('Zambeze'), or Nyassi, be the continuation of this series of lakes? In this case it would be simply the upper course of the Nile."

Acting on this suggestion, Professor Berghaus, in 1850, laid down Mr. Cooley's "Nyassi, or the Sea" as the head of the Nile; but, as I pointed out to him, he had under any circumstances carried the river too far south, because the Chevalier Bunsen and I had in the previous year come to the positive conclusion, on the reports of the Church missionaries at Mombas, that Zambre (now Tanganyika) and Nyassa were two separate lakes, a conclusion which every fresh discovery only tended to confirm.

The Cuama and Quilimane mentioned by me were all that we then well knew of the Zambesi, the great western extent of which river only became revealed to us through the former explorations of Livingstone. He thus absolutely closed the basin of the Nile in that direction; though the fact of his having done so was not then demonstrable. When he wrote to Lord Clarendon in February 1867, as he says in his present letter, he "had the impression that he was then on the watershed between the Zambesi and either the Congo or the Nile." His present determination of the want of connection between the Chambeze and the Zambesi, and of the western and north-western course of the former river, has proved the soundness of his impression of February 1867.

The question is therefore now narrowed to this:—Do the united streams of the Chambeze and the Lufira, under the name first of Luapula, and then of Lualaba, flow into the Nile or into the Congo? I am of opinion that they join the former river, and that the explorations of Dr. Livingstone have established the correctness of the views I have long entertained, and especially those enunciated in the *Athenæum*, No. 1,969, of July 22, 1865, on the first announcement by Sir Samuel Baker of his (unconscious) discovery of the main stream of the Nile under the name of "Albert Nyanza," and consequently I believe we are at length enabled to strip the veil from the Nile Mystery.

CHARLES BEKE

Bekesbourne, December 1

Food of Oceanic Animals

UNDER the above head, in a note which appeared in NATURE of the 16th Dec. p. 192, Mr. Gwyn Jeffreys "calls the attention of physiologists to the fact that plant-life appears to be absent in the ocean, with the exception of a comparatively narrow fringe, known as the littoral and laminarian zones, which girds the coasts, and of the 'Sargasso' tract in the Gulf of Mexico." He then proceeds to say that, "during the recent exploration in H.M.S. *Porcupine* of part of the North Atlantic, he could not detect the *slightest trace* of any vegetable organism at a greater depth than fifteen fathoms. Animal organisms of all kinds and sizes, living and dead, were everywhere abundant, from the surface to the bottom . . . some of them being zoöphagons, others sarcophagons, none phytophagons." And, lastly, after asking "whence do oceanic animals get that supply of carbon which terrestrial and littoral or shallow-water animals derive, directly or indirectly, from plants?" and "can any class of marine animals assimilate the carbon contained in the sea, as plants assimilate the carbon contained in the air?" Mr. Jeffreys sums up his conclusions on the subject in the following words:—"At all events, the usual theory, that all animals ultimately depend for their nourishment on vegetable life, seems not to be applicable to the main ocean, and consequently not to one-half (*sic*) of the earth's surface."

As Mr. Jeffreys has been constituted an authority on deep-sea exploration, and now claims the view above cited as original, I must be permitted to point out that he has either forgotten what, at one period, he professed to have read and acquiesced in, in one of my writings; or that, for some unaccountable reason, he now repudiates both my opinions and those which were once his own.

As the entire absence of plant-life, even in its primitive phases, in the deeper abysses of the ocean, and the process whereby the nutrition of the lowest animal forms is secured in the absence of even the rudimentary digestive apparatus which is observable amongst the higher Rhizopods, were fully discussed by me in my "Notes on the Presence of Animal Life at great depths in the Ocean" (p. 27), published in 1860; in my work on "The North Sea-bed" (pp. 131-2), published in 1862; in a note which appeared in the *Annals and Magazine of Natural History* for August 1863 (p. 166); and more recently in two papers contributed by me to the *Monthly Journal of Microscopical*

Science, No. 1, pp. 32-33, and No. 4, pp. 231-2-3, published in the present year,—it will, I think, be admitted that Mr. Jeffreys can hardly claim originality in his statement.

But to prove that Mr. Jeffreys was well acquainted with my previously published observations on the subject, I invite attention to two distinct statements of his which appeared in his Reports on Dredging, and were published in the *Annals and Magazine of Natural History*, on the respective dates given below:—

Annals, Nov. 1866, p. 391.	*Annals*, Oct. 1868, p. 305.
"Dr. G. C. Wallich, in his admirable and philosophic treatise, with which all marine zoologists and geologists are, or ought to be, familiar, believed," &c. &c. "As to the accuracy of his statements, *no reasonable doubt can be entertained.*"	"Coccospheres and Foraminifera cover the bed of the Atlantic at enormous depths. The occurrence, therefore, of such organisms on the floor of the ocean, at great depths, does not prove that they ever lived there. *I should rather be inclined to believe* that they dropped to the bottom when dead, or after having passed through the stomachs of other animals which had fed on them."

It thus becomes manifest that Mr. Jeffreys had studied my writings, but that the opinions entertained by him in 1866 became revoked in 1868; whilst those held by him in 1868 were in turn superseded by views formed and published in 1869! This circumstance is the more significant, inasmuch as Dr. Carpenter, in his "Official Report on Dredging," for 1868 (p. 181), actually singles out the opinion published by Mr. Jeffreys, as above, in the autumn of the same year, as an authoritative illustration of the want of credence which my discoveries had met with!

With regard to Mr. Jeffreys' new division of oceanic animals into *zoophagons* and *sarcophagons*, I have nothing to urge beyond my avowed inability to discern any physiological difference between creatures that are zoophagous and those that are sarcophagous. It only remains for me to express my belief that, up to the present period, I have stood alone in maintaining, against Ehrenberg and others, that plant-life, even of the lowest types, becomes extinct at depths exceeding four or five hundred fathoms; and in endeavouring, by a series of observed facts, to prove that the nutrition of the Foraminifera and certain other oceanic Rhizopods is effected by a special vital process, which enables them to eliminate and apply to the formation and sustenance of their body and shell-substance, through their surfaces only, the materials which exist in the medium in which they reside.

Kensington, Dec. 21 G. C. WALLICH

Colouring of the Cuckow's Egg

As I see Professor Newton has, in his very interesting paper on Dr. Baldamus' theory of the colour of Cuckoo's eggs, noticed my "stigmatising" the Doctor's theory as "wild," in my "Birds of Somerset," will you be kind enough to allow me space for a few lines on the subject? Although it is with great diffidence that I venture to differ from Professor Newton, I still cannot help considering Dr. Baldamus' theory as "wild," not perhaps as it appears under the manipulation of Professor Newton, for he seems to me to have pruned and pared it down so nicely that there is but little of the original left; and I think he would not much differ from me in my opinion as to the wildness of the theory, if he had to accept all the allegations in Dr. Baldamus' paper published in *Naumannia*:* For instance, compare the following passage in Professor Newton's paper in No. III. of NATURE with some passages from Dr. Baldamus' paper:—"Having said thus much, and believing as I do the Doctor to be partly justified in the carefully-worded enunciation of what he calls 'a law of nature,' I must now declare that it is only 'approximately,' and by no means universally true, that the Cuckow's egg is coloured like those of the victims of her imposition. Increase as we may by renewed observations the number of cases which bear in favour of his theory, yet, as almost every bird's-nesting boy knows, the instances in which we cannot, even by dint of straining our fancy, see resemblances where none exist, are still so numerous as to preclude me from believing in the generality of the practice imputed to the Cuckow. In proof of this I have only to mention the many eggs of that bird which are yearly found in nests of the *Hedge-Sparrow* in this country, *without ever bearing the faintest similarity to its well-known green-blue eggs.* One may grant that an ordinary English Cuckow's egg will pass well enough, in the eyes of the dupe, for that of a Titlark, a Pied Wagtail, or a Reed Wren, which according to my experience are the most common foster-parents of the Cuckow in this country; and indeed one may say, perhaps, that such an egg is a compromise between the three, or a resultant, perhaps, of the three opposing forces; *but any likeness between the Hedge-Sparrow's egg and the Cuckow's so often found alongside of it, or in its place, is not to be traced by the most fertile imagination.* We must keep, therefore, strictly to the letter of the law laid down by Dr. Baldamus, and the practice imputed to the Cuckow is not universally, but only approximately true." This certainly is very different from Dr. Baldamus' own statement:—"If Mr. Braune, the forester of Griezland, had not cut this large Willow Wren's (*Shippolais*) egg (as it seems) out of the ovary of the Cuckoo, which was killed as she was flying out of the Willow Wren's nest; if Count Rödern, of Breslau, was not a reliable authority that this apparent Redstart's egg was taken out of the nest of the Redstart (*Ruticilla phœnicurus*); if M. Halricht had not taken this large Tree Pipit's egg out of the nest of a Tree Pipit (*Anthus arboreus*); if I myself had not taken out of the nests of the Red-backed Shrike (*Lanius collurio*) this reddish and this green-greyish peculiarly marked Cuckoo's egg, one might indeed entertain doubts whether this variously-coloured collection—these *green eggs, with and without markings;* these on white, grey, green, greenish, brownish, yellowish, reddish, and brown-reddish ground; these grey, green, olive green, ash grey, yellow brown, yellow red, wine red, brown red, dark brown and black; these spotted, streaked, speckled, grained and marbled eggs could one and all be the eggs of our Cuckoo! And yet this is indeed the fact!" How different this from the much more cautious and limited statement of Professor Newton, first quoted, which would entirely sweep away some of these varieties, especially those resembling the eggs of the Redstart or the Hedge-Sparrow, for the eggs of these two species do not differ much from each other, and what might be said of the eggs of the one would apply equally to those of the other; yet these are two of Dr. Baldamus' selected species, for, a little further on, he gives a list of the various species from the nests of which Cuckoo's eggs have been taken resembling those of the foster-parent. Of the eggs of the Redstart he says:—"These four specimens, which were found in the nests of *Ruticilla phœnicurus*, are all of a light-green ground colour; two of them have the larger and more or less brownish spots, which on one of them form a zone; the third has similar markings, but only sparingly scattered over the whole surface, whilst the fourth is without any marking at all—herein it is identical with one in the possession of Dr. Dehne, which is *uniformly light-greenish blue, without any markings whatsoever.*"

Of the single specimen of the egg resembling that of the Hedge-Sparrow, No. 15 in his list, he says:—"One of the most interesting of the Cuckoo's eggs is a beautiful blue-green one, which was taken out of the nest of *Accentor modularis, without any markings*, and which even to the shell, the grain, and the size (bis auf Shale, Korn, und Grösse) is like a very dark egg of the Hedge-Sparrow." On reading this quotation from the statement of the facts on which his theory is founded by Dr. Baldamus in the paper in *Naumannia*, and comparing it with Professor Newton's paper above quoted, we cannot help seeing that there is a decided issue of fact between them, especially as to the eggs of *Accentor modularis*.

The conclusion which Dr. Baldamus draws from the facts stated by him is that Nature, by means of such arrangements, has ensured and facilitated the preservation of a species otherwise much exposed to danger, and that she has attained this object by investing every hen Cuckoo with the faculty of laying eggs coloured exactly like the eggs of the bird of whose nest she prefers to make use, according to the locality. Now if this were really the case, and it were really true that this colouring of the eggs were essential for the preservation of the species, would it not be just one of those laws of Nature which we should expect to find universal, or so nearly so that there would be but very few exceptions? But according to Dr. Baldamus himself the exceptions are numerous, and Professor Newton would make them still more numerous, and would no doubt be quite right in doing so. How, then, do the eggs in the exceptional cases prosper? Does the Hedge-Sparrow or the Redstart throw the egg of the Cuckoo out of its nest because it does not resemble its own? or do the birds to whose tender mercies the Cuckoo, according to Dr. Baldamus himself, is occasionally obliged to entrust its eggs when it cannot find a fitting nest in which to place them, do so? This does not appear to be at all

* Where I have quoted from this paper, I have quoted from the translation by the Rev. A. C. Smith, published in the *Zoologist* for 1868, which professes to be an accurate translation, and there seems to be no possible reason to doubt its being so.

the case, but the eggs remain in the nest in which they were originally placed by the parent Cuckoo, and are duly hatched by the foster-parent. That being so, the necessity for the law of nature which the Doctor wishes to establish falls to the ground. I do not like to put forward my own opinion against such great authorities as Dr. Baldamus and Professor Newton, but I think the inquiry now set on foot in this country by the publication in English of Dr. Baldamus' paper in *Naumannia* will be to show that Cuckoo's eggs do not in fact vary from each other more than those of many others, and that the resemblances to the eggs of many other species are not greater than sometimes arises in many ordinary cases.

CECIL SMITH

The Cloaca Maxima

YOUR correspondent "Ignoramus" will find some account of the drainage of Rome in Pliny ("Hist. Nat." xxxvi. 15, s. 24). He will also find further particulars in Livy (i. 38), and in Ulpian ("Dig." 43, tit. 23, s. 1).

History repeats itself. Just as the London sewers were originally natural brooks or artificial ditches by which the rainfall of the district was carried off, and into which it was penal, down to the year 1815, to turn any "sewage" proper; so the Cloaca Maxima was built originally, in very early times (by Tarquinius Priscus, according to Livy), to carry off the rain-water from the Forum. Afterwards, however, all kinds of liquid refuse were allowed to find their way into it; and this seemed such a convenient way of getting rid of troublesome matter, that the whole city was eventually undermined by a network of sewers, including small pipes of wood and earthenware connecting the houses with the main sewers. Whether "traps" were also used I am unable to say, but I think it very probable that some simple combination of trap and cess-pit, in masonry, was used to prevent an up-blast of foul gas into the *atrium*.

What became of the solid refuse I do not know, but from all that I can gather I imagine it must have been carted away periodically. I trust some of your readers may have compassion for our ignorance, and, by enlightening us on this point, completely restore to "Ignoramus" that peace of mind which he lost in early childhood.

I trust also that the days of river cloacal pollution, in this country at least, are numbered, and that the advances which other sciences have made in the last 2,000 years will at last make our engineers ashamed of their ignorant violation of what I hope I may be allowed to call one of the laws of Nature.

W. HOPE

Hydro-carbon Colours

CAN your readers inform me of any book in which I can get to know all that is known on the "Hydro-carbon colours, and their application to Art industry," or direct me to any sources where the information can be obtained?

Plymouth, December 18 T. W. FRECKELTON

NOTES

THE *Journal of Botany* will pass into new management with the commencement of the year. The leading English botanists have promised their co-operation towards making it a complete record of the progress of botany at home and abroad during the month. It will in future be edited by Mr. W. H. Trimen, M.B., of the British Museum, author of "A Flora of Middlesex."

THE persistent decrease in the yield of our sea-fisheries has assumed a serious aspect, and urgently calls for systematic investigation at the hands of the Government. The usual machinery for such investigations, namely, a Royal Commission, could, however, hardly obtain the exact kind of information necessary for a determination of the probable cause of the mischief. Nothing short of the appointment of Inspectors of Sea Fisheries, with analogous functions to those discharged (with such beneficial results) by the Inspectors of Salmon Fisheries, can afford the opportunity for a thorough examination of the subject, and prepare the way for useful legislation. This course is ably advocated in the last number of *Land and Water*, and we feel it incumbent upon us strongly to second the recommendations of our contemporary on this point.

THE Ethnographical Section of the Geographical Society of Berlin, which has existed in a more or less definite form for about three years, has just separated itself from the parent organism, and entered upon an independent career as the Society for Anthropology and Ethnology. The first ordinary meeting of the new society took place on the 10th instant, when a paper was read by Professor Virchow on the North-German Pile-works. As compared with the great majority of such remains in Switzerland and South Germany, the pile-works of the North are not of very high antiquity. There is only one colony, that of Wismar, which belongs to the Stone period; even the older forms of bronze are rarely met with. The mode of construction of the pile-works likewise indicates an advance on that employed in Switzerland. Professor Virchow is of opinion that some, at least, of the earthworks found in certain districts are contemporary with the lake habitations: evidence on this interesting point is promised at some future time. That the pile-works, although of comparatively recent date, are really pre-historic, is indicated by the discovery of the remains of beaver and elk. The latter animal is not mentioned by the old chroniclers of Brandenburg and Pomerania; neither do we find mention of any lake-dwelling people in the ancient Scandinavian or Polish historians.

WE understand that steps are being taken to found an anthropological society in Hamburg, but no particulars have as yet reached us.

WE extract the following from the last Weekly Bulletin (26th inst.) of the Scientific Association of France:—"The vine occupies in France almost 2,500,000 hectares (6,175,000 acres). This constitutes the one-and-twentieth part of the French territory, and the sixteenth part of its soil capable of cultivation. The gross produce amounts to more than 1,500,000,000 francs. This industry occupies six million men, women, and children, and nearly two million merchants, agents, traders, &c. Sixty-nine departments cultivate the vine, from the Gironde, which reckons more than 150,000 hectares (370,500 acres), to the department of Ille-et-Vilaine, which only possesses 104 hectares (256 acres)."

THE commission appointed by the Imperial Academy of Medicine in Paris to investigate the subject of vaccination has just concluded its labours by the presentation of its Report, which has been adopted.

MR. J. MIERS, so well known for his researches in the Botany of South America, is about to publish the second and third volumes of his "Contributions to Botany," which will include a complete monograph of the *Menispermaceæ*, and of the South American species of *Ephedra*, showing that this genus does not belong to the Gymnosperms or naked-seeded plants, as generally believed.

IN a letter of the 17th ultimo, addressed to the *Astronomische Nachrichten*, Dr. Oppolzer discusses the observations of a faint comet discovered by Pons in February 1808, and arrives at the conclusion that it is exceedingly probable that the comet referred to is identical with that named after Winnecke. Dr. Oppolzer is at present engaged in working out the observations of the latter comet, more especially in reference to its supposed identity with Comet II. of 1766.

WE regret to learn from the recent report of the Miners' Association for Cornwall and Devonshire, that that useful body is in danger of being dissolved in consequence of the inadequate support it receives from the mining interest. The importance of combining scientific knowledge with practical experience, if we intend to maintain our present position in mining and metallurgy as against the highly-trained miners of other countries, is acknowledged by every competent person. Surely, then, when owners of mines and shareholders in mining companies learn that the Miners' Association not only discusses and publishes important scientific papers of a practical character, but is at the present moment educating in its classes more than a hundred young men in chemistry, mineralogy, geology, and mining, they will not suffer so important an institution to die out or languish for want of funds. Mr. Robert Hunt, F.R.S., keeper of the Mining Records, is the hon. general secretary of the association. The Report for 1869 is published at Truro (Heard and Sons), and is to be had for a shilling.

BENZOL has been applied to a somewhat novel purpose. If poured on a piece of ordinary paper, immediate transparency is produced, to such an extent as to enable one to dispense entirely with tracing-paper. On exposure to air, or, better, a gentle heat, the liquid is entirely dissipated, the paper recovers its opacity, and the original design is found to be quite uninjured.

WE are glad to learn that the acceptance, by Dr. Czermak, of an honorary professorship in the University of Leipzig is likely to lead to a departure from the rule hitherto observed in the German universities, of treating physiology as an integral part of the medical course. No doubt lectures on general physiology, with a more particular view to the special requirements of the medical student, will always be necessary; but the claims of the general student to a sound knowledge of the principles and methods of this science can no longer be ignored. Independently of the fact that physiology deals with subjects of the highest possible general interest, it must not be forgotten that in its present stage of development it can hardly be looked upon otherwise than as an extension of the physical and chemical sciences. The lectures which Prof. Czermak contemplates giving for the general benefit of the University of Leipzig are not intended to be of a so-called popular nature. They will be of the same general character as the ordinary lectures on physics, logic, or general history. The Professor insists very strongly upon the absolute necessity of direct observation for a thorough understanding of the subject; and it is solely the want of a suitable theatre and apparatus for enabling large audiences to view physiological experiments, that prevents his entering upon the promised course of lectures this winter. Dr. Czermak spoke so eloquently and so thoroughly in earnest on this subject on the occasion of his recent installation as Honorary Professor, that we make no doubt he will be able to carry out his plans successfully during the ensuing summer term.

WE have a fresh illustration of the intimate alliance between science and commerce. Mr. Winwoode Reade recently set out from Sierra Leone to explore the interior, the funds of the expedition being defrayed by the munificence of Mr. Andrew Swanzy, a London merchant. Communications have been recently received stating that Mr. Reade, travelling on a line to the south-east of the routes of Park and Caillie, has reached a point farther south than any of his predecessors. The solitary traveller, after surmounting many difficulties, was rewarded by reaching a hitherto unknown town named Farabana, situate about 10° N. lat. and 10° W. long. He had crossed several rivers, flowing we presume from the watershed of Mount Loma, and was among the head-waters of the River Niger. The town, Farabana, contains about 10,000 inhabitants, well-disposed, and eager for trade. Mr. Reade mentions his having experienced protection and help from the Sultan of Bornir; we suppose, by orders issued to his subordinate chiefs and headmen, in this outlying district of his kingdom. We may hope that Mr. Reade's discoveries will enrich our maps with accurate geography of the country to the north of the Cong Mountains, as marked on the maps, and of the Niger from its source to the point where previous travellers have struck its stream.

THE theory of the derivation of the primitive population of Western Europe from an African source is likely to receive some confirmation from recent researches in Algeria. A Mr. Faidherbe, who has examined a necropolis of 3,000 Megalithic graves at Roknia, in the province of Constantine, reports that the skulls obtained have led him to the conclusion that the Berbers were the original people of the Atlas; and that they do not resemble any African or Semitic race, but rather the earliest inhabitants of Western Europe.

THE "Transactions of the Swedish Academy of Sciences for 1868" contain a paper proposing the use of the reindeer moss and various other species of lichen as a material for the manufacture of sugar and alcohol. By means of dilute sulphuric or muriatic acid, the cellulose of the plant is turned first into dextrine, and then into grape-sugar. No experiments on a large scale have as yet been made, but the author of the paper is sanguine as to the economic success of such an undertaking. Of the other papers printed in this volume of "Transactions," we may mention the following:—"On a remarkable species of sponge living in the North Sea," by Professor Sven Lovén, and "Swedish and Norwegian Diatoms," by P. T. Cleve. These communications are illustrated by drawings. The other papers, with the exception of three by Edlund, detailing researches in reference to the electric spark, relate chiefly to the fauna and geology of various parts of the Swedish kingdom. The Memoirs of this Academy for the year 1868, containing the more important papers presented, have not yet reached us.

THE Native Guano Company, now successfully treating the sewage of the town of Leamington by the A.B.C. process, have applied to the Metropolitan Board of Works to enter into a treaty with them for the concession of the sewage on the south side of the Thames. The question has been referred to the Works Committee. Should the concession be granted, the movements of the company will be watched with great interest, as their success or failure will tend greatly to settle the question of the possibility of making the purification of the sewage of *great towns* a commercial success.

HERR KARL BRUHNS, director of the Berlin Observatory, is preparing for publication a scientific life of Humboldt, to which several illustrious German scientific men have promised to contribute. The first portion, from the pen of Dr. Ave Lallemand, will contain the life, properly so called, of Humboldt. The second part will be devoted to an account of his researches and discoveries. This latter part will occupy eight chapters, and will be confided to writers possessing special qualifications for the task. Persons having in their possession unpublished materials relative to the life or labours of Humboldt are requested to transmit them to Herr Bruhns.

OYSTERS are now so dear in London that we may reap some contentment by learning that they are sold wholesale in San Francisco, at the rate of six shillings a dozen. These oysters are said very much to resemble our "natives;" being round, fat, full-flavoured, and very good; but they do not suit the taste of those who have long enjoyed the luxury of the large, delicate molluscs of the Atlantic seaboard. There are fine beds of the long-shelled oyster in the Gulf of California, and as they will not grow in the Pacific, they are transported 1,700 miles by steamer to "Frisco;" about half the cargo dying on the passage. Notwithstanding all the oyster controversy and oyster literature of recent years, it is still very hard to understand why they should be so dear in London. At Van Laar's shop, in the Kalverstraat, at Amsterdam, the very finest oysters, thought by many to be much superior to the "natives," may be eaten at the rate of 50 cents (10*d.*) the dozen.

THE first part of a Hand-List of Genera and Species of Birds, by Mr. G. R. Gray, has just been issued from the British Museum. It includes the *Accipitres*, *Tenuirostres*, and *Dentirostres*, and forms an octavo volume of 400 pages. All the recognised genera, sub-genera, and species are enumerated, and not merely the species represented in the national collection. The latter are, however, specially indicated. Some notion of the marvellous variety of bird-form may be gathered from the fact that this volume gives the name and habitat of no less than 6,057 species. The second and concluding volume is stated to be far advanced towards completion. We have also to chronicle, for the benefit of our entomological readers, the appearance of Part II. of the Catalogue of Specimens of *Dermoptera Saltatoria* in the British Museum, by Mr. Francis Walker.

A LARGE depôt of petroleum has just been discovered in the Caucasus. It is situated on the east of the Caspian, where there are large numbers of these springs, many of them occurring in close proximity. This new spring is said to be capable of producing 40,000 livres daily. The American method has recently been adopted with the greatest success.

DR. ROBINET, formerly president of the Paris Academy of Medicine, member of the Municipal Council, and at one time president of the Hygienic and Sanitary Commission of the City of Paris, has just died. His decease was due to an affection of the chest, contracted whilst on a scientific expedition in Germany. Dr. Robinet had completed his 72nd year.

IT appears that the surface glass which contains soda undergoes considerable change after a lengthy exposure to the air. Bluish glass undergoes no such alteration, but that which has originally a greenish tinge becomes brown after a time, whilst very pure white deteriorates rapidly, showing first a yellow, then a brown, and finally a violet film. At this season of the year we do not require this additional colouring to the appearance of our already discoloured atmosphere. It has been noticed that some modern stained glass on a foggy day has almost the richness of the ancient. We need not go far for a solution of this. The old glass has acquired in the course of ages a film which takes the place of a permanent fog, especially on those colours which, like the ruby, are formed by a thin coating of the coloured glass on a thicker plate of transparent metal.

THE Agricultural Society of France has recently addressed the following questions to each of its members, and to the presidents of all the French Agricultural Associations:—"1. Can the depreciation in the price of wool be remedied; and, if so, by what means? Does the rise in the price of meat afford a sufficient compensation to the producers of wool? 2. Do the production and sale of cereals meet with any obstacle demanding the attention of the legislator? 3. Is there any defect in the facilities for increasing the domestic consumption or the exportation of wine? 4. Have the agricultural industries, especially those which produce alcohol and sugar, any need o modification as regards the economic regulations to which they are subject? 5. Are there in your district any other branches of agricultural produce suffering from a crisis to which it would be necessary to call public and legislative attention?"

WE have been requested to state that the cable laid between Salcombe and Finisterre (Dec. 2nd) was manufactured at W. T. Henley's Telegraph Works, North Woolwich.

SCIENTIFIC SERIALS

IN the *Annales des Sciences Naturelles* (Zoologie, Tome xii. Nos. 3 and 4), M. Marcy continues his elaborate paper on the flight of Insects and Birds. Prof. E. Lartet describes and figures *Trechomys Boudnellii* and two other fossil rodents of the Eocene of Paris. New observations on the Zoological Characters and Natural Affinities of the Æpyornis of Madagascar are given by MM. Alphonse Milne-Edwards and Alf. Grandidier. Their paper is illustrated by a fine series of figures of the bones of these gigantic fossil birds: even the enormous bones of the lower limb are drawn the size of nature. The present double number of the *Annales* is concluded by a communication from M. Edward Perrier, entitled "Researches on the *pedicellaria* and *ambulacra* of star-fishes and sea-urchins."

THE November number of the *Annales de Chimie et de Physique* contains the termination of a long memoir by Lecoq de Boisbaudran, on Supersaturation; a memoir by Des Cloiseaux, on Gadolinite, a mineral whose anomalies are very lucidly connected and explained; a very interesting paper by Boussingault, on the Function of Leaves, in which the influence of light is studied as affecting the decomposition of carbonic acid; Observations on a Note of M. Velter as to the agricultural utility of salt, by Peligot; a Chemical Study of Egyptian wheat, by Aug. Houzeau; the Polarisation of the Blue Light of Water, by J. L. Soret (taken from the Geneva *Archives*); and an account of Roberts's elegant experiment, showing the increase of volume undergone by palladium in combining with hydrogen.

THE November number of Reichert and Du Bois Reymond's *Archiv fur Anatomie* contains the following papers:—"The Influence of Artificial Respiration on Reflex," by Dr. P. Urspensky, of St. Petersburg; "Musculi subcrurales et Subanconaci," by Dr. M. Kulaewsky; "The 'Ramus collateralis ulnaris nervi radialis again," by Professor W. Krause, of Göttingen; "The Inter-arytænoid Cartilage of the Human Vocal Organs," by Professor H. von Luschka, of Tübingen (plate); "On the Influence of the Curara Poison on the Electromotor Power of Muscles and Nerves," by Hermann Rocher; "The Nervi Splanchnici and the Ganglion Cœliacum," by F. Bidder, of Dorpat; "On the Musculus Broncho-œsophagus Dexter," a communication by Dr. Wenzel Gruber, Professor of Anatomy at St. Petersburg.

POGGENDORFF's *Annalen der Physik und Chemie*, 1869. (No. 11. Vol. cxxxviii. Part 3). The physical papers in this number (the last published) are:—

(1.) "On the applicability of Ohm's Law to Electrolytes, with a numerical determination of the Electrical Resistance of dilute sulphuric acid by means of alternating currents," by F. Kohlrausch and W. A. Nippoldt (pp. 370 to 390). This paper forms the continuation and conclusion of one begun in the previous number of the "Annalen." After discussing the special difficulties that lie in the way of accurate determinations of the galvanometric properties of electrolytes, the authors show how the most important of them, the polarisation of the electrodes, may be overcome by substituting for a continuous current in one direction a rapid succession of currents of short duration in opposite directions. Such currents were obtained by the rotation of a steel magnet inside a coil of wire; and the employment of them necessitated the use of a Weber's bifilar dynamometer, instead of an ordinary galvanometer. There is a full discussion of the action of the rotating magnet, showing the mean electromotive force due to a given velocity of revolution, and the action of the resulting current on the dynamometer. In the part of the paper now published, the strength of the current traversing a column of dilute sulphuric acid is proved to be proportional to the electromotive force even when the latter does not exceed $\frac{1}{74}$ part of that of a Grove's cell. By using thermoelectric currents, the proportionality between electromotive force and strength of current, in the case of solution of sulphate of zinc between amalgamated zinc electrodes, is shown to hold good even when the electromotive force is only $\frac{1}{429000}$ of that of a Grove's cell. The paper concludes with a series of numerical determinations of the specific resistance of dilute sulphuric acid of various degrees of concentration, from which we quote the following:—At 22° C. the maximum conducting power is possessed by sulphuric acid of specific gravity 1·233 (containing 31·5 per cent. hydric sulphate); taking the conducting power of mercury at 0° as unity, the conducting power of such acid is 0·000077274.

(2.) "On a Comparable Scale for Spectroscopic Observations," by A. Weinhold (pp. 417 to 439). In order to compare the indications of various spectroscopes, the author proposes to denote the various parts of the spectrum by reference to the interference-bands seen in the spectrum of light reflected from a thin plate of biaxial mica; and to reduce the results obtained by the use of plates of various degrees of thickness to a common denomination, by taking two definite parts of the spectrum, *e.g.*, Fraunhofer's lines D and F, as fixed points, and dividing the interval between them into 100 parts. The bands of the interference-spectrum then become comparable with the divisions on an arbitrarily graduated thermometer, the value of which is determined by observing two fixed temperatures. The paper contains a full and careful description of the way of carrying out the proposed method in practice.

(3.) "Experiments on Retarded Ebullition" (third part), by

G. Krebs (pp. 439 to 448). The author describes experiments, with tiresome fulness of detail, in proof of the fact that the pressure upon water which has been long boiled may be reduced considerably below the maximum tension of aqueous vapour at the temperature of the water, without ebullition taking place; but if, under these circumstances, a further sudden diminution of pressure takes place, or if the water is heated, very rapid or even explosive ebullition is liable to occur.

(4). "Lightning without Thunder," by Prof. Th. Hoh (p. 496). In the night between the 25th and 26th July, the author observed *forked* lightning unaccompanied by thunder.

The other papers in this number are: "Investigation of Mica and allied minerals," by M. Bauer (pp. 337 to 370); "Studies of the oxygen-compounds of the Halogens," by Hermann Kämmerer (pp. 390 to 417); "Mineralogical Communications" (eighth part), by G. von Rath (pp. 449 to 496).

BOTANY

The Diffusion of Plants

PROF. DELPINO, of Florence, has published some interesting researches on the relation between the diffusion of plants and animals. The life of every plant has three principal objects: its nourishment, its reproduction, and the distribution of its seeds; for each of these three objects special bio logical conditions being requisite. The fertilisation of many plants can be effected only by some particular animal; as *Arum italicum*, *Aristolochia*, and *Asarum*, by gnats; the fig tribe by different species of *Cynips* (or gall-fly); *Arum dracunculus*, *Stapelia*, and *Rafflesia*, by blue-bottle flies; many others by different kinds of flies or bee-like insects (*Hymenoptera*), and some even by small birds belonging to the family of *Trochilidæ*, or humming-birds; *Rosa*, *Pæonia*, and *Magnolia grandiflora*, by beetles of the chafer tribe; others again by small slugs. If in any particular locality the animal necessary for the fertilisation of a particular plant is absent, it is certain that the plant cannot spread; and thus the conditions for the diffusion of plants are dependent on the geographical distribution of animals. A remarkable illustration is furnished by two plants belonging to the same genus, grown in the botanic gardens in Italy, *Lobelia syphilitica* and *L. fulgens*; the flowers of the former are abundantly visited by *Bombris terrestris* and *italicus*, and freely produce seeds; the latter, notwithstanding its beauty and its great store of honey, is never visited by insects in the neighbourhood of Florence, and never bears seeds spontaneously, but can be readily fertilised by artificial impregnation. Prof. Delpino conjectures that it is naturally fertilised by humming-birds. He believes that the scarlet colour of the corolla, so common in the tropics, but comparatively rare with us, is especially attractive to small birds, but offensive rather than otherwise to *Hymenoptera*. As a rule, scarlet flowers are large, bag-like in form, horizontal in position, and with the nectar completely separated, which would of itself perfectly prevent their fertilisation by insects. The largest European flowers, such as the pæony and large bird-weed (*Convolvulus sepium*) are fertilised by sphinxes and rose-chafers. [Botanische Zeitung.]

The Victoria Regia

THIS magnificent plant has thriven to an unprecedented degree during the past summer in the Botanic Garden at Ghent. Several leaves have attained a diameter of nine feet, and have supported a weight of 250 lbs., and one even the enormous weight of 500 lbs. Seven of the gigantic leaves completely covered the basin of 164 feet square, and they were obliged to be removed to make room for the young leaves which continued to develop in the centre. Every four or five days a fresh flower appeared, which lasted only two days, or rather two nights, opening in the morning of a perfectly white colour, diffusing about five or six P.M. a very powerful odour of vanilla, closing the next morning at 8 or 9 A.M., opening the same day towards evening, this time of a beautiful carmine, and finally closing the next morning. The magnificent leaves last through the summer; the plant begins to dwindle in October, and dies towards December. About this time the seeds, which have been obtained by artificial fecundation, arrive at maturity. They are sown in January, and appear above the ground in about six weeks. Their infancy is very critical; but once past this period, the young plants grow with astonishing rapidity; the plant in the Ghent Botanic Gardens, unquestionably the finest that has ever been cultivated, arrived at its full development in five months.

CHEMISTRY

Lenz on Electrolytic Iron

THE remarkable results of Graham's experiments on the occlusion of gases have induced Lenz to examine the relation of galvanically-deposited iron to this important function. With the aid of a Sprengel pump and apparatus differing but little from that employed by Graham, he has arrived at the following conclusions. Iron and copper, prepared by the reducing action of a galvanic current, contain gases, hydrogen more especially. The volume of the gas absorbed by iron varies within very wide limits, but may amount to 185 times the bulk of the iron, to the surface of which its presence is principally confined. The gas extricated from such iron, at temperatures under 100°, consists almost solely of hydrogen.

MINERALOGY

Des Cloiseaux on Gadolinite

THIS rare mineral has been studied by different crystallographers with apparently contradictory results. Haüy, Phillips, Lévy, Scheerer, and Waage have included it in the clino-rhombic system; Miller, Nordenskiöld, and Von Lang regard it as orthorhombic. The question could not be definitively settled by angular measurements, inasmuch as the primitive prism is a limiting form, bearing upon the corresponding elements of its anterior and posterior portions modifications whose incidences only differ by a few minutes. The author showed in 1860 that some species of gadolinite are mono-refractive, some bi-refractive, and some are mixtures of those two kinds; but it was not until the summer of last year that he was able to accumulate sufficient material for an exhaustive investigation. It now appears (1) that the Hitteröe crystals measured by Waage and the author, and analysed by Scheerer, have an energetic bi-axial refraction on two optic axes; the orientation of these axes, that of their bisectrix and their *inclined* dispersion, prove that the primitive form is an oblique rhomboidal prism, whose plane of symmetry is the same as that of the axes: this variety contains 10 to 12 per cent. of glucina. (2) The most homogeneous of the Ytterly crystals, measured by Von Lang and analysed by Berlin, are mono-refractive; they exhibit a certain number of peculiar modifications, in addition to those shown in the Hitteröe crystals, of which they are the pseudomorphs; and they do *not* contain glucina. (3) The heterogeneous specimens are forms in transition from the first to the second variety; they contain from 2 to 6 per cent. of glucina. These three kinds of gadolinite differ entirely in their symbolic chemical relations. The bi-refractive kind has the formula $\dot{R}_3\ddot{Si}$; the mono-refractive is a sort of peridote, $\dot{R}_2\ddot{Si}$; and the transition forms give an undecided result, the ratio between the oxygen of the silica and that of the bases varying from 3 : 4 to 4 : 5. These differences of constitution probably originate in local circumstances. The Hitteröe mineral seems associated with malacon and polycrase, in a granitic vein composed of quartz, orthose, and oligoclase (with a little mica), and crossing the "gabbro" of which the greater part of the island of Hitteröe is formed: but that of Ytterby is chiefly accompanied by yttrotantalite and fergusonite, and imbedded in a red lamellar orthose, divided by large plates of black mica. [Ann. Ch. et Phys. (4) xviii. 305.]

ZOOLOGY

Development of Sacculina

IN a note, published last February, on the development of the egg in those curious crustacean parasites, the *Sacculinæ*, M. Gerbe stated that the ovules of these animals are formed at first of two transparent vesicles or cells, each furnished with a nucleus and a common membrane; that one of these cells enlarges considerably, and that at the maturity of the ovum, the large cell in which the elements of the vitellus have been developed predominates to such an extent that the smaller one forms only a minute prominence at one pole of the ovum. M. Gerbe compared the large cell to the yolk in the eggs of birds, and regarded the small one as representing the germ or cicatricula. This homology was also applied by him to the ova of the *Arachnida* and *Myriopoda*.

M. E. van Beneden finds that the ovules are not at first composed of two closely applied cells, but that they form a single cell, formed of a transparent protoplasm, containing a few strongly refractive globules, and of a vesicular nucleus with a nucleolus. With these are observed others of an elongated form, and possessing two nuclei, but showing no signs of division, and others, again, which present at one end a small bud, the size of which increases until it equals that of the mother-cell, when one of the nuclei passes into the daughter-cell, and as the division between the two cells becomes more distinct, the appearance described by M. Gerbe is produced. M. van Beneden could could not, however, detect any cell-membrane.

The development of the ovule then goes on much as described by M. Gerbe, one of the daughter-cells being enlarged much more rapidly than the other, and acquiring a vitelline character. When it has attained a diameter of 0·015—0·018 millimetre, a cell-membrane (vitelline membrane) may be detected, which, however, only covers the larger cell. With these ova others are found in which the smaller or polar cell is no longer to be distinguished, but which present at one point a depression representing the surface to which it was attached: the ova when deposited never present the least trace of the polar-cell; but after oviposition the ovaries contain numerous cells, resembling the original mother-cells, which are really the polar-cells thrown off from the mature ova. These, M. van Beneden believes, *become the mother-cells of a new set of ovules.* He supports this opinion by several instances derived from crustacea of other groups, such as *Caligus*, *Calvella*, *Lernanthropus*, *Congericola*, *Anchorella*, *Lernæopoda*, &c., in which analogous phenomena occur.

M. van Beneden remarks, that in the ova of *Sacculina* segmentation of the whole contents of the ovum takes place, and he describes the process. This, as he says, excludes the idea of a cicatricula, which occurs only where a great part of the nutritive material exists outside the protoplasm of the ovicell, as in birds. Hence there can be no comparison between the egg of the *Sacculinæ* and that of birds, nor has it any special analogy to that of the *Arachnida* and *Myriopoda*.

SOCIETIES AND ACADEMIES

London

Ethnological Society, December 21.—Prof. Huxley, LL.D., F.R.S., president, in the chair. An ancient calvaria, which has been assigned to Confucius, was exhibited and described by Prof. Busk, F.R.S. This calvaria was formerly set in gold, richly ornamented, and mounted on a tripod, probably for use as a drinking vessel. It was taken from the Emperor of China's Summer Palace at Peking. The author has discovered four figures upon the skull in faint relief; that upon the frontal portion being the letter A in a Tibetan form of Sanskrit, referable to about the seventh or eighth century of our era. The skull was evidently that of a male advanced in age, but all the evidence tended to show that it ought not to be attributed to Confucius. The President suggested that those portions of the skull which now appear sculptured in relief might have been originally covered with some solid material which would have served as a protection, while the surrounding surface was worn down by constant handling. The Australians still use calvariæ, ornamented in a like manner. Mr. Fergusson alluded to the character of the workmanship displayed by the ornamentation, which had been barbarously removed. He regarded the skull as that of a distinguished personage—either a friend or a foe of some Chinese emperor; and thought that its use as a drinking-cup was supported by a passage in "Herodotus." Mr. Mummery, the present owner of the calvaria, explained the curious manner in which it came into his possession. Dr. Campbell referred to the Buddhist practice of using human thigh-bones as trumpets for calling to prayers. Mr. Donovan regarded the skull, from its small size, as belonging to an uneducated female.—At the same meeting Major Millingen, F.R.G.S., read a long paper on the "Koords and Armenians," in which he gave his reasons for identifying the modern Koords with the ancient Karduks mentioned by Xenophon. The language spoken in Koordistan is entirely different from either Persian or Turkish, and is said to be divided into several dialects. The Koords were described as a rapacious and faithless people, rejoicing in plunder and slaughter; and not the least interesting part of the paper was the description of a peculiar system of female brigandage. The Koordish race were said to be remarkably handsome, and to exhibit a great variety of complexion; a dark skin, with black hair and black eyes, is the most common, but light hair and blue eyes are also to be seen.

Statistical Society, December 21.—Mr. Newmarch, F.R.S., president, in the chair. A Report on the Seventh International Statistical Congress at the Hague was read by Mr. Brown, after which Mr. R. H. Inglis Palgrave read a paper "On the House Accommodation of England and Wales." Mr. Palgrave commenced by stating that the population of England is now probably better housed than at the commencement of the century. The average number of inhabitants to a house has slightly diminished since 1801. Mr. Palgrave continued to point out that, covered by a general average, which appeared to show ample accommodation, were great inequalities. The information obtained in the English census inquiries scarcely gives the means of tracing the subject further; but the last census in Scotland showed that one-third of the population lived each family in dwellings of only one room; another third in dwellings of two rooms; only the remaining third being lodged with comfort and decency. Mr. Palgrave showed by an analysis of Mr. Dudley Baxter's calculations, that the lowest section of the population in England was nearly twice as closely packed as the general average, in dwellings more than proportionately inferior; and by a reference to the Report on the Employment of Children and Women in Agriculture, that the condition of some rural districts apparently well provided for was scarcely superior to that of Scotland. Mr. Palgrave concluded by proposing that the census inquiry for 1871 should include more details on the house accommodation of England, Wales, and Scotland, thus to ascertain present deficiencies, and to assist those who desire to remedy the evils arising therefrom. The following gentlemen were elected Fellows, viz.:—Sir Massey Lopes, Bart., M.P., Hon. H. N. D. Beyts, Dr. Macaulay, Messrs. J. O. Chadwick, A. H. Smee, C. Inglis, M.D., Hammond Chubb, S. Ingall, and James M. Davies.

Institute of Actuaries, December 21.—Mr. S. Brown, president, in the chair. The following gentlemen were elected members, viz.:—Fellows, Messrs. Cornelius Walford and Joseph J. Dymond; and Associates, Messrs. A. C. Waters, Ainslie, Talon, E. J. Sims, jun., Henry Jeula, James D. Hobson, J. Ashton, J. H. Elder, and Joseph Burne. Mr. J. B. Sprague, M.A., read a paper "On the rate of mortality prevailing among assured lives, as influenced by the length of time for which they have been assured."

Edinburgh

Royal Society of Edinburgh, December 20.—Professor Kelland, president, in the chair. The Keith Prize for the biennial period ending May 1869 having been awarded by the Council to Professor P. G. Tait, for his paper "On the Rotation of a Rigid Body about a Fixed Point," the medal was formally delivered to him, after which Professor Kelland, in making the presentation, said he had great pleasure in accompanying it with the sum of £57 0s. 10d. He briefly referred to the manner in which Professor Tait was applying the method of quaternions, and mentioned that he was now putting on a more solid basis what they might call the mechanical sciences. On every account Professor Tait was entitled to the honour which had been conferred upon him, and he had no hesitation in saying that this was only the first of a series of successes.—Mr. Archd. Geikie read a paper "On the Geological Structure of some Alpine Lake Basins." In this paper the author reviewed the arguments which had been adduced by the geologists of Switzerland to prove that the great lakes of that country are essential parts of the architecture of the Alps. He stated that this view was untenable, for the lakes, instead of coinciding with the foldings and fractures of the rocks, ran directly across them. He entered in some detail into the geological structure of several of the Alpine lakes, particularly of the Lake of the Four Cantons, with the view of showing that between the contortions and dislocations of the rocks and the trend of the lake there is no ascertained connection. By a series of diagrams he pointed out how vast an amount of rock had been removed from the site of the lake and the adjacent mountains, and that it was physically impossible that any remnant of the original surface at the time when the rocks were folded could now remain. Particular attention was called to the fact that the greatest of the known dislocations of the Alps—the fracture which has brought down the miocene against the older tertiary and secondary rocks—has not given rise to lakes and valleys, but actually crosses them, as at the lakes of Geneva, Thun, and Lucerne, and in the valleys of the Rhine and Linth. After combating the explanation by which the lakes are referred to general and special movements of subsidence, the author dwelt upon the intimate connection between the Alpine lakes and the innumerable rock basins of the rest of the northern hemisphere. This connection, he said, could hardly be accidental. It pointed to some general cause which had been at work during a recent geological period, and he could not doubt but that this general cause was the thick mantle of ice which, from independent evidence, can be shown to have enveloped a great part of Europe and North America. The idea of the erosion of lake basins by the grinding power of land ice had been first propounded by Professor Ramsay, and there seemed every reason to believe that this view would come eventually to be accepted even by the geologists of Switzerland. — Professor Turner read a preliminary notice of the great finner whale recently stranded at Longniddry. It was so seldom that one of these large whales found its way to our very doors, and there were still so many unsolved problems to be worked out in connection with the structure and classification of the larger cetacea, that he gladly availed himself of the arrival of the rare visitor to devote such time as he could spare to the study of the huge creature. The length of the animal, he said, measured from the tip of the lower jaw to the end of the tail, 78 feet 9 inches. The girth of the body, immediately behind the flipper, was 45 feet. Its girth, in line with the oval orifice, was 28 feet, whilst around the root of the tail it was only 7 feet 6 inches. The inner surface of the lower jaw close to its upper edge and on the border was concave, and sloped inwards so as to admit the edge of the upper jaw within it. The length from the angle of the mouth to the top of the lower jaw, along the curved border, was 21 feet 8 inches. The dorsum of the upper jaw was not arched in the antero posterior direction. It sloped gently upwards and backwards to the blow holes, from which a low but readily recognised median ridge passed forwards on the back, gradually subsiding some distance behind its tip. On each side of this ridge was a shallow concavity immediately in front of the blow holes, the ridge bifurcated and the forks passed backwards, enclosing the nostrils for several inches, and then subsided. The outer borders of the upper jaw were not straight, but extended forward from the angle of the mouth for some distance in a gentle curve, and then rapidly converging in front formed a somewhat pointed tip. Their rounded palatal edges fitted within the arch of the lower jaw. The transverse diameter of the upper jaw over its dorsum between the angles of the mouth was 13 feet 3 inches. From the blow holes the outline of the back, curved upwards and backwards, was uniformly smooth and rounded, and for a considerable distance presented no dorsal mesial ridge. From the tip of the lower jaw to the anterior border of the dorsal fin, the measurement was 59 feet 3 inches. Behind the dorsal fin the sides of the animal sloped rapidly downwards to the ventral surface, so that the dorsal and ventral mesial lines were clearly marked, and the sides tapered off to the tail. The ventral surface of the throat, and the sides and ventral surface of the chest and belly, were marked by numerous longitudinal ridges and furrows. When he first saw the animal, the furrows separating the ridges were not more than from $\frac{1}{4}$ to $\frac{3}{4}$ of an inch broad, whilst the ridges themselves were in many places 4 inches in breadth; but as the body began to swell by the formation of gas from decomposition, the furrows were opened up, became wider and shallower, and the ridges underwent a corresponding diminution in breadth. The flipper projected from the side of the body thirty-one feet four inches behind the top of the lower jaw, and fourteen feet behind the angle of the mouth. It curved outwards and inwards, terminating in a free, pointed end. The distance between the two flippers, measured over the back between the anterior borders of their roots, was eighteen feet six inches. On the dorsum of the beak and of the cranium, on the back of the body, and for some distance down its sides, the colour was dark steel, amounting in some sights almost to black. On a line with the pectoral flipper the sides were mottled with white, and on the ventral surface irregular, and in some cases large patches of silver grey or whitish colour were seen. The dorsal fin was steel grey or black, except near its posterior border, where it was a shade lighter and streaked with black lines. The anterior of the lobes of the tail, its upper surface near the root and for the anterior two-thirds, were black. The upper surface of the flipper was steel grey, mottled with white at the root, at the tip along its posterior or internal border and on the under surface white patches were seen, on the upper surface near the tip, and here they were streaked with black lines running in the long axis of the flipper. White patches also extended from the root of the flipper to the adjacent parts of the sides of the animal. The outside of the lower jaw was black, whilst the inside was streaked with grey and brown. The tongue of the whale was of enormous size. The dorsum was comparatively smooth in front, but at the posterior part it was elevated into hillocks, which were separated by deep furrows. The baleen had a deep black colour, and consisted on each side of the plates which projected from the palate into the cavity of the mouth. The plates were arranged in rows—370 were counted on each side—which lay somewhat obliquely across the palate, extending from near the base of the great mesial palatal ridge to the outer edge of the palate. The plates diminished in size so much that at the tip, where the two sets of baleen became continuous, they were merely stiff bristles. He was happy to state, however, that the skeleton had been secured by the directors of the Museum of Science and Art in this city, who had granted him permission to examine it as soon as it was in a fit state. Prof. M'Donald gave it as his opinion that the whale which stranded at Longniddry was a water-breathing animal, and not an air-breathing animal.—The other paper read was "On the Aggregation in the Dublin Lying-in Hospital."

MILAN

Royal Lombardian Institute, November 11.—Professor Schiaparelli communicated a note upon a recent pamphlet by Signor Gaetano Baratta, proposing a method for the geometrical trisection of any given angle. He showed by a table of measurements that the first angle obtained by M. Baratta's rule is always greater than one-third of the primary angle.—Professor Emilio Villari presented a memoir on the electro-motor force of palladium in gas batteries. The author was led by the consideration of the great attractive force of palladium for hydrogen, and the fact that the hydrogen thus held by palladium possesses great chemical activity, to apply it to the construction of gas batteries. He described the mode in which he constructed his batteries and the experiments performed with them, which showed very complex actions, but proved that a palladium-element has a greater electro-motor force than one of Grove's gas-elements, because hydrogen in contact with palladium is considerably more oxydisable than hydrogen in contact with platinum. This electromotor force is still further increased if the palladium which is in contact with oxygen (*i.e.*, the positive electrode) is oxydised.—A new determination of the orbit of Clytie (asteroid 73), with ephemerides, by Signor Giovanni Celoria, was communicated by Professor Schiaparelli.

MONTREAL

Natural History Society, November 29.—Principal Dawson in the chair. Mr. Billings read a paper on the genus *Scolithus*, and some allied Fossils. The fossils known under the names of *Scolithus* and *Arenicolites* were described as consisting of cylindrical or rod-like bodies, which penetrate the layers of sandstone perpendicularly downwards, to a distance varying from a few lines to two or three feet. There are several varieties, the most common of which has the rods from one-twelfth to one-fourth of an inch in diameter; in another more rare form they have at the surface of the beds a wide trumpet-shaped expansion, two or three inches across, but taper to a point below, where they are, in general, more or less curved. Under certain circumstances, they can be entirely separated from the rock, and then present the appearance of simple cylindrical or conical rods of sandstone with no internal structure. All the varieties are more or less distinctly marked by a series of oblique annulations—a character which Mr. Billings thought to be of importance, as it seemed to show they were all members of one family of organisms. So long as these fossils were only known by specimens exhibiting no internal structure, it was impossible to decide to which division of the animal or vegetable kingdom they belonged. The Geological Survey had, however, ascertained that the Potsdam formation included a considerable deposit of limestone, in which the same fossil forms were found, with the internal structure beautifully preserved. By these it was proved that they were not the casts of worm-burrows, but sponges. Mr. Billings believed that these ancient sponges, or at least many of them, lived in the sand or soft ooze of the ocean's bottom, with their sometimes wide and trumpet-shaped mouths either even with or a little elevated above the surface. During the discussion that followed the reading of the paper, Dr. Dawson said that if Mr. Billings was right, it would appear that in the seas of the earlier ages protozoic life had the preponderance. In reply to a question by Mr. Whiteaves, Mr. Billings said that siliceous spiculæ were found in great abundance in association with these sponges. They were generally of an elongated pyriform shape (the "acerate" form of Bowerbank). He supposed they were originally calcareous, but had become siliceous during the progress of fossilisation.—The next communication was from Dr. Carpenter upon "Different modes of Computing Sanitary Statistics, with special reference to the opinions of Mr. Andrew A. Watt." Upon this subject, which related exclusively to the statistics of population of the city of Montreal, there was an animated discussion.

Norwich

Naturalists' Society, November 30.—The Rev. J. Crompton, the president, in the chair. Mr. Southwell read a long and interesting paper "On the Flight of Birds." The seeming impossibility of a heavy body supporting itself in mid-air, gliding along, changing its direction at will, apparently violating all the known forces of nature, is sufficiently astonishing to attract the attention and engage the researches of scientific men; and yet, till of late, the subject has been neglected, or the theories formed to account for so remarkable a phenomenon have been altogether erroneous. The great stumbling-block to the arrival at the truth seems to have been the very natural idea that buoyancy was the first essential to flight, whereas it is now shown, that so far from being an essential, it is an actual impediment. Hunter discovered the presence of air-cells in the bones and dispersed over various parts of the bird's body, and it was believed that by this means heated air was used to render them lighter, and that it was possible by thus inflating the body to increase the bulk, at the same time decreasing the weight; forgetting that additional bulk without a corresponding increase of weight would but enlarge the surface presented to atmospheric resistance, thereby rendering the too buoyant body of the bird the sport of every wind that blows. Sir Charles Bell follows up this idea of excessive lightness; but Captain Hutton, in a paper on "The Birds inhabiting the Southern Ocean," shows that in order to bring the specific gravity of the albatross to that of the atmosphere, the air-cells in its body should contain 1,820 cubic feet of air heated to 108 degs.—equal to a sphere of more than 15 feet in diameter; or, in other words, they must be 1,200 times the size of the body itself, "which," he adds, "would give it, when flying, an aldermanic appearance which I have never observed." It is obvious, therefore, that the air-cells are not intended to aid the bird in flight by rendering it lighter than the air itself. After referring to the opinions of Sir Charles Bell, Mr. Southwell gave an account of the principles enunciated in France by M. de Lucy, who has shown that three great properties are absolutely essential in all winged animals—(1) weight, or the force of gravity; (2) surface, or the area presented to atmospheric resistance; and (3) force, or the power of projection. Without weight the object might float, but it could never fly, there would be no resisting force to form a fulcrum to its movements, and it would, in fact, be part of the atmosphere and subject to it, wafted hither and thither without the power of resisting. The bird being elevated in the air, possesses, in virtue of its weight, a force always exerting itself in a downward direction, thereby producing motion, which, if it has the power to control, will prove the mainspring of its flight. In order to counteract this downward motion, surface is called into request. The expanded wing is presented to a column of air perpendicular to itself, and a new law of nature comes into operation—that of atmospheric resistance. This is not sufficient to counteract the force of gravity without some mechanical action on the part of the bird, but it would in a great measure break the force of the fall, causing it to descend in a series of zigzags, as a sheet of paper falls from a balloon. We should expect to find the surface increase in proportion to the weight of the animal; but, strange to say, it has been shown by M. de Lucy that the extent of surface is always in an inverse ratio to the weight of the winged animal. The heavier the animal, the smaller its wing surface, referred to a fixed standard. This is shown remarkably in flying insects; the body is very light, but the wing surface is enormous. The bird would soon be brought down from mid-air but for the muscular power of depressing the expanded wing forcibly and rapidly so as to cause the elastic column of the air beneath to rebound with sufficient force to destroy the remaining effects of gravity and so to equalize all the forces as to leave the bird ready to pursue its course at will. The most striking thing about the skeleton of a bird is its great lightness combined with strength. By a beautiful arrangement, the greatest power is given to the wings. The front part of the wing, that first presented to the air in forward flight, is stiff and unyielding, well adapted for cutting its way through the air; the other feathers become weaker and more pliable as they are placed nearer to the body of the bird. The feathers, which are divided into two portions by a nearly central shaft, overlap each other, the anterior web, which is the strongest and stiffest, being uppermost. When the down stroke is delivered, the wing presents to the air an impenetrable and unyielding surface, but when the corresponding up stroke is made, the yielding posterior web of each feather becomes depressed by the resistance of the air above, thus separating the feathers so as to allow of the free passage of the air; by this means giving the maximum amount of force to the down stroke, which would otherwise be neutralised by the resistance of the up stroke. But this is not all; the under surface of the wing is more or less concave, while the upper surface is convex. It is obvious, therefore, that when the up stroke is made, the air will rush off and through the wing in all directions, but when the motion of the wing is reversed, the air will be gathered up in its hollow, and the resistance immensely increased. By a wonderful contrivance, the same stroke which elevates the bird gives it a forward motion also. Mr. Southwell then gave an elaborate description of the mode in which forward motion is effected, from the Duke of Argyll's work, "The Reign of Law." Those birds with very long and pointed wings possess the greatest powers of flight; as, for instance, the sharp-winged martin for speed, and the long-winged albatross for both speed and endurance. The power of turning in flight appears to be the result of an involuntary effort, as we turn or incline to the left or right in walking. It is a matter of considerable difficulty to obtain reliable data as to the actual velocity with which birds travel through the air. The flight of a hawk, when its powers are fully exerted, has been calculated at 150 miles an hour; the usual flight of the eider duck at the rate of 90 miles an hour. Audubon estimates the flight of the American passenger pigeon at a mile a minute, and the carrier pigeon to possess, probably, an average of 50 or 60 miles in a long flight, although over short distances, as when pursued by a hawk, its speed is much greater. The flight of rooks "going home to bed with full stomachs," and taking it easy, Major Holland estimates at about 26 to 30 miles an hour; the speed of the albatross whilst coursing in company with a ship, he reckons at about 90 miles an hour. The flight of other birds, such as the swallow, the eagle, and the peregrine falcon, has been estimated as of much greater speed. The power of passing with ease and rapidity over long distances is of vast importance to birds living in communities. Rooks, for instance, would soon exhaust the supply of food in their own neighbourhood. Mr. Stevenson is satisfied that the guillemots and gulls seen feeding in Yarmouth and Lowestoft Roads in summer, come from the great nesting-places on the Yorkshire coast; and Mr. Yarrel states, on the authority of Dr. Jenner and the Rev. N. Thornbury, that the domestic pigeons about the Hague "make daily marauding excursions at certain seasons of the year to the opposite shore of Norfolk, to feed on vetches—a distance of forty leagues." Mr. Southwell quoted many instances of the extraordinary power of birds to endure protracted flights; and concluded by saying that man with all his boasted skill has not been able to construct a machine to enable him to navigate the air, and, even with the bird before his eyes, he has failed to learn its lesson. In the discussion which ensued, Mr. Southwell said he hoped his paper would attract attention to the subject of the flight of birds, as very little was known about it; and the very fact that in modern days men attributed the powers of flight in birds to the air-cells being filled with hot air, showed how little the principles of flight must have been considered.

Paris

Academy of Sciences, December 20.—M. E. Becquerel presented a note by M. J. M. Gaugain on the electromotive forces developed by platinum in contact with various liquids. The author stated that when two platinum electrodes, *not platinised*, have remained in an acidulated liquid until they furnish no sensible current, if one of them be washed in distilled water and dried with blotting paper, it becomes negative on being again placed in the liquid. The opposite effect is produced with solution of potash. The effect in the latter case is much greater when the electrodes are platinised. The author ascribed this phenomenon to a modification of the electrodes consisting in a superficial adherence set up between the platinum and the acid or alkaline substance. He also remarked upon the difference of function in platinised and non-platinised electrodes, and stated that with these substances as opposite electrodes an electromotive force, equal to more than one-fourth of that of a Daniell's couple, is at first developed, but that this gradually diminished. This was ascribed by him to the slow modification of the electrodes in opposite directions. According to the author, the modification in question takes some time for its production, but it is also long persistent; and he indicated that this property of platinum electrodes may be applied to the determination of the acid or alkaline nature of liquids, even when these are so dilute as to have no action upon test-papers.—M. Peligot read a note "On the presence of potash and the absence of soda in most plants." He maintained, as on former occasions, that soda is not necessary for the nutrition of plants, and cited experiments made with potatoes cultivated close to and far from the sea, which showed no difference of constituents; soda was always absent. M. Boussingault remarked upon this communication that he had already shown, by analysis, that soda was in many cases far inferior in importance to potash, but he thought the question was especially a geological one, the composition of the ground appearing to be of much importance. M. Payne considered that spectrum analysis should be made use of in this investigation.—A discussion was raised by M. Bertrand on M. Carton's note for the demonstration of the proposition that the three angles of a triangle cannot be less than two right angles. M. Bertrand explained M. Carton's proposed demonstration.—M. Faye called attention to a passage in Genesis, in which mules are mentioned as existing in the time of Abraham, and suggested that where there were mules the horse must have been known. MM. Roulin and Milne-Edwards remarked that the passage cited by M. Faye probably related to the Hemiornis.—The following papers were also communicated:—A note by M. Bulliani on the Constitution of the Ovum in the *Sacculinæ*; a note showing that œdema does not always result from the mere ligature of vessels, but that this must be accompanied by paralysis of the vaso-motor nerves, presented by M. Claude Bernard on the part of one of his pupils; a second note by M. Perizeux on the Secular Acceleration of the Movement of the Moon; a note on the Modifications produced in Skins by the operation of Tanning, presented by M. Boussingault on the part of one of his pupils; and a note by M. Blaserga on the Graduation of Galvanometers.

PRAGUE

National Museum of Bohemia, Natural Sciences Section, Nov. 20.—Prof. T. Krejci gave a *résumé* of his researches on the Permian strata at the foot of the Riesengebirge, on the northern frontier of Bohemia. The most interesting district is that near Schwadowitz. The Permian strata and the cretaceous grit here form a crest about 2,000 feet in height, the Faltengebirge, which fills up the space between the two masses of the Riesengebirge and the Adlergebirge. Its elevation is attributable to an extensive fault situated at its southern foot; this same fault having occasioned the denudation of the coal strata of Schwadowitz which have been actively worked for some years past. The latter belong partly to the carboniferous formation, partly to the Permian, which possess a good number of species in common, just as in the basin of Schlan, near Prague, thus indicating a gradual transition from the one of these formations to the other. To the south of the Schwadowitz fault extends an abruptly-elevated ridge of Permian and cretaceous grit, the former of which is in reality the margin of an ancient fjord of the cretaceous sea running up (from the direction of Hronar) far into the Permian strata. Similar cretaceous fjords are found in the primitive strata near Czaslaw, in the centre of Bohemia, and at Kieslingswalde, in Silesia. At the northern foot of the Faltengebirge, near Radoventz, there is also a deposit of coal supposed for a long time to be carboniferous, but now acknowledged to be Permian.—M. O. Feistmantel reported on the fossil plants of Schwadowitz collected by himself and M. Krejci, in 1869. This deposit yields in point of richness to that of Radnitz: nevertheless, M. Feistmantel has discovered among nearly 2,000 specimens forty-eight species, only one of which (from this mine) was known to M. Ettingshausen. These remains are arranged in three zones. The lowest, that of the pure schist, contains Pterideæ (*Lonchopteris, Alepthopteris, Neuropteris, Sphenopteris, Adiantites, Cyatherites*), and Equisetaceæ (*Calamites, Asterophyllites, Annularia, Sphenophyllum*). The second zone, that of the black schist, contains Lycopodiaceæ (*Lepidodendron, Lepidostrobus, Lycopodites, Sagenaria*), Nöggerathiœ (*Cordaites, Noggerathia*), and Sigillariæ (*Sigillaria, Stigmaria*). The third, that of coal, contains only Sigillaria and Stigmaria. At Radganice, where fossil-trunks of Araucaria in the red grit were the only remains of plants heretofore observed, M. Feistmantel obtained from the Permian coal eleven species of the genera *Annularia, Asterophyllites, Sphenophyllum, Alettsopteris, Cyatherites, Calamites*, and *Stigmaria*. A fine specimen from this locality shows that *Huttonia spicata* is the fruit of *Calamites Suckowi*, and the constant presence of Stigmaria without Sigillaria is a strong argument against the received doctrine that Stigmaria is the root of Sigillaria.

November 24.—Prof. J. Blazek demonstrated, by an elegant method, and without making use of the higher calculus, a series of theorems relating to *polyhedra maxima* inscribed in an ellipsoid of three axes. The latter being considered as a sphere distorted according to certain laws, the author demonstrates that the *corpora maxima* inscribed in the sphere are distorted according to the same laws, and that this likewise holds good for the *corpora maxima* of the derivative ellipsoid.—M. T. Palacky explained his views of the botanical geography of Asia. M. Grisebach has recently divided Asia into four botanical provinces—Western, or that of the steppes; Eastern, or Chinese; Boreal, or Siberian; and Southern, or that of India. M. Palacky only admits two provinces, the one Southern, the other Boreal, including in the latter the whole of Asia beyond the Himalayas, because the first three provinces of M. Grisebach do not appear to him to differ more from one another in regard to their flora than the sub-provinces of each do. The author lays special stress upon the tropical species inhabiting China—where they are not arrested by steppes—as far as Pekin, and even as far as the Amoor. According to him the existing flora of Central Asia is an invasion of the Mediterranean flora, which took place after the elevation of the Turcoman plateau in the place of the ancient post-tertiary sea between Europe and Asia. The principal obstacle in the way of researches connected with botanical geography is the diversity of the views adopted by various botanists; one species of Hooker, Wallich, &c., being at least equivalent to twenty-five species of Maximowicz, Ruprecht, and most of the German botanists.

DIARY

THURSDAY, DECEMBER 30.

ROYAL INSTITUTION, at 3.—On Light (Lectures adapted to a Juvenile Auditory): Prof. Tyndall, F.R.S.

SATURDAY, JANUARY 1.

ROYAL INSTITUTION, at 3.—On Light (Juvenile Lectures): Prof. Tyndall, F.R.S.

MONDAY, JANUARY 3.

ENTOMOLOGICAL SOCIETY, at 7.
MEDICAL SOCIETY, at 8.

TUESDAY, JANUARY 4.

PATHOLOGICAL SOCIETY, at 8.—Anniversary meeting.
ANTHROPOLOGICAL SOCIETY, at 8.—On the Psychical Elements of Religion: Mr. Owen Pike.—On the Inhabitants of the Chatham Islands: Dr. Barnard Davis and Mr. A. Welsh.
SYRO-EGYPTIAN SOCIETY, at 7.30.—On the Suez Canal: Mr. W. H. Black, F.S.A.
ROYAL INSTITUTION, at 3.—On Light (Juvenile Lectures): Prof. Tyndall, F.R.S.

WEDNESDAY, JANUARY 5.

PHARMACEUTICAL SOCIETY, at 8.
OBSTETRICAL SOCIETY, at 8.—Anniversary meeting.
ROYAL SOCIETY OF LITERATURE, at 8.30.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH

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THURSDAY, JANUARY 6, 1870

ON THE LABOURING FORCE OF THE HUMAN HEART

THERE is no organ in our bodies that has a more important influence upon health, at all ages of our lives, than the heart, whose rhythm and force are governed by laws of nerve-force, of which we are at present almost totally ignorant. Regarded, however, from a mechanical point of view, as a hydraulic pumping machine, our knowledge of the heart is more accurate, and may yet lead the way to greater knowledge of the physiological action of this vital organ.

I propose, in the present communication, to give an estimate of the daily labouring force of the human heart, and to compare it with that of other muscles, such as those used in rowing or climbing, reserving for a future communication the proof of the data to be now employed.

The heart, regarded as a pumping machine, consists of two muscular bags (*ventricles*), one of which drives the blood through the lungs, and the other through the entire body. This blood is forced, by a pumping action, repeated seventy-five times each minute, through both lungs and body, and experiences in each case a resistance which is measured by the hydrostatical pressure of the blood in the pulmonary artery and aorta. The resistance offered to the circulation of the blood, by the capillary vessels of the lungs and body, is different; but the total quantity of blood that passes through the lungs and body in a given time, must be the same; from which it follows, that the resistance offered by the capillaries must be in the proportion of the hydrostatical pressure in the great arteries leading from the ventricles of the heart. If, therefore we knew that pressure for one side of the heart, and the relative forces of the two ventricles in contracting, we should know the entire resistance overcome by the heart at each of its beats.

If, in addition to the hydrostatical pressure in one ventricle, and its ratio to that in the other ventricle, we knew also the quantity of blood forced out of each ventricle against this pressure, we should have all the elements necessary to calculate the labouring force of the heart, as will be presently shown.

I demand, therefore, that my reader shall grant me, provisionally, the following postulates, which are necessarily three in number :—

I. That three ounces of blood are driven from each ventricle at each stroke of the heart.

II. That the hydrostatical pressure in the left ventricle and aorta, against which the blood is forced out, amounts to a column of blood 9·923 feet in vertical height.

III. That the muscular force of the left ventricle, in contracting, bears to that of the right ventricle the proportion of 13 to 5.

With these postulates granted, we may now proceed to calculate the daily labouring force of the heart as follows. At every stroke of the heart, three ounces of blood are forced out of the left ventricle against a pressure of a column of blood 9·923 feet in height. The work done, therefore, at each stroke is equivalent to lifting three ounces through 9·923 feet. This work is repeated 75 times in each minute, and there are 60×24 minutes in the day. Hence, the daily work of the left ventricle of the human heart is $3 \times 9·923 \times 75 \times 60 \times 24$ ounces lifted through one foot; or, since there are 16 ounces in the pound, and 2,240lbs. in the ton, the work done by the left ventricle of the heart in one day is $\frac{3 \times 9·923 \times 75 \times 60 \times 24}{16 \times 2,240}$ tons lifted through one foot. Multiplying and dividing out this quantity, we find the daily work of the left ventricle is 89·706 foot-tons. The work done by the right ventricle is five-thirteenths of this quantity (post. III.); the daily work of the right ventricle is therefore 34·502 foot-tons. Adding these two quantities together, we find for the total daily work of the human heart 124·208 tons lifted through one foot.

It is not easy for persons unaccustomed to these calculations to appreciate quickly the enormous amount of labouring force denoted by the preceding result; but in order to facilitate this appreciation, I shall compare it with the following descriptions of labour :—

1. The daily labour of a working man.
2. The work done by an oarsman in an eight-oar boat-race.
3. The work done by locomotive engines, or animals climbing a height.

1. The daily labour of a working man, deduced from various kinds of labour, from observations spread over many months, is found to be equivalent to 354 tons lifted through one foot, during the ten hours that usually constitute the day's work. This amount of work is less than three times the work done by a single heart, beating day and night for 24 hours: thus, three old women sitting beside the fire, alternately spinning and sleeping, do more work, by the constant beating of their hearts, than can be done in a day by the youngest and strongest "navvy."

2. If an Oxford eight-oar boat be propelled through the water at the rate of one knot in seven minutes, the resistance offered by the water may be estimated at 81·36 lbs. by calculation, or at 74·15 lbs. by actual observation. From this result, and from the fact that 575 ounces of muscle are employed by each of the eight oarsmen, we can calculate that 15 foot-pounds of work are expended by each ounce of muscle during each minute of work.

No labour that we can undertake is regarded as more severe than that of the muscles employed during a boat-race; and yet this labour, severe as it is, is only three-fourths of that exerted day and night during life by each of our hearts.

The average weight of the human heart, which increases with age (for obvious reasons), may be estimated from the following tables :—

	Average oz.
1. Meckel	10·0
2. Cruveilhier	7·5
3. Bouilland	8·4
4. Lobstein	9·5
5. Boyd (æt. 30—40)	10·4
6. Boyd (æt. 40—50)	10·5
Mean	9·39

From this weight, and the work done by the heart in one day (124 foot-tons), we can calculate the work done by each ounce of the heart in one minute, as follows :—

Work done by the human heart, in foot-pounds per ounce per minute, $\frac{124·208 \times 2240}{9·39 \times 24 \times 60} = 20·576$ foot-pounds.

This amount of work exceeds the work done by the muscles during a boat-race (as already stated) in the proportion of 20 to 15, or of 4 to 3.

3. There is yet another mode of stating the wonderful energy of the human heart. Let us suppose that the heart expends its entire force in lifting its own weight vertically; then the total height through which it could lift itself in one hour is thus found, by reducing the daily work done in foot-tons (124·208) to the hourly work done in foot-ounces, and dividing the result by the weight of the heart in ounces:—

Height through which the human heart could raise its own weight in one hour $= \frac{124·208 \times 2240 \times 16}{24 \times 9·39} = 19754$ ft.

An active pedestrian can climb from Zermatt to the top of Mont Rosa, 9,000 feet, in nine hours; or can lift his own body at the rate of 1,000 feet per hour, which is only one-twentieth part of the energy of the heart.

When the railway was constructed from Trieste to Vienna, a prize was offered for the locomotive Alp engine that could lift its own weight through the greatest height in one hour. The prize locomotive was the "Bavaria," which lifted herself through 2,700 feet in one hour; the greatest feat as yet accomplished on steep gradients. This result, remarkable as it is, reaches only one-eighth part of the energy of the human heart.

From whatever mechanical point of view, therefore, we regard the human heart, it is entitled to be considered as the most wonderful mechanism we are acquainted with. Its energy equals one-third of the total daily force of all the muscles of a strong man; it exceeds by one-third the labour of the muscles in a boat-race, estimated by equal weights of muscle; and it is twenty times the force of the muscles used in climbing, and eight times the force of the most powerful engine invented as yet by the art of man.

No reflecting mind can avoid recognising in its perfection, and regarding with reverential awe, the Divine skill that has constructed it.

SAMUEL HAUGHTON

THE SCIENCE OF LANGUAGE

Darwinism tested by the Science of Language. Translated from the German of Professor August Schleicher, by Dr. Alex. V. W. Bikkers. (London: J. C. Hotten, 1869.)

IT is not very creditable to the students of the Science of Language that there should have been among them so much wrangling as to whether that science is to be treated as one of the natural or as one of the historical sciences. They, if any one, ought to have seen that they were playing with language, or rather that language was playing with them, and that unless a proper definition is first given of what is meant by nature and by natural science, the pleading for and against the admission of the science of language to the circle of the natural sciences may be carried on *ad infinitum.* It is, of course, open to anybody so to define the meaning of nature as to exclude human nature, and so to narrow the sphere of the natural sciences as to leave no place for the science of language. It is possible also so to interpret the meaning of growth that it becomes inapplicable alike to the gradual formation of the earth's crust, and to the slow accumulation of the *humus* of language. Let the definitions of these terms be plainly laid down, and the controversy, if it will not cease at once, will at all events become more fruitful. It will then turn on the legitimate definition of such terms as nature and mind, necessity and free-will, and it will have to be determined by philosophers rather than by scholars.

Unless appearances deceive us, it is not the tendency of modern philosophy to isolate human nature and to separate it by impassable barriers from nature at large, but rather to discover the bridges which lead from one bank to the other, and to lay bare the hidden foundations which, deep beneath the surface, connect the two opposite shores. It is, in fact, easy to see that the old mediæval discussions on necessity and free-will are turning up again in our own time, though slightly disguised, in the discussions on the proper place which man holds in the realm of nature; nay, that the same antinomies have been at the root of the controversy from the days when Greek philosophers maintained that language existed either *φύσει* or *θέσει*, to our own days, when scholars range themselves in two hostile camps, claiming for the Science of Language a place either among the physical or the historical branches of knowledge.

It is by supplying a new point of view for the consideration of these world-old problems, that Darwin's book "On the Origin of Species" has exercised an influence far beyond the sphere for which it was originally intended. The two technical terms of "Natural Selection" and "Struggle for Life," which are in reality but two aspects of the same process, are the very categories which were wanted to enable us to grasp by one effort of thought the reciprocal action of the one on the many and of the many on the one; the mutual dependence of individuals, species, and genus; or, from another point of view, the inevitable limitation of spontaneous action by the controlling influences of social life. I may be allowed to repeat what I said on a former occasion:—"Who has thought about the changes which are brought about, apparently by the exertions of individuals, but for the accomplishment of which, nevertheless, individual exertions would seem to be totally unavailing, without feeling the want of a word—that is to say, in reality, of an idea—to comprehend the influence of individuals on the world at large, and of the world at large on individuals; an idea that should explain the failure of Huss in reforming the Church, and the success of Luther; the defeat of Pitt in carrying parliamentary reform, and the success of Russell? How are we to express that historical process in which the individual seems to be a free agent, and yet is the slave of the masses whom he wants to influence; in which the masses seem irresistible, and are yet swayed by the pen of an unknown writer? Or, to descend to smaller matters, how does a poet become popular? How does a new style of art or architecture prevail? How, again, does fashion change?—how does what seemed absurd last year become recognised in this, and what is admired in this become ridiculous in the next season? Or take language itself. How is it that a new word, such as 'to shunt,' or a new pronunciation, such as '*gold*' instead of '*goold*,' is sometimes accepted, while at other times the last words newly coined or newly revived by our best writers are completely ignored or fall dead? We want an idea that is to exclude caprice as well as necessity—that is, to include individual exertion as well as general co-operation—an idea applicable neither to the unconscious building of bees, nor to the conscious architecture of human beings, yet combining within itself both these operations, and raising them to a new and higher conception. You will guess both the idea and the word, if I add that it is likewise to explain the extinction of fossil kingdoms and the origin of new species:—it is the idea of 'Natural Selection' that was wanted, and being wanted it was found, and being found it was named. It is a new category, a new engine of thought; and if naturalists are proud to affix their names to a new species which they discover, Mr. Darwin may be prouder, for his name will remain affixed to a new idea, to a new genus of thought." *

Professor Schleicher, whose recent death has left a gap in the ranks of the students of language which it will be difficult to fill, has written down the impressions which he, as a comparative philologist, received from a perusal of Mr. Darwin's work, in a letter addressed to his distinguished colleague, Professor Haeckel, of Jena. It is but a slight sketch, and it would not be fair if the English public took the measure of Professor Schleicher's powers from the translation of his pamphlet which has just been published by Dr. Bikkers, under the somewhat inappropriate title of "Darwinism tested by the Science of Language." Professor Schleicher could hardly have thought that the truth or falsehood of Mr. Darwin's theories depended on any test that can be applied to them by the Science of Language. But he thinks rightly that the genesis of species, as explained by Mr. Darwin, receives a striking illustration in the genealogical system of languages, and particularly of the Aryan and Semitic languages; and he very properly calls attention to the fact, that as this ramification of human speech took place within what may be called, if not historical, at least post-tertiary times, it may be useful as a kind of confirmation of Mr. Darwin's theory, which postulates a similar process in far more distant periods of the world's history. "We observe," he says, "during historical periods how species and genera of speech disappear, and how others extend themselves at the expense of the dead. I only remind you, by way of illustration, of the spread of the Indo-Germanic family, and the decay of the American languages. In the earlier times, when languages were still spoken by comparatively weak populations, this dying-out of forms of speech was, no doubt, of much more frequent occurrence, and, as the idioms of a higher organisation must have existed for a very long time, it follows that the pre-historic period in the life of speech must have been a much longer one than that which falls within the limits of historical record. . . . . It is very possible that many more species of speech perished during the course of that time than the number of those which have prolonged their existence up to the present day. This explains the possibility of so great an extension as, for instance, that of the Indo-Germanic, the Finnic, the Malay, and South African families, which, over a large territory, branched off into such a multitude of directions. A similar process is assumed by Mr. Darwin with regard to the animal and vegetable creation; that is, what he calls 'the struggle for life.' A multitude of organic forms had to perish in the struggle in order to make room for comparatively few favoured races."

Although this struggle for life among separate languages exhibits some analogy with the struggle for life among the more or less favoured species in the animal and vegetable kingdoms, there is this important difference that the defect and the gradual extinction of languages depend frequently on external causes, *i.e.* not on the weakness of the languages themselves, but on the weakness, physical, moral, or political, of those who speak them. A much more striking analogy, therefore, than the struggle for life among separate languages, is the struggle for life among words and grammatical forms which is constantly going on in each language. Here the better, the shorter, the easier forms are constantly gaining the upper hand, and they really owe their success to their own inherent virtue. Here, if anywhere, we can learn that what is called the process of natural selection, is at the same time, from a higher point of view, a process of rational elimination; for what seems at first sight mere accident in the dropping of old and the rising of new words, can be shown in most cases to be due to intelligible and generally valid reasons. Sometimes these reasons are purely phonetic, and those words and forms are seen to prevail which give the least trouble to the organs of pronunciation. At other times the causes are more remote. We see how certain forms of grammar which require little reflection, acquire for that very reason a decided numerical preponderance; become, in fact, what are called regular forms, while the other forms, generally the more primitive and more legitimate, dwindle away to a small minority, and are treated at last as exceptional and irregular. In the so-called dialectic growth of languages we see the struggle for life in full play, and though we cannot in every instance explain the causes of victory and defeat, we still perceive, as a general rule, that those words and those forms carry the day which for the time being seem best to answer their purpose. Why did the French use *maison*, i.e. mansion, for house? Because *casa* having dwindled down to *chez* was not sufficiently distinct in pronunciation, and because *domus* being frequently used for ecclesiastical buildings, was no longer sufficiently precise in its meaning, if applied to an ordinary house. Why do verbs in *ir*, like *finir*, form the plural *nous finissons*, instead of *nous finons?* Because the example which was set in Latin by the early formation of so-called inchoative verbs, like *durescere, florescere, implescere, gemiscere*, proved attractive, partly on account of its removing any doubts on the exact terminations of a verb, partly because of its giving a fuller body to monosyllabic verbs. Thus *finiscere* was substituted for *finire* in all tenses but the infinitive, the perfect, the future, and the conditional; and while this new species, the so-called second conjugation, was gradually being established, a few scattered remnants only survived of the former race, fossilised, petrified, or, as they are called in grammatical parlance, irregular, such as *nous venons* from *venir*, *nous partons* from *partir*, &c.

There is one point on which Professor Schleicher seems to have misapprehended the meaning of Mr. Darwin. According to him, the different species of the Aryan as well as of the Semitic languages presuppose each a typical language from which they are genealogically

* "Lectures on the Science of Language." Second Series. Second Edition, p. 309.

derived. There was, according to him, an ancient Aryan language, not only perfect and complete in itself, but so constituted that it contained the germs of everything which we find in Sanskrit, Greek, Latin, German, Celtic, and Slavonic. Such a language may no doubt be constructed theoretically, in the same manner as out of French, Italian, Spanish, and Portuguese, some kind of Latin language might be reconstructed. But such Latin would be very different from real Latin. Historically the admission of type-languages is perfectly impossible. No one would think of deriving the ancient Greek dialects from one actually existing common language containing within itself the germs of every dialect. No one could realise a language which should be at the same time both High and Low, and yet neither High nor Low German. What kind of language could the primitive Celtic have been, if it had to combine the peculiarities of the Gadhelic and the Cymric branches? How could a common Italian language have existed, if it had to maintain and to neutralise the distinctive features of Oscan, Latin, or Umbrian speech? What applies to the dialects of each language, applies with the same force to all these languages in common, when considered themselves as dialects of Aryan speech. As we cannot derive the Greek dialects from a presupposed primitive κοινή, we should not attempt to derive the great dialects—viz. Greek, Latin, Celtic, Teutonic, and Slavonic—from a presupposed primitive Palæo-Aryan type of speech. In tracing the origin of species, whether among plants or animals, we do not begin with one perfect type of which all succeeding forms are simply modifications, but we begin with an infinite variety of attempts, out of which by the slow but incessant progress of natural selection, more and more perfect types are gradually elaborated, some of which are still further improved by artificial domestication. It is the same with languages. The natural state of language consists in unlimited dialectic variety, out of which, by incessant weeding, more and more definite forms of languages are selected, till at last by literary cultivation those highly elaborated classical languages are produced which, in spite of their beauty, are nevertheless abnormal and unnatural, and invariably die without leaving any offspring. New languages do not spring from classical parents, but draw their life and vigour from the spoken rustic and vulgar dialects. No reader of Mr. Darwin's books can fail to see that an analogous process pervades the growth of a new species of language, and of new species of animal and vegetable life. But these analogies should not be carried too far. At all events we should never allow ourselves to forget that, if we speak of languages as natural productions, and of the science of language as one of the natural sciences, what we chiefly wish to say is, that languages are not produced by the free-will of individuals, and that if they are works of art, they are works of what may be called a natural or unconscious art—an art in which the individual, though he is the agent, is not a free agent, but checked and governed from the very first breath of speech by the implied co-operation of those to whom his language is addressed, and without whose acceptance language, not being understood, would cease to be language.

There are other spheres of mental activity to which the same remark applies, but to none so much as to language. It might be said, and it has been said by high authorities, that neither in framing his codes of law, nor in settling the rules of morality, nor in believing the truths of religion, is man an entirely free agent, but that the freedom of the individual is necessarily limited by the pressure exercised by all upon all, and by the circumstances and conditions of the age in which we live. It is true, also, that the science of psychology, which forms the basis of juridical, ethical, and religious science, is imperfect unless it has its foundations in physiology. "La tendance de la physiologie moderne," as M. Claude Bernard remarks, "est donc bien caractérisée ; elle veut expliquer les autres phénomènes intellectuels au même titre que tous les autres phénomènes de la vie ; et si elle reconnait avec raison qu'il y a des lacunes plus considérables dans nos connaissances relativement aux mécanismes fonctionnels de l'intelligence, elle n'admet pas pour cela que les mécanismes soient par leur nature ni plus ni moins accessibles à notre investigation que ceux de tous les autres actes vitaux ?"

But in none of these spheres of mental activity is the freedom of the individual so completely absorbed, and all but annihilated, as in the sphere of language. Not only are the first impulses of language purely physical ; not only is the material of language entirely dependent on the physical organs, such as they are ; not only does the activity of the functional nervous centre of speech become quickly habitual, automatic, and almost instinctive, but even in its purely mental aspect, language rests from the very first on an unconscious compromise. Speech in its very nature is mutual : even a mere exclamation is nothing unless it is understood. Even now we do not speak to others as we should speak to ourselves, but speak their language rather than our own. So it was, only in an infinitely higher degree, in the first formation of speech. If we represent the individual speaker by ^{1}, and the unlimited number of his fellow-creatures by x, the conscious freedom of action which can be claimed for any individual speaker may be expressed by $^1/x$, a quantity oscillating between one divided by one, and one divided by infinity. With every generation this x becomes larger and larger, because it includes not only the present, but the more powerful influence of the past, till at last use and habit exercise the power of a tyrant,

"Quem penes arbitrium est et jus et norma loquendi,"

and whose behests we can no more think of disobeying than the laws of nature.

It is but fair to state, in conclusion, that the first suggestion of the necessity of admitting some of the so-called moral sciences to the circle of the natural sciences came, not from the students of psychology and glossology, but from the historian of the inductive sciences, who saw that the old definition of natural science was becoming too narrow, and that with a new definition the circle of physical knowledge had necessarily to be widened. Dr. Whewell wrote in 1845 :—"We have seen that biology leads us to psychology, if we choose to follow the path ; and thus the passage from the material to the immaterial has already unfolded itself at one point ; and we now perceive that there are several large provinces of speculation which concern subjects belonging to man's immaterial nature, and which are governed by the same laws as sciences altogether physical.

It is not our business to dwell on the prospects which our philosophy thus opens to our contemplation; but we may allow ourselves, in this last stage of our pilgrimage among the foundations of the physical sciences, to be cheered and animated by the ray that thus beams upon us, however dimly, from a higher and brighter region."

MAX MÜLLER

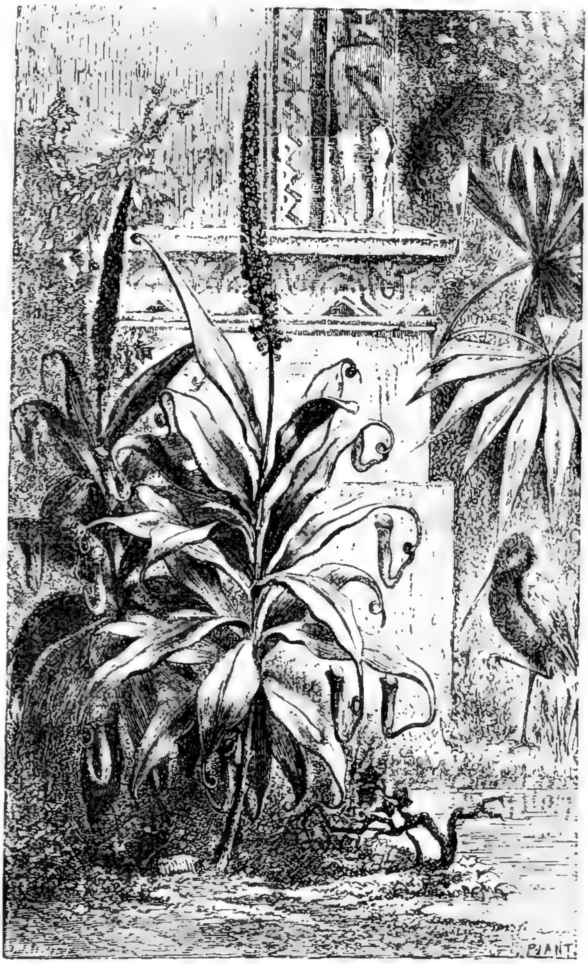
THE UNIVERSE

The Universe; or, the Infinitely Great and the Infinitely Little. By F. A. Pouchet, M.D., &c. Pp. 790, 343 engravings, 4 coloured plates. (London: Blackie and Son.)

"WHAT a charming title!" was the thought which first came to us when we saw the announcement of this splendid book. "What a terrible title!" was the thought which swiftly followed. Is it a message from some modern prophet to a people, who, having eyes, see not, and having ears, hear not; imploring them to take heed to the tale written in every character in all space, and chanted in every note by every atom, so long and so often in vain? Will it tell us of the signs written in lines of light and lines of black, which have been travelling earthward from the outermost space since the oldest time, till now unnoticed and unread? Will it speak of the oozy mother of living things, which lies and creeps and grows over the whole bottom of the ocean's depths, and comes and goes in every little stagnant pool and slimy puddle? Will it teach us of the quivering flight of atoms in every fire that burns on earth, and in the flaming ministers which rush through illimitable space; of the fairy chains which are welded when the chamber window is sculptured with the frost, and which hold in bonds the elements of the salt that is spilt; and of the giant chains which curb the comets and bind the invisible stars to us? Will it make us to know the great pulsations which shake the earth, and the little throbs which stir the tiny cells of every thing which lives and dies?

All notions of this kind were scattered to the winds when the volume came into our hands. The prophets of old were clothed in sackcloth and ashes, and those of to-day go about in black, mourning for the sins of the people; but this work is resplendent in purple and gold—a very Dives among books. And every anticipation of a prophetic wail died away when we found that the author was a Frenchman.

NEPTUNE'S CUP (*Raphidophora latera*)



PITCHER PLANT (*Nepenthes distillatoria*, Linn.)

It is just such a work as might be expected from a nimble-witted gyrating Gaul, a sort of *petit maitre* of omniscience. We remember to have heard a criticism passed on a controversial work, made up of many short, somewhat disconnected chapters, to the effect that it reminded the reader of a dog in a kennel coming out at intervals to have a short sharp bark, and then quickly going in again. "The Universe," in a somewhat similar manner, reminds us of the dissolving-views at which the lecturer goes in and out at every view. It is, in fact, a pictorial entertainment, in which M. Pouchet takes the reader, agreeably and without exertion, through all time and all space, with remarks by the way. A picture is presented and the author tells us a little about it, playing all the while (so that the affair may not be tedious) a pretty accompaniment of eloquent diction, charming fancies, and pleasing sarcasm; then another picture is put before the readers, and again another entertainment is begun and finished in like fashion. In this way the author brings before his audience something about most things, treading with a light fantastic mind over the animal and vegetable kingdoms, the formation of the globe, fossils, volcanoes, glaciers, the sun, the stars and immensity, and many other things besides; and as dissolving-views generally end, or used to end, with a chromatrope, so M. Pouchet finishes with an amusing chapter on monsters and superstitions. To every topic there is a picture. We have reproduced two of the smallest and simplest; but a very large number of them are extremely beautiful full-page drawings. And if in them the naked truth is anywhere departed from, it is only for the purpose of heightening the entertainment.

Our readers will already have seen that we regard the letter-press as subsidiary to the pictures; and as far as we can judge, that seems to be also M. Pouchet's own view. The great fault we have to find with the writing, relates to the extreme elegance of the diction. In England we generally talk of bird's nests, but M. Pouchet dwells with zest on the Nuptial Arbour of the Bower Birds; and in the same spirit we have a good deal about "the Nuptials of Plants." In the next edition we shall probably hear something about the Hymeneals of Bathybius.

It is an old question which has puzzled many generations of mothers and nurses, "whether it is better to give a child his powder in jam until he discover the deception, or to be straightforward from the beginning and make the powder go down all nasty as it is." And we may take it for granted that to the general reader simple naked scientific truths are at first as unpalatable as medicine; so that with them too the question of what the old apothecaries used to call "a vehicle" has always to be considered. This question we do not pretend to decide, however strong our own private convictions may be; but to those who range themselves on the side of jam we may recommend this volume as a most skilfully prepared, and not unwholesome confection, with not too much medicine in it. The author states in his preface that he wrote it in the hope of exciting some love of science in his readers, and the researches which have made his name distinguished, are evidence that he has himself a real love of science to no small degree. We can readily imagine how a mind, especially a young mind, fascinated by these beautiful pictures and interested in the lightsome narrative, should let the things grow upon him until there sprang up an actual fondness for plain scientific truth, and he came at last to think that "the medicine was food." To such, and towards such an end, we can heartily commend it.

OUR BOOK SHELF

The Origin of the Seasons. By Samuel Mossman. (Edinburgh: Blackwood & Sons. 1869.)

A PLEASANTLY written and interesting work, spoiled by being coupled with a preposterous theory. Mr. Mossman boldly attempts a difficult task. He proposes to solve a complex problem on very simple principles. Unfortunately his principles are unsound; and overlooking this, there remains the objection that they do not solve his problem. This problem is the well-known fact that in bygone ages plants existed in high latitudes—as far north as England, for example—whose analogues are now only found in the tropics. Mr. Mossman explains this very simply. The obliquity of the ecliptic is now slowly decreasing; therefore it must once have been increasing, and doubtless—though astronomy objects—there was at one time no obliquity: in those days perpetual spring reigned on the earth. But there began a series of upheavals, he says, "directed chiefly towards the northern hemisphere almost exclusively," and this hemisphere becoming overweighted, naturally began to incline. The inclination became at length perhaps twice as great as at present, or even more; but then the southern hemisphere began in its turn to be upheaved, and so checked the increase of inclination, and caused the present process of slow decrease. Mr. Mossman thinks there is nothing in this "contrary to the universal law of gravitation," an opinion which he would modify were he more familiar with that law. The want of balance he speaks of would affect precession and nutation, but not the inclination of the earth's axis. Supposing gravity were on his side, however, and we granted his extension of the tropics, he should remember that the Arctic regions would be equally extended. If he brings the northern tropic to the latitude of London, he has brought the Arctic circle to the latitude of Madrid. Tropical plants in the latitude of Paris, say, would fare ill under this arrangement.

Recherches sur la Faune de Madagascar et de ses Dépendances. Ire. Partie: Relation de Voyage. Par Francois P. L. Pollen. (Leyde: Steenhoff, 1868.)

M. POLLEN, being fond of sport, and having a mind to travel, after consulting Professor Schlegel, started for Madagascar, and spent there a considerable time exploring that and the neighbouring islands, having M. C. Van Dam for companion and preparer of skins, &c. He now publishes the results of his expedition, in large quarto, with profuse illustration in the form of lithographic plates. There are to be five parts to this work—(1) The account of the expedition, (2) the mammifers and birds, (3) the reptiles, (4) the fish, (5) the insects, crustacea, and molluscs. M. Pollen writes the first himself, whilst Professors Schlegel, Bleeker, Vollenhoven, Herklots, and Selys Longchamps assist in the more strictly scientific portion. At present we have only M. Pollen's account of his voyage before us, which is written in a popular style—as he says in the preface—and is as interesting as could be expected. We should suppose that M. Pollen is not himself profoundly scientific; but he has good assistance for the rest of his work.

Country Walks of a Naturalist with his Children. By Rev. W. Houghton. (London: Groombridge and Sons, 1869.)

IF the author had aimed at interesting children of a somewhat larger growth than he has had in view, we think he would have succeeded. The trivial parts of the book will hardly please boys and girls capable of understanding the more solid portions.

A PLEA FOR THE MATHEMATICIAN

II.

I MIGHT go on, were it necessary, piling instance upon instance to prove the paramount importance of the faculty of observation to the process of mathematical discovery.* Were it not unbecoming to dilate on one's personal experience, I could tell a story of almost romantic interest about my own latest researches in a field where Geometry, Algebra, and the Theory of Numbers melt in a surprising manner into one another, like sunset tints or the colours of the dying dolphin, "the last still loveliest" (a sketch of which has just appeared in the Proceedings of the London Mathematical Society),† which would very strikingly illustrate how much observation, divination, induction, experimental trial, and verification—causation, too (if that means, as, if it mean anything, I suppose it must, mounting from phenomena to their reasons or causes of being)—have to do with the work of the mathematician. In the face of these facts, which every analyst can vouch for out of his own knowledge and personal experience, how can it be maintained, in the words of Professor Huxley (who, in this instance, is speaking of the sciences as they are in themselves and without any reference to scholastic discipline), that Mathematics "is that study which knows nothing of observation, nothing of induction, nothing of experiment, nothing of causation"?‡

I, of course, am not so absurd as to contend that the habit of observation of external nature‖ will be best or at all cultivated by the study of mathematics, leastways as that study is at present conducted; and no one can desire more earnestly than myself to see natural and experimental science introduced into our schools as a primary and indispensable branch of education: I think that that study and mathematical culture should go on hand in hand together, and that they would greatly influence each other for their mutual good. I should rejoice to see mathematics taught with that life and animation which the presence and example of her young and buoyant sister could not fail to impart; short roads preferred to long ones; Euclid honourably shelved or buried "deeper than did ever plummet sound" out of the schoolboy's reach; morphology introduced into the elements of Algebra; projection, correlation, and motion accepted as aids to geometry; the mind of the student quickened and elevated and his faith awakened by early initiation into the ruling ideas of polarity, continuity, infinity, and familiarisation with the doctrine of the imaginary and inconceivable.

It is this living interest in the subject which is so wanting in our traditional and mediæval modes of teaching. In France, Germany, and Italy, everywhere where I have been on the Continent, mind acts direct on mind in a manner unknown to the frozen formality of our academic institutions; schools of thought and centres of real intellectual co-operation exist; the relation of master and pupil is acknowledged as a spiritual and a lifelong tie connecting successive generations of great thinkers in an unbroken chain, just as we read, in the catalogue of our French Exhibition, or of the Salon at Paris, of this man or that being the pupil of one great painter or sculptor and the master of another. When followed out in this spirit, there is no study in the world which brings into more harmonious action all the faculties of the mind than the one of which I stand here as the humble representative and advocate. There is none other which prepares so many agreeable surprises for its followers, more wonderful than the transformation scene of a pantomime, or, like this, seems to raise them, by successive steps of initiation, to higher and higher states of conscious intellectual being.

This accounts, I believe, in part for the extraordinary longevity of all the greatest masters of the Analytical art, the Dii Majores of the mathematical Pantheon. Leibnitz lived to the age of 70; Euler to 76; Lagrange to 77; Laplace to 78; Gauss to 78; Plato, the supposed inventor of the conic sections, who made mathematics his study and delight, who called them the handles or aids to philosophy, the medicine of the soul, and is said never to have let a day go by without inventing some new theorems, lived to 82; Newton, the crown and glory of his race, to 85; Archimedes, the nearest akin, probably, to Newton in genius, to 75, and might have lived on to be 100, for aught we can guess to the contrary, when he was slain by the impatient and ill-mannered sergeant sent to bring him before the Roman General, in the full vigour of his faculties, and in the very act of working out a problem; Pythagoras, in whose school, I believe, the word mathematician (used, however, in a somewhat wider than its present sense) originated, the second founder of geometry, the inventor of the matchless theorem which goes by his name, the precognizer of undoubtedly the miscalled Copernican theory, the discoverer of the regular solids and the musical canon (who stands at the very apex of this pyramid of fame), if we may accept the tradition, after spending 22 years studying in Egypt and 12 in Babylon, opened school when 56 or 57 years old in Magna Græcia, married a young wife when past 60, and died, carrying on his work with energy unspent to the last, at the age of 99. The mathematician lives long and lives young; "the wings of his soul do not early drop off, nor do its pores become clogged with the earthy particles blown from the dusty highways of vulgar life."

Some people have been found to regard all mathematics, after the 47th proposition of Euclid, as a sort of morbid secretion, to be compared only with the pearl said to be generated in the diseased oyster, or, as I have heard it described, "une excroissance maladive de l'esprit humain.

* Newton's Rule (subsequently and for the first time deduced to demonstration in No. 2 of the London Mathematical Society's Proceedings) was to all appearance, and according to the more received opinion, obtained inductively by its author. So also my reduction of Euler's problem of the Virgins (or rather one slightly more general than this) to the form of a question (or, to speak more exactly, a set of questions) in simple partitions was (strangely enough) first obtained by myself inductively, the result communicated to Prof. Cayley, and proved subsequently by each of us independently, and by perfectly distinct methods.

† Under the title of "Outline Trace of the Theory of Reducible Cyclodes."

‡ Induction and analogy are the special characteristics of modern mathematics, in which theorems have given place to theories and no truth is regarded otherwise than as a link in an infinite chain. "Omne exit in infinitum" is their favourite motto and accepted axiom. No mathematician now-a-days sets any store on the discovery of isolated theorems, except as affording hints of an unsuspected new sphere of thought, like meteorites detached from some undiscovered planetary orb of speculation. The form, as well as matter, of mathematical science, as must be the case in any true living organic science, is in a constant state of flux and the position of its centre of gravity is liable to continual change. At different periods in its history, defined with more or less accuracy, as the science of number or quantity, or extension or operation or arrangement, it appears, at present, to be passing through a phase in which the development of the notion of continuity plays the leading part. In exemplification of the generalising tendency of modern mathematics, take so simple a fact as that of two straight lines or two planes being incapable of including "a space." When analysed this statement will be found to resolve itself into the assertion that if two out of the four triads that can be formed with four points lie respectively *in directum*, the same must be true of the remaining two triads; and that if two of the five tetrads that can be formed with five points lie respectively *in plano*, the remaining three tetrads (subject to a certain obvious exception) must each do the same. This at least is one way of arriving at the notion of an unlimited rectilinear and planar scheme of points. The two statements above made, translated into the language of determinants, immediately suggest as their generalised expression my great "Homaloidal Law," which affirms that the vanishing of a certain specifiable number of minor determinants of a given order of any matrix (*i.e.* rectangular array of quantities) implies the simultaneous evanescence of all the rest of that order. I made (*inter alia*) a beautiful application of this law (which is, I believe, recorded in Mr. Spottiswoode's valuable treatise on Determinants, but where besides I know not) to the establishment of the well-known relations, wrung out with so much difficulty by Euler, between the cosines of the nine angles which two sets of rectangular ones in space make with one another. This is done by contriving a matrix such that the six known equations connecting the nine cosines taken both ways in sets of threes shall be expressed by the evanescence of six of its minors; the simultaneous evanescence of the remaining minors given by the Homaloidal Law will then be found to express the Eulerian relations in question, which are thus obtained by a simple process of inspection and reading off, without any labour whatever. The fact that such a law, containing in a latent form so much refined algebra, and capable of such interesting immediate applications, should present itself to the *observation* merely as the extended expression of the ground of the possibility of our most elementary and seemingly intuitive conceptions concerning the right line and plane, has often filled me with amazement to think of.

‖ As the prerogative of Natural Science is to cultivate a taste for observation, so that of Mathematics is, almost from the starting point, to stimulate the faculty of invention.

Others find its justification, its "raison d'être," in its being either the torch-bearer leading the way, or the handmaiden holding up the train of Physical Science; and a very clever writer in a recent magazine article, expresses his doubts whether it is, in itself, a more serious pursuit, or more worthy of interesting an intellectual human being, than the study of chess problems or Chinese puzzles.* What is it to us, they say, if the three angles of a triangle are equal to two right angles, or if every even number is, or may be, the sum of two primes,† or if every equation of an odd degree must have a real root? How dull, stale, flat and unprofitable are such and such like announcements! Much more interesting to read an account of a marriage in high life, or the details of an international boat-race. But this is like judging of architecture from being shown some of the brick and mortar, or even a quarried stone of a public building—or of painting from the colours mixed on the palette, or of music by listening to the thin and screechy sounds produced by a bow passed haphazard over the strings of a violin. The world of ideas which it discloses or illuminates, the contemplation of divine beauty and order which it induces, the harmonious connexion of its parts, the infinite hierarchy and absolute evidence of the truths with which mathematical science is concerned, these, and such like, are the surest grounds of its title to human regard, and would remain unimpaired were the plan of the universe unrolled like a map at our feet, and the mind of man qualified to take in the whole scheme of creation at a glance.

In conformity with general usage, I have used the word mathematics in the plural; but I think it would be desirable that this form of word should be reserved for the applications of the science, and that we should use mathematic in the singular number to denote the science itself, in the same way as we speak of logic, rhetoric, or (own sister to algebra‡) music. Time was when all the parts of the subject were dissevered, when algebra, geometry, and arithmetic either lived apart or kept up cold relations of acquaintance confined to occasional calls upon one another; but that is now at an end; they are drawn together and are constantly becoming more and more intimately related and connected by a thousand fresh ties, and we may confidently look forward to a time when they shall form but one body with one soul. Geometry formerly was the chief borrower from arithmetic and algebra, but it has since repaid its obligations with overflowing usury; and if I were asked to name, in one word, the pole-star round which the mathematical firmament revolves, the central idea which pervades as a hidden spirit the whole corpus of mathematical doctrine, I should point to Continuity as contained in our notions of space, and say, It is this, it is this! Space is the Grand *Continuum* from which, as from an inexhaustible reservoir, all the fertilizing ideas of modern analysis are derived; and as Brindley, the engineer, once allowed before a parliamentary committee that, in his opinion, rivers were made to feed navigable canals, I feel sometimes almost tempted to say that one principal reason for the existence of space, or at least one principal function which it discharges, is that of feeding mathematical invention. Everybody knows what a wonderful influence geometry has exercised in the hands of Cauchy, Puiseux, Riemann, and his followers Clebsch, Gordan, and others, over the very form and presentment of the modern calculus, and how it has come to pass that the tracing of curves, which was once to be regarded as a puerile amusement, or at best useful only to the architect or decorator, is now entitled to take rank as a high philosophical exercise, inasmuch as every new curve or surface, or other circumspection of space, is capable of being regarded as the synthesis and embodiment of some specific organised system of continuity.*

The early study of Euclid made me a hater of geometry, which I hope may plead my excuse if I have shocked the opinions of any in this room (and I know there are some who rank Euclid as second in sacredness to the Bible alone, and as one of the advanced outposts of the British Constitution) by the tone in which I have previously alluded to it as a school-book; and yet, in spite of this repugnance, which had become a second nature in me whenever I went far enough into any mathematical question, I found I touched, at last, a geometrical bottom; so it was, I may instance, in the purely arithmetrical theory of partitions; so, again, in one of my more recent studies the purely algebraical question of the invariantive criteria of the nature of the roots of an equation of the fifth degree; —the first inquiry landed me in a new theory of polyhedra, the latter found its perfect and only possible complete† solution in the construction of a surface of the ninth order and the sub-division of its infinite contents into three distinct natural regions.‡

Having thus expressed myself at greater length

* Is it not the same disregard of principles, the same *indifference to truth for its own sake*, which prompts the question "Where's the good of it?" in reference to speculative science, and "Where's the harm of it?" in reference to white lies and pious frauds? In my own experience I have found that the very same people who delight to put the first question are in the habit of acting upon the denial implied in the second. *Abit in mores incuria.*

† This theorem still awaits proof; it is stated, I believe, in Euler's correspondence with Goldbach: I re-discovered it in ignorance of Euler's having mentioned it, in connection with a theory of my own concerning cubic forms. The evidence in its favour is *induction* of the undemonstrative or purely accumulative kind, and it may or may not turn out eventually to be true. As a most learned scholar who heard this address given at Exeter remarked to me not many days ago, it is certainly by no process of deduction that we make out that five times six is thirty. I mention this, because I know some, who agree, or did agree, with Professor Huxley's published opinions about mathematics, are under the impression that the higher processes of mind in mathematics only concern "the aristocracy of mathematicians:" on the contrary, they lie at the very foundations of the subject. There are besides, and in abundance, mathematical processes which only by a forced interpretation can be brought under the head of demonstration, whether deductive or inductive, and really belong to a sort of artistic and constructive faculty, such for example as evaluating definite integrals, or making out the best way one can the number of distinct branches, and the general character of each branch of a curve from its algebraical equation.

‡ I have elsewhere (in my Trilogy published in the "Philosophical Transactions") referred to the close connection between these two cultures, not merely as having Arithmetic for their common parent, but as similar in their habits and affections. I have called "Music the Algebra of sense, Algebra the Music of the reason; Music the dream, Algebra the waking life—the soul of each the same!"

* M. Camille Jordan's application of Dr. Salmon's Eikosi-heptagram to Abelian functions is one of the most recent instances of this reverse action of geometry on analysis. Mr. Crofton's admirable apparatus of a reticulation with infinitely fine meshes rotated successively through indefinitely small angles, which he applies to obtaining whole families of definite integrals, is another equally striking example of the same phenomenon.

† *Complete* in the sense of *universal*, more *than perfect or complete* in the ordinary sense. Two criteria are absolutely fixed; but in addition to these two an additional criterion or set of criteria must be introduced to make the system of conditions sufficient. The number of such set may be either one or whatever number we please, and into such one or into each of the set (if more than one) an indefinite number of arbitrary parameters (limited) may be introduced. Now the geometrical construction I arrive at contains implicitly the totality of all these infinitely varied forms of criteria, or sets of criteria, and without it, the existence and possibility of such variety in the shape of the solution could never have been anticipated or understood. My truly eminent friend M. Charles Hermite (Membre de l'Institut), with all the efforts of his extraordinary analytical power, and with the knowledge of my results to guide him, has only been able by the non-geometrical method to arrive at one form of solution consisting of a third criterion absolutely definite and destitute of a single variable parameter. As is well known, I have made a very important use of a criterion of the same form as M. Hermite's, but containing one arbitrary parameter (limited). The subject will be found resumed from the point where I left it, and pursued in considerable detail by Prof. Cayley, in one of his more recent memoirs on Quartics in the Philosophical Transactions. M. Hermite it was who first surprised Invariantists (l'Eglise Invariantive, as we are sometimes styled) by an *à priori* demonstration that the nature of the roots or factors of quartics could in general be found by means of invariantive criteria. This was known to be possible up to the *fourth* order of binary quartics, and impossible for the *fourth*. M. Hermite showed that this negation which seemed to stop the way to further progress was an exceptional case; that whereas for the second, third, fifth, sixth, and all higher degrees the thing could be done, for the fourth alone it was impossible: as regards linear quartics, the question does not arise. I look upon this failure of a law for one term in the middle of an infinite progression as an unparalleled *miracle of arithmetic*, far more real and deeper seated than the one alluded to by Mr. Babbage in connection with the discontinuous action of a supposed machine in his ninth Bridgwater Treatise.

‡ So I found, as a pure matter of observation, that allineation (*alignement*) in ornamental gardening—*i.e.* the method of putting trees in positions to form a very great number or the greatest number possible of straight rows, of which a few special cases only had been previously considered as detached porismatic problems, forms part of a great connected theory of the pluperfect points on a cubic curve, those points, of which the nine points of inflection and Plücker's twenty-seven points serve as the lowest instances.

than I originally intended on the subject, which, as standing first on the muster roll of the Association, and as having been so recently and repeatedly arraigned before the bar of public opinion, is entitled to be heard in its defence (if anywhere) in this place,—having endeavoured to show what it is not, what it is, and what it is probably destined to become, I feel that I must enough and more than enough have trespassed on your forbearance. J. J. SYLVESTER

The remarks on the use of experimental methods in mathematical investigation led to Dr. Jacobi, the eminent physicist of St. Petersburg, who was present at the delivery of the foregoing address, favouring me with the annexed anecdote relative to his illustrious brother, C. G. J. Jacobi *—

"En causant un jour avec mon frère défunt sur la nécessité de contrôler par des expériences réitérées toute observation, même si elle confirme l'hypothèse, il me raconta avoir découvert un jour une loi très-remarquable de la théorie des nombres, dont il ne douta guère qu'elle fût générale. Cependant par un excès de précaution ou plutôt pour faire le superflu, il voulut substituer un chiffre quelconque réel aux termes généraux, chiffre qu'il choisit au hasard, ou, peut-être, par une espèce de divination, car en effet ce chiffre mit sa formule en défaut ; tout autre chiffre qu'il essaya en confirma la généralité. Plus tard il réussit à prouver que le chiffre choisi par lui par hasard, appartenait à un système de chiffres qui faisait la seule exception à la règle.

"Ce fait curieux m'est resté dans la mémoire, mais comme il s'est passé il y a plus d'une trentaine d'années, je ne rappelle plus les détails. "M. H. JACOBI

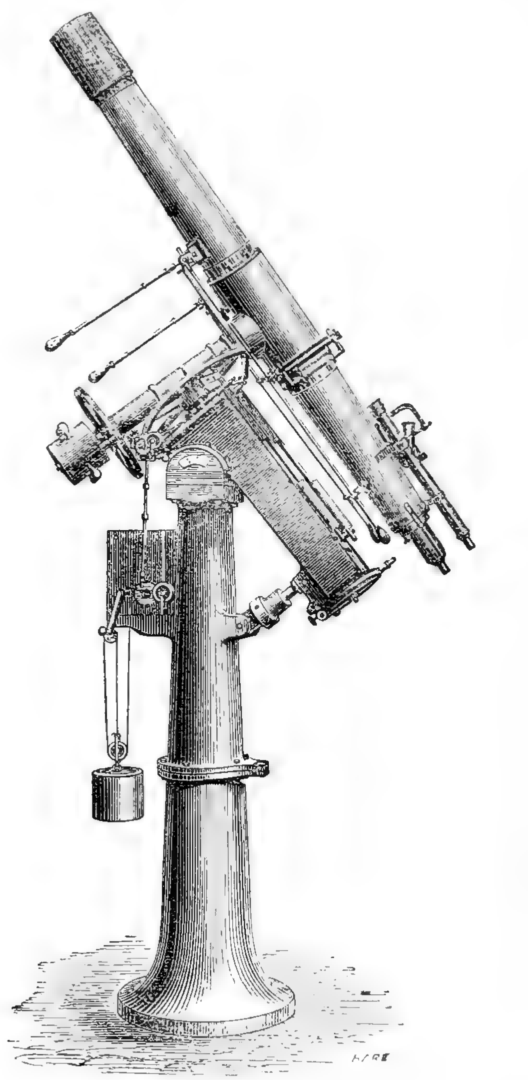
"Exeter, 24 Août, 1869."

THE NEW TELESCOPE AT ETON

IN furtherance of natural science work at Eton, an excellent telescope has been recently given to the school by the energy and liberality of some of the masters.

The instrument is a refractor, with object glass of 5·9 inches clear aperture, and 88 inches focus, and was made by Messrs. Cooke and Sons, of York, who also supplied the observatory and superintended the erection of the telescope. It is, as will be seen from the engraving, mounted equatorially on the German system, with declination circle reading to 10″ of arc, and hour circle reading to 2″ of time. The mechanical details do not, with one exception, deviate materially from the pattern usually adopted by Messrs. Cooke, whose name is a guarantee for skill of design and excellence of workmanship. The exception alluded to is in the construction of the driving clock, the speed of which is not regulated, as usual, by a centrifugal governor, or fly, alone, but by a fly supplemented by an ordinary clock escapement. This arrangement is quite new, and is the invention of the late Mr. T. Cooke, the senior partner in the firm. It was described by him in a paper read before the Royal Astronomical Society a short time ago. The details would hardly be intelligible without drawings, but the general mode of action is as follows :—

The barrel is connected with two trains of wheel-work : one (the lowest wheel of which gives motion in the ordinary way to the telescope) is terminated by a fly of insufficient power *per se* to reduce the speed within proper limits ; the other train is terminated by a half-dead escapement of the usual kind. One of the wheels of the fly-train has a broad rim, on which presses a brake actuated by a wheel in the escapement train. When the escapement is stopped, this brake presses on the wheel with sufficient force to stop the motion of the clock entirely. When the escapement is set to work the brake is released, and the fly-train moves, communicating motion to the telescope. If the speed becomes too great, so as to outrun the escapement, the latter immediately applies increased brake-power, and checks the motion of



THE ETON EQUATORIAL

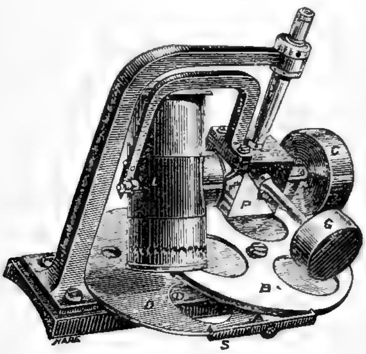
the fly ; and *vice versâ*, if from increased friction or other cause the motion is too slow, so that the fly lags behind the escapement, the brake-spring is relaxed by the latter until the due speed is regained. Thus the two trains are balanced against each other, and since one of the wheels of the escapement-train is, as in some forms of train *remontoires*, supported in a swinging-frame (which frame, in fact, controls the brake-spring), the intermittent motion of the escapement does not reach the telescope. This clock seems to work very smoothly; and not the least advantage of the arrangement is the facility with which

* It is said of Jacobi, that he attracted the particular attention and friendship of Böckh, the director of the philological seminary at Berlin, by the zeal and talent he displayed for philology, and only at the end of two years' study at the University, and after a severe mental struggle, was able to make his final choice in favour of mathematics. The relation between these two sciences is not perhaps so remote as may at first sight appear; and indeed it has often struck me that metamorphosis runs like a golden thread through the most diverse branches of modern intellectual culture, and forms a natural link of connection between subjects in their aims so remote as grammar, philology, ethnology, rational mythology, chemistry, botany, comparative anatomy, physiology, physics, algebra, versification, music, all of which, under the modern point of view, may be regarded as having morphology for their common centre. Even singing, I have been told, the advanced German theorists regard as being strictly a development of recitative, and infer therefrom that no essentially new melodic themes can be invented until a social cataclysm, or the civilisation of some at present barbaric races, shall have created fresh necessities of expression, and called into activity new forms of impassioned declamation.

the speed may be altered from sidereal to lunar rate by merely raising the bob of the pendulum through a small space, so as to diminish the time of oscillation.

For special purposes, still greater accuracy might be obtained if the escapement were worked by the observatory clock by means of a small electro-magnet connected with the pendulum of the latter. Conversely, the escapement train might, with slight modifications and the addition of a dial, be made to serve as a journeyman-clock, and show sidereal time with sufficient accuracy to be very useful in finding stars during two or three hours' work.

There is, by the way, another important modification well worthy of notice. When astronomers wish to determine the position of a star, the diameter of a planet, &c., with rigorous accuracy, they employ a micrometer with spider webs, which in the daytime are visible in the field of view. At night, however, they, or the field itself, require to be lit up. This is managed by a lamp outside and a reflector inside the tube, and to make this lamp perform effectively in every position of the telescope is a difficult matter; so difficult, in fact, on the old arrangement, that Messrs. Cooke and Sons, with their wonderful ingenuity, have entirely superseded it in this their latest instrument. Their exquisite contrivance will be seen from the annexed woodcut.



THE COOKE ILLUMINATING APPARATUS.

L is the lamp. P, a prism to reflect the light on to the tube. D, a disc with diaphrams to regulate the quantity of light. B, a disc with glasses to regulate the colour of the light. S, spring catches to clamp these discs. C, counterpoise of lamp. G, Gravity poise.

The telescope is furnished with a sufficient battery of eye-pieces, of powers ranging from 30 to 400, and also with a bifilar micrometer. The position circle is permanently attached to the lower end of the main tube.

The observatory is erected on the roof of the western tower of the New Schools. It is square, and surmounted by a revolving dome. It is obvious that an instrument erected on a tower cannot be wholly free from vibration; but the latter is reduced to a minimum by supporting the telescope on two massive trussed iron girders stretching across the tower. The floor of the observatory is supported quite independently.

Owing to the unfavourable weather of late, the final adjustments of the telescope have not been completed; but it is hoped that before long it will be in a condition for good and accurate work, such as will justify the enlightened liberality which has placed it where it is.

H. G. MADAN

REMARKS ON TERRESTRIAL MAGNETISM

(*Being the substance of a paper read at the Royal Astronomical Society, on Friday, Dec.* 10)

SOME years since I was led to the belief that earth currents and auroræ are secondary currents produced by rapid, though small, changes in the earth's magnetism.

In this hypothesis the earth was viewed as similar to the soft iron core of a Ruhmkorff's machine, and the upper and rarer strata of the atmosphere and the moist upper surface of the earth as conductors in which secondary currents would be generated whenever any change took place in the magnetism of the core.

This hypothesis is, I think, confirmed by the very interesting and valuable photographic traces of earth currents obtained by Mr. Airy, at Greenwich, in which, during times of great magnetic disturbance, the earth currents are seen to be very strong, and to vary alternately from positive to negative, lying about equally on both sides of the zero.

It has occurred to me that this method of viewing things is capable of extension, and that it ought to be borne in mind that secondary currents are produced, not only in a *stationary conductor* such as that of the Ruhmkorff's machine, where the magnetic core is made to vary, but also in a conductor which moves in the presence of a magnetic core of constant strength.

Have we not in the earth such conductors in constant motion? We have the return trades constantly proceeding at a high elevation from the equator to the poles, the upper strata of which, from their tenuity, may no doubt be considered to be conductors; in their journey they cross the lines of the earth's magnetic force: ought they not, therefore, to be the vehicles of electrical currents? My friend Mr. Lockyer has lately impressed upon me that the zodiacal light may possibly be a terrestrial phenomenon, and, therefore, that it may be connected in some way with the phenomena of terrestrial magnetism. May it not be the return trades rendered luminous through electric currents in the higher regions of the atmosphere, and may there not also be two species of auroræ, the one occurring in stationary conductors, when the earth's magnetism changes, and the other, in moving conductors, when the earth's magnetism is constant?

But again, it must be allowed that these conductors conveying currents must react on the magnetism of the earth, and we might therefore expect that at those periods of the year at which the system of currents, viewed as meteorological phenomena, change most abruptly, the earth's magnetism would also be particularly liable to change. May not this be an explanation of the excess of magnetic storms about the times of the equinox?

But besides these great terrestrial currents, we have the daily convection currents caused by the sun, which, when they reach the upper regions of the earth's atmosphere, we may imagine to be conductors; and as they also pass across lines of magnetic force, we may suppose them to convey currents. May not these, to some extent at least, account for the diurnal variations of terrestrial magnetism? If this be the case we should have a ready explanation of the likeness observed by Mr. Baxendell between the wind curves and those of the declination.

I have hitherto alluded only to atmospheric currents, but there are also oceanic currents, and more especially there is the tidal wave, which occurs twice every lunar day. No doubt the influence of the tidal wave, as a moving conductor, must be very small; but may it not help to account for the lunar-diurnal variation, which is very small likewise?

But if there is an electric current of this kind in the ocean, it ought to be detected by the system of earth current wires which Mr. Airy has at Greenwich, inasmuch as the surface of the earth and the ocean are in electric communication with each other. Mr. Airy has, if I am not mistaken, detected indications of lunar-diurnal inequalities in the results of his observations. On the other hand, he has detected no current with a single daily period that would account for the diurnal variation—a result in accordance with these views, since the currents producing such would be in the upper regions of the atmosphere.

These views are given in order to invite criticism and comment; and they will have served their purpose if they direct attention to the part played in the phenomena of terrestrial magnetism by moving conductors. It will be noticed that they leave untouched the mysterious and important connection between sun spots and magnetic disturbances. B. STEWART

P.S.—Since writing the above, Prof. Sir W. Thomson has informed me that Faraday tried to detect induction currents by tides in the Thames, but found no positive result. In an article in the *Philosophical Magazine*, Dec. 1851, Prof. Sir W. Thomson quotes this idea of Faraday, and makes a proposal to test it from tides in the Channel. He also discusses the part which may be played in the phenomena of terrestrial magnetism by moving conductors.

BRITISH RAINFALL

MR. G. J. SYMONS (62, Camden Square, N.W., December 22, 1869) sends us the following list of localities whence observations are "urgently required;" we think he will have many volunteers:—Cornwall: Falmouth, Jacobstow. Devon: Hatherleigh, Hartland, Exmoor. Dorset: Bere Regis. Oxford: Thame. Surrey: Redhill. Suffolk: Halesworth, Mildenhall. Lincoln: Kirton. Nottingham: Mansfield. Warwick: Stratford-upon-Avon. Shropshire: Bishop's Castle. Yorkshire: Milford Junction, Pateley Bridge, Kettlewell, Askrigg, Driffield, Bridlington, on the North York Moors. Lancashire: Broughton. Northumberland: Haltwhistle. Cumberland: Kirkoswald. Westmoreland: Ravenstonedale. Isle of Man: any part of the Island. Pembroke: Tenby, Fishguard. Cardigan: Aberaeron, Brecknock, Llanwrtyd. Radnor: Builth, Knighton. Montgomery: Montgomery, Llanfyllin. Merioneth: Barmouth, Harlech. Carnarvon: Pentrevoclas. Wigtown: Northern part of. Kirkcudbright: Western part of. Peebles: Peebles, Biggar. Ayr: Muirkirk. Argyle: Mull of Cantire, Ballimore, Glencoe, near Ben Cruachan. Perth: North-west part of. Forfar: Western part of. Inverness: along the Caledonian Canal, and in Lochaber. Aberdeen: North-west part of. Nairn: any part of. Banff: Southern part of. Ross: any place inland, or in Lewis or Harris. Sutherland: any place inland. Caithness: any place inland. Ireland: except from the vicinity of Belfast, Dublin, Londonderry, and Waterford, where there are many observers, returns are required from nearly all parts of the country.

THE LATE PROFESSOR MICHAEL SARS, OF CHRISTIANIA

THIS eminent zoologist died on the 22nd of October last; and his loss will be much felt by all naturalists who have benefited, as I have done, by his long, laborious, and conscientious investigation of the invertebrate fauna of the Norwegian seas.

He was born on the 30th of August, 1805, at Bergen, where his father was a shipowner. After finishing his academical studies at Christiania, and evincing at an early age his predilection for natural science, he entered into priest's orders, and in 1830 became pastor at Kinn, in the diocese of Bergen. Ten years afterwards he had charge of the parish of Manger in the same diocese. As both these parishes were on the sea-coast, Sars had constant opportunities of pursuing his zoological researches. In 1829 he published his first essay, entitled "Bidrag til Söedyrenes Natur-historie," and in 1846 the first part of his celebrated work "Fauna littoralis Norvegiæ." In 1854 he was appointed Professor Extraordinarius of Zoology at the University of Christiania, a position which he filled up to the time of his lamented death with great honour to his country, and to the satisfaction of the whole world of science. His celebrity as a zoologist, as well as a palæontologist, was fully recognised by all naturalists and geologists, and he was elected a member of several foreign scientific societies. Our own distinguished countryman, the late Edward Forbes, individually showed his appreciation of Sars's labours in eloquent pages (66 and 67) of his own posthumous work, "The Natural History of the European Seas," when he said, "More complete or more valuable zoological researches than those of Sars have rarely been contributed to the science of Natural History, and the success with which he has prosecuted investigations claiming not only a high systematic value, but also a deep physiological import, is a wonderful evidence of the abundance of intellectual resources which genius can develop, however secluded and wherever its lot be cast;" and he added that the name of this Norwegian priest, "who reaped reputation when seeking no more than knowledge familiar to every naturalist in Europe and America, in Asia, and at the Antipodes—for there are great naturalists settled far in the south, and many in the far east—is a sufficient proof that able work brings the rewards of applause and veneration, even when they be unasked for." By the observations of Sars on the development of the Medusæ he greatly advanced our knowledge of that remarkable physiological phenomenon known as the alternation of generations, which Chamisso had first indicated in the Salpæ. His last publication, "Mémoire pour servir à la connaissance des Crinoïdes vivants," caused especial interest, by showing that a race of animals, supposed to be extinct for a period so long as only to be measured by the duration of several past geological epochs, occurred in a living state in the abysses of the Norwegian seas. This discovery mainly induced the recent exploration of our own seas at great depths, which has produced such wonderful results; and the living Crinoid, or "stone-lily" (*Rhizocrinus Lofotensis*), has now been ascertained to inhabit many parts of the Atlantic from the Loffoden Isles to the Gulf of Mexico. The published works of Sars are seventy-four, and they are not less sound and valuable than numerous. One of his sons, Dr. George Ossian Sars, inherits the zoological inclinations and talent of the late Professor, and is second to none in the knowledge of the Sessile-eyed Crustacea.

It is exceedingly to be regretted that, in spite of the most rigid economy, the large family of Professor Sars is left in very impoverished circumstances, six of his children being wholly unprovided for. May I hope that naturalists and lovers of science will assist me in making a subscription for the temporary relief of this distressed family, and that they will by such tribute to his memory express their admiration of his career and services? I shall be very glad to receive any contributions.

J. GWYN JEFFREYS

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Cuckows' Eggs

I AM very grateful to Mr. Sterland for asking for further information "on some points of difficulty" in my recent paper on Cuckows' Eggs, because it shows me where I have failed in making myself plainly understood. In endeavouring to reply so far as lies in me to his questions, I will take them in order.

1. "Are they [Cuckows' Eggs] so variable as some assert?"

Mr. Sterland supports the doubt here indicated by the statement of "one of the most eminent and experienced of living oologists;" but who this oologist may be he leaves to be guessed, and I venture with all respect to remark, that quoting an anonymous authority in natural history is quoting no authority at all. I am therefore not willing to bring such experience as I myself have had into conflict with that of this eminent but nameless person. Still, as Mr. Sterland is not satisfied with the opinion on this point of the German authors* cited by Dr. Baldamus, I will here adduce the following passages :—

"Quant au genre Coucou (*Cuculus*) et notamment à l'espèce type du genre, notre Coucou Chanteur (*C. canorus*), on sait quelle étonnante diversité offre la coloration de son œuf, toujours de forme ovée, diversité telle que nous nous abstiendrons d'en aborder la description détaillée."—DES MURS, *Traité Général d'Oologie Ornithologique*, &c. Paris : 1860, p. 219.

"Ces œufs sont très-petits relativement à la taille de l'oiseau, et varient beaucoup pour la couleur. Ils sont ou cendrés, ou roussâtres, ou verdâtres, ou bleuâtres avec des taches petites et grandes, rares ou nombreuses, d'un cendré foncé, vineuses, olivâtres ou brunes, avec quelques points et parfois des traits déliés noirâtres. Nous en possédons deux du blanc le plus pur, et un autre d'une seule teinte bleu-verdâtre, pris dans un nid de Stapazin."—DEGLAND et GERBE, *Ornithologie Européenne*, &c. Paris : 1867, vol. i. p. 163.

I produce this testimony as to *facts* with the greater confidence, because the *opinions* of the witnesses differ from my own, and not one of them, so far as I can gather from their works, was acquainted with Dr. Baldamus's essay.

2 and 3. "Were these [sixteen varieties of eggs] seen to be deposited by the bird, or how were they identified as those of the cuckow? . . . . Is there not room for error here?"

The evidence on which the eggs in question were referred to the Cuckow has been printed in full by Dr. Baldamus and the translator of his essay. To repeat it here would occupy much space and, I think, be unnecessary. It is of much the same kind as the evidence with regard to most Cuckows' eggs. I will freely grant that it might be more satisfactory—if it were so my former paper would never have been written, since naturalists must then have at once accepted the theory. But, on the other hand, I have a right to ask this : If the eggs in question were not Cuckows', what birds laid them? Surely not those in whose nests they were found, because it is a fact which most oologists will confirm, that when birds lay larger eggs than usual the colouring is commonly less deep, and though exceptions may occasionally be found, yet here we have sixteen which are at the same time larger than usual, and of a colour at least as deep, supposing them to belong to the nest-owners. *Sixteen* cases are too many to be exceptional, but this is the number only of the specimens *figured* by Dr. Baldamus ; upwards of *sixty* are more or less fully *described* by him.

4. "How then is this process effected?"

In answer to this, Mr. Sterland quotes a very brief summary of my own explanation, to which I have nothing now to add.

5 to 9. The next five questions, for brevity's sake, I will not repeat. They are very pertinent, but are far more easily asked than answered, for they open a wide field of speculation and investigation, since all the hitherto unexplained phenomena of "Dimorphism," "Trimorphism," and "Polymorphism," seem to enter here. But with respect to one of the questions (No. 6), I submit that even if there were no other instance satisfying the conditions imposed by Mr. Sterland than that which I alleged, it is no true argument against the truth of what I advanced. But I think there is an indication of it in other species bearing very directly on the point. Take the Blackcap Warbler and the Tree-Pipit. The eggs of the first are well known to present at least two very different appearances, and those of the second are still more variable. Since Mr. Sterland will not allow that my Eagles fulfil his conditions (and of course he has a perfect right to do so), perhaps he will permit me to bring forward these birds. I have some reason for believing that the same hen Blackcap constantly lays eggs of similar colour. Do the birds of this species hatched from eggs with reddish shells lay eggs of the same character, or brownish ones, and *vice versâ?* If of the same character, we have such an example as is required. If of the other colour, it becomes a case in some measure of "Alternate Generation," but still reducible to a law. That there should be no law at all seems to me at least unlikely, though I fear its discovery is hard.

Certain facts of Dimorphism and Polymorphism are known, but I have not met with any attempted explanation of the phenomena even in such decided and remarkable cases as those of the Malayan Butterflies given by Mr. Wallace (Trans. Linn. Soc. vol. xxv. pp. 5-11). Why the different forms of one species of *Papilio* inhabiting the same district remain distinct is perhaps more unaccountable than that the different forms of Cuckows' eggs should be preserved, for it does not seem to me unlikely that the colour of the egg and the maternal instincts should depend upon the *hen* bird ; in which case, granting the hereditariness (if I may make such a word) of the qualities already specified, I think there would be no difficulty.

10. A full reply to Mr. Sterland's last question would lead me to anticipate much that I intend to say when you again permit me to trespass on your readers' forbearance. Consequently, I must defer it until I come to the consideration of "Cuckows' Dupes." ALFRED NEWTON

Cambridge, Dec. 11, 1869

By way of postscript of my letter of the 11th of December (for the delay in publication of which I am in no way accountable*), permit me to offer a few remarks on the communications of Mr. Dresser and Mr. Cecil Smith which have since appeared.

Mr. Dresser says (p. 218) that he "cannot quite agree with Professor Newton that Cuckows' eggs *as a rule* are subject to great variety." I am not aware that I had made such an assertion. The nearest approach to it that I can find is my statement (p. 74), that "it has long been notorious to oologists that eggs of the Cuckow (*i.e.* of the Common Cuckow of Europe —the only species I had mentioned) are subject to very great variety," and in proof thereof I have since furnished some other (and, I think, satisfactory) evidence. Mr. Dresser himself has also brought two or three additional examples which confirm my statement. For the knowledge of these I am much obliged to him, as well as for stating the result of his own experience in support of my supposition that the eggs of the same hen Cuckow resemble each other.

Mr. Cecil Smith (p. 242) seems to me to be as unfortunate in his interpretation of my remarks as he was in that of Dr. Baldamus's (p. 75, note). I feel sure that I have not "pruned and paved" down the doctor's theory so "that there is but little of the original left." To the facts alleged by that naturalist I have taken no exception—on the contrary, I have borne witness (pp. 74, 75) to their general truth ; and in the attempt to offer a reasonable explanation of them, I am certain that my "manipulation" is not open to any such charge as that made by Mr. Smith. My "cautious and limited statement" is not different from that of the doctor, nor does "it entirely sweep away" a single assertion of his as to matters of fact. Mr. Smith, apparently, thinks because I have referred to the number of Cuckows' eggs yearly found in nests of the Hedge-Sparrow in this country, without ever bearing any resemblance to the eggs of that bird—a fact, of course, fully admitted by him—that I must thereby deny the single exceptional case adduced from Germany by Dr. Baldamus ; but I have never maintained, because no likeness is to be traced in a great many instances, that none was ever perceptible, and accordingly there is no "issue of fact" between the doctor and myself. I must take the liberty of adding, that Mr. Smith, having, as I before showed, misunderstood Dr. Baldamus, has now misunderstood me ; and this being the case, it is perhaps needless for me to take up more of your space. ALFRED NEWTON

January 3, 1870

The Veined Structure of Glaciers

I THINK there is no one point in connection with glaciers more interesting than their veined structure, or one upon which so much has been written that remains equally unsettled. The difference of opinion about it between the authors who have published most upon the subject are not less remarkable than the phenomenon itself : no two are agreed, except in considering it as a constitutional feature.

Professor Agassiz maintains (*Atlantic Monthly*, Dec. 1863) that the horizontal layers of pure ice which are formed between the beds of snow from which a glacier is born, constitute many of the identical veins or plates of pure ice which pervade the glacier when it is in full life and activity ; and attributes the inclination which they make, in the latter case, to their former horizontal position, to the contortion, bending, or folding, to

* They are Naumann, Thienemann, Brehm, Gloger, and Von Homeyer. Unfortunately, Dr. Baldamus does not refer to the passages in their writings wherein this opinion is expressed ; and as most of these writings are somewhat voluminous, I have not always been able to find what are the passages meant. I presume that Mr. Sterland has been more fortunate, for he would scarcely doubt the assertions without knowing what they were, and I should be much indebted to him if he will tell me where they occur—indeed, I am uncertain which of the Brehms and which of the Von Homeyers is intended.

* [The delay in the publication of Prof. Newton's letter is owing to an oversight. It was received prior to the communications of Mr. Dresser and Mr. Cecil Smith, printed in our eighth and ninth numbers.—ED.]

which they have been subjected on their downward course; but, at the same time, he distinguishes between these veins—the result of stratification, and others which he terms bands of infiltration, and which he believes to have been formed by the infiltration and freezing of water.

The late Principal J. D. Forbes maintained ("Occasional Papers on the Theory of Glaciers," 13th letter) that the veins of stratification were annihilated at a certain point, and that at precisely the same time other veins, approximately at right angles to the former ones, were formed. These effects he referred to intense pressure.

Professor Tyndall ("Glaciers of the Alps," pp. 380, 425-6), agrees with Professor Forbes "in ascribing to the structure a different origin from stratification," and, if I understand him rightly, does not believe that *any* portion of the (approximately) vertical veins have such an origin. He divides the veins into marginal, transverse, and longitudinal structure, and asserts that all are produced by pressure, which causes partial liquefaction of the ice, and that the water is refrozen when the pressure is relieved.

If any one cause produced the whole of the veins of pure ice that are found in the imperfect ice of glaciers (which all are agreed are a constitutional feature of those bodies), it is obvious that that cause would have to be equally generally distributed. It is indisputable that all the veins are not veins of stratification, because examples have been frequently observed crossing (cutting) the strata lines at a larger or smaller angle. But although such observations prove conclusively that all the veins must not be attributed to stratification, they do not prove any more. I believe, with Professor Agassiz, for reasons advanced elsewhere,* it can be demonstrated, equally conclusively, that many of the veins which are seen in the lower courses of glaciers in the Alps are veins originally produced by stratification, and dissent entirely from the "annihilation" of Principal Forbes. But as it is proved that some have a different origin, we must look to other causes for an explanation. It is probable that the theories quoted above offer a practical solution of the difficulty, although they are unfortified by direct proofs. But I have seen examples which it was difficult to explain by either one or the other.

There is one means by which the veins might be produced, which, if not overlooked, is at least not generally advanced. All glaciers have crevasses; a glacier is known by its crevasses. The sides of all crevasses become more or less weathered and coated with a glaze of pure ice. When they close up again, when the sides join by virtue of regelation, does this leave no trace? Can it be annihilated? Or, do the two coalesced films leave their mark as a vein of pure ice throughout the generally whitish mass of the glacier? I consider a large number of the veins of pure ice which constitute the "veined structure" of glaciers as nothing more than the *scars of healed crevasses.*

It is not easy to say whether this was the meaning of the following passage, taken from p. 201 of Forbes's "Occasional Papers:" "Most evidently, also, the icy structure is first induced near the sides of the glacier where the pressure and working of the interior of the ice, accompanied with intense friction, comes into play, and the multitudinous incipient fissures occasioned by the intense strain are reunited by the simple effects of time and cohesion." Judged by his preceding pages, it is not, and I am unaware that it has been, advanced in any other place. Some of your readers may perhaps be able to throw some light upon the subject.

Dec. 13, 1869 EDWARD WHYMPER

* British Association, 1866 (Nottingham).

Irish Lepidoptera

IN reply to the note appended to the report of the Dublin Natural History Society's Meeting, Dec. 1st (NATURE, No. 6, p. 176), allow me to say that I perfectly remember the specimen of *Liminitis* to which Mr. Andrews refers, and which he exhibited some years ago as *Liminitis Sibylla* from Tarbert in the county of Limerick. It was subsequently given by him to my friend Mr. A. Dunlop, of Sutton, near Dublin, and sent to me for identification.

I examined it carefully, and it is a specimen of *Liminitis Camilla*, and *of Continental origin.* How it came to be mixed with Mr. Andrews's Irish specimens remains for him to explain.

To say that the insect is neither Sibylla nor Camilla is absurd; these are the only two species of the genus which inhabit Europe; and Camilla, to which Mr. Andrews's specimen belongs, is the most unlikely of the two to occur in Ireland, as Sybilla is found in England, but not Camilla. However, the insect is in Mr. Dunlop's Collection, and I am sure that gentleman will have pleasure in allowing anyone to inspect it.

As to *Chrysophanus Virgaurea*, there is no British specimen known, nor is there any trustworthy record of the capture of the species in the British Islands.

Chrysophanus Hippothoe (variety *Dispar*) was formerly taken in profusion in the fen districts of Cambridge and Huntingdon, but not that I am aware of in any other part of England. It has been extinct for many years as a British insect, and there is no record of its capture in Ireland at any time. Mr. Andrews's statement that he "met with" Dispar in Kerry is indefinite. Did he capture it? or did he only see it, or suppose he saw it? The most experienced collector may mistake an insect on the wing; and delighted as entomologists would be to welcome back the long-lost Hippothoe, they will require very different proof of its reappearance to any which has yet been adduced.

EDWIN BIRCHALL

Airedale Cliff, Newlay, near Leeds, Dec. 20, 1869

Deep Sea Corals

IN the postscript to Mr. J. Gwyn Jeffreys's report on the "Deep-sea Dredging Expedition in H.M.S. *Porcupine*," I notice the following sentence:—"The presence of corals at great depth will also materially alter the views generally received of the depth at which reef-builders may work, and modify to a certain extent Darwin's theory of the reefs and their mode of growth." This opinion has gained much credence, but it is founded upon error, and is a mistake. Count Pourtales has been good enough to send me the commonest corals which he dredged up off Florida and the Havana from depths greater than 100 fathoms. He has forwarded also the description of the species, and a note upon the nature of the *genera* represented in the depths of the Gulf of Mexico, and which have not been as yet described. I have received the greater part of the corals dredged up during the expedition in the *Porcupine*, and have examined the specimens carefully. Being thus acquainted with the deep-sea coral fauna of both sides of the Atlantic, and having a previous knowledge of the species of the Mediterranean, I have no hesitation in asserting that there is not one species found in these deep seas which is "reef-building" in its habit or whose structures resemble those of the true reef forms. Mr. Darwin's theory is therefore as yet as strong as ever.

Dec. 23, 1869 P. MARTIN DUNCAN

A Meteor

MY attention has just been called to an error in my letter of November 6, which appeared in NATURE, p. 58, respecting the meteor of that evening. I refer to the statement that, of the meteor-cloud, the "longest axis was in the line from the north-west point of the horizon to the pole-star." Instead of *north-west*, it should have been *south-west*, or, perhaps, more correctly, S.W. by W. WM. PENGELLY

Lamorna, Torquay, Dec. 31, 1869

NOTES

THE trigonometrical survey of England and Wales, on the scale of one inch to a mile, has been completed during the past week. It was commenced in the year 1791.

TELEGRAPHIC connection with Australia is about to be carried out by the British-Australian Telegraph Company. The work will consist of 563 miles of cable from Singapore to Batavia, and will join the Dutch line which crosses to the south-eastern extremity of Java, from which point another cable of 1,163 miles is to be laid to Port Darwin. A land line of about 800 miles will connect this with all the Australian colonies. From England to Singapore the messages will be taken by the Falmouth and Malta, the Anglo-Mediterranean, and the British-Indian Extension Companies; thus forming a complete route.

THE eighth part of Wurtz's *Dictionnaire de Chimie* has just been issued. The *Revue des Cours Scientifiques*, to which we are indebted for this announcement, calls particular attention to the articles *Eaux* and *Composés diazoïques* by M. Gautier, *Dissociation* by M. H. Debray, and *Engrais* by M. Dehérain.

THE Agricultural Academy of Poppelsdorf, near Bonn, has recently sustained a severe loss in the death of its able and energetic director. Dr. Edward Hartstein was not only a man of wide scientific attainments, but a good practical farmer, and thoroughly acquainted with the English and Scotch systems of agriculture in their more advanced phases. Appointed to the directorship of the Poppelsdorf Academy at the early age of 32, he devoted himself heart and soul to the interests of that institution, and to the advancement of agriculture in his native country. He was the author of various works on rural economy, and for some time immediately previous to his death had been busily engaged in working up the materials for a book which should combine the results of his practical experience with the most recent conclusions of the botanist, the chemist, and the physiologist. Dr. Hartstein was born in 1823, and died on the 14th ultimo, a victim to over-work. He was a member of the Royal British Agricultural Society, a distinction which he highly prized.

THE *Engineer* states that a meeting of Government science teachers was held in Manchester on Monday week, when it was resolved to submit to the Department of Science and Art an expression of regret and disapproval of the sudden and unanticipated mode in which that department has repudiated its engagements with the teachers, chiefly with reference to lectures. The received theory that public companies have no conscience seems to be very generally true of public departments, except when they happen to be dealing with interests strongly represented in the House of Commons.

M. LORTET, Professor at the School of Medicine in Lyons, has undertaken the Natural History Course at the Faculty of Sciences in that city, vice M. Jourdan, who retires.

THE Council of the Society of Arts have decided to create a new office, that of Inspector of the Educational Department, and have selected for this appointment Mr. Critchett, who has been for thirteen years Assistant-Secretary. The latter office will not be filled up.

THE series of public lectures on scientific subjects which is given every winter at the Sorbonne commenced on the 23rd ultimo, when M. Fernet discoursed on the subject of optical illusions. The other lectures comprised in this course are as follows:—Jan. 6.—M. Garnier, Mining Engineer, "The Island of Otaheite." Jan. 13.—M. A. Cazin, "The Motor Forces." Jan. 20.—"M. P. Bert, Professor at the Faculty of Sciences of Paris, "Sympathetic Nervous Actions." Jan. 27.—M. Lies-Bodard, Professor at the Faculty of Sciences at Strasbourg, "Ozone." Feb. 3.—M. Janin (of the Institute), "Sound and Light." Feb. 10.—M. Wolf (of the Imperial Observatory), "The Shape of the Earth." Feb. 17.—M. Jansen, "The Eclipse of the 18th August observed in the East Indies." Feb. 24.—M. Bouley (of the Institute), "On Insanity." March 10.—M. Faye (of the Institute), "On the Figure of Comets." March 17.—M. G. Ville, Professor at the Museum of Natural History in Paris, "Theoretical Agriculture." When shall we be able to announce a like series of lectures by men of scientific eminence, as open free to all comers in our own metropolis?

A COMMITTEE has been formed at Leipzig to collect funds for the purchase of the celebrated museum of the late Dr. Klemm, of Dresden. This museum consists of some 14,000 admirably arranged objects, illustrative of what is known in Germany as the history of civilisation. Should the committee succeed in raising sufficient money to attain their purpose, the collection will be handed over to the University of Leipzig, on condition that it is made available for all classes of society. In consideration of the scientific importance of keeping together such a collection as this, the representatives of Dr. Klemm are willing to sell it to the committee for the moderate sum of 10,000 thalers.

THE first number of the *Annales des Sciences Géologiques*, a periodical on the same plan and of the same size as the *Annales des Sciences Naturelles*, has just been issued. M. Hébert, Professor of Geology at the Faculty of Sciences of Paris, is the geological editor; M. Alphonse Milne-Edwards undertakes the palæontology. One volume, consisting of four numbers, will be published annually. The greater portion of the number before us is occupied by the first part of an important treatise by M. Louis Lartet, secretary of the French Geological Society, "On the Geology of Palestine and the neighbouring countries." This treatise embodies the observations obtained during the course of the expedition of the Duc de Luynes to the Dead Sea. M. Hébert contributes a paper "On the Lignite-bearing grit of Helsingborg and Höganäs in Southern Sweden."

WE have been requested to contradict the statement contained in our last number, that the *Journal of Botany* will in future be edited by Mr. Henry Trimen, of the British Museum. Dr. Seemann will continue to edit the journal; but greater prominence than hitherto will be given to British Botany, and that department will be under the joint superintendence of Mr. Trimen and Mr. Baker, of Kew.

A SPECIAL JOURNAL for the publication and discussion of observations of shooting-stars and bolidæ is about to appear under the editorship of M. Kieselmeyer, of Dresden. It will be published at irregular intervals dependent upon the amount of material in the hands of the editor. The price will be from 2fr. 50c. to 1fr., according to the number of subscribers.

THE culture of the Cinchona, or Peruvian bark, in St. Helena is progressing satisfactorily, The plants are all in excellent health, and have a fine, green, vigorous appearance. There are now about 4000 planted out, and it is thought a sufficient number can be obtained from them to stock the whole colony.

THE Southampton Town Council have decided to adopt the "A B C" process for the utilisation of sewage, and to make such arrangements with the Native Guano Company as may be agreed upon.

AUTHENTIC cases of the successful treatment of snake bites are of some interest. Dr. Bell supplies two in his "New Tracks in North America." On the Rio Grande, in October, 1867, two horses were bitten by the same rattlesnake, while grazing. A few hours afterwards the submaxillary, parotid, and all glands situated about the head and neck were greatly enlarged; from the nostrils and gums, a clear, mucous discharge ran down; the eyes were glairy, with the pupils greatly dilated, and the coat was rough and staring. To each animal Dr. Bell gave half-a-pint of whisky, with a little water, and half an ounce of ammonia, while the wounds were fomented with a strong infusion of tobacco, and afterwards poulticed with chopped tobacco leaves. Both horses recovered. One, although reduced in flesh, and thrown out of condition, was fit for work in a week, but the other only just escaped with his life, becoming a perfect skeleton, and only commencing to mend at the end of three months. Dr. Bell adds that a little weed, common throughout the Western States (called by Engelmann, *Euphorbia lata*, and by Torney, *E. dilatata*), is said to be a specific for the bite of the rattlesnake, but at the very time the plant was wanted it could not be found, although continually met with elsewhere, along the route, so that the experiment could not be tried.

PROFESSOR GIEBEL, of Halle, reports the results of some interesting experiments which he has made with the object of ascertaining the correctness of the popular notion that sparrows are destructive animals, feeding chiefly on grapes and stone-fruit. He found on examining the intestines of seventy-three young sparrows, between the 18th of April and the 24th of June last, that forty-six of them had fed exclusively on insects (beetles, caterpillars, &c.), and seven only exclusively on stone-fruit, the rest having all more or less fed on insects. An examination of forty-six old sparrows gave similar results; three only were fruit-eaters and the rest chiefly insect-eaters.

A HAPPY idea, very ingeniously carried out, is the Pharmaceutical or Medico-Botanical Map of the World, produced by Mr. George Barber, of Liverpool. In a very clearly printed and carefully-coloured map we are shown at a glance the *habitats* of all the medicinal plants and drugs in general use, as well as the mean annual temperature of the countries whence they are obtained. The map is published by Simpkin, Marshall, and Co.

M. E. LIPPMANN has communicated to the *Annales Industrielles* an account of the operations for sinking the Artesian Well at La Chapelle. The engineers employed by the authorities of the city of Paris to execute this great work, are MM. Degosée, Laurent, and Co. When completed, this well will supply water to one of the most populous quarters of Paris. It is intended that the well shall not only strike the water-bearing stratum—at a depth of about 2,000 feet—into which the great well at Passy penetrates, but shall extend through the stratum to a total depth of 2,950 feet. In this way, other water-bearing layers will be intersected. The work was at first commenced by the ordinary method of sinking a masonry shaft 2 metres (6ft. 3¾in.) in diameter to a depth of 445 feet through the tertiary strata which lie above the chalk. Many difficulties presented themselves, chiefly due to the looseness of the earth through which the excavation penetrated, and to the insufficient pumping-power. After two years of persistent labour, it was decided to try another system. At this period the shaft had reached a depth of 113 feet; new boring machinery driven by steam power was now set up, and until the present time the work has proceeded most satisfactorily.

ASTRONOMY

Prizes for the Discovery of Comets

THE following circular has been issued by the Imperial Academy of Sciences at Vienna :—

For several years past there have been remarkably few discoveries of new comets. The cause of this fact, which seems inconsistent with that of the wider distribution of telescopes suitable for such discoveries, may be due to the special attention that has been given to the small planets. It is, however, much to be regretted that there has been such slight increase in our knowledge of the comets, in view of the recently established connection between the shooting stars and the comets. It is exceedingly desirable that we should know more than two or three hundred out of the many thousands of comets which undoubtedly belong to our system, especially as most of those which we know move in parabolic orbits. Were our knowledge of comets more complete we should surely know of more meteor streams and comets belonging one to the other. Mindful of Herr Schumacher's words "it is natural that astronomers intrusted with the administration of a well furnished observatory should have no time left for sweeping the sky so minutely and so perseveringly as is necessary for discovering these faint bodies, whilst, on the contrary, it seems certain that to the many amateur astronomers who have less extensive means of observation hardly any more useful kind of activity could be recommended," the Imperial Academy of Sciences at Vienna is induced to propose for the discovery of comets during the three years from May 31, 1869, to May 31, 1872 eight prizes annually, consisting, as the receiver may choose, of a gold medal, or of twenty Austrian ducats representing its value in money.

The award of these prizes will be subject to the following regulations :—

1. The prize will be given only for the first eight comets discovered in each of the three years named, and only for such comets as are telescopic at time of discovery, that is, invisible to the naked eye. The comet must not have been before seen by another observer, and must be one whose appearance could not be predicted with certainty.

2. The discovery must be communicated immediately and without waiting for further observations, to the Imperial Academy of Sciences, by telegraph if practicable; and otherwise by the earliest post. The Academy undertakes to transmit the news immediately to other observatories.

3. The time and place of discovery with the plan and course of the comet must be given as exactly as possible with the first notice. This first notice is to be supplemented by such later observations as may be made.

4. If the discovery should be confirmed by other observers, the prize will not be awarded unless the observations of the discoverer suffice for the determination of the orbit.

5. The prizes will be awarded in the general meeting of the Academy held at the end of May of each year. In case the first notice of a discovery arrives between the 1st of January and the end of May, the final award of the prize will be deferred till the general meeting in May in the following year.

6. Application for the prize must be made to the Academy within five months from the time of the arrival of the first notice. Later applications will not be considered.

7. The Imperial Academy will procure the decision of the permanent astronomers of the Observatory at Vienna as to the fulfilment of the conditions in Nos. 1, 3, and 4.

The New Planet (109)

IN the *Astronomische Nachrichten*, 1779-80, there is a long and important article on Piazzi's observations by M. Argelander; also the approximate place of this planet, discovered by Prof. Peters of Clinton, New York.

The following elements of the Planet are by Prof. Peters, and are considered by him to be nearly accurate. We print in a parallel column the elements for the same planet as furnished by Prof. Axel Möller, of Lund. The latter are calculated from observations taken at Clinton on Oct. 13th, Leipzig Nov. 8th, and Lund Nov. 26th, 1869 :—

Epoch 1869, Oct. 0·0 Berlin mean time.

M_0 =	337° 1′ 3·35″	350° 53′ 28·6″
π =	55° 53′ 48·0″	
Ω =	4° 51′ 45·4″	4° 57′ 30·
ι =	7° 56′ 56·55″	8° 3′ 57·8″
ϕ =	17° 25′ 14·13″	17° 27′ 51·0″
μ =	809″580	800″476·
log a =	0·4278314.	

CHEMISTRY

Transformation of Chlorinated into Iodated Compounds

AD. LIEBEN has made important experiments on this kind of transformation. Ethyl chloride, mixed in a sealed tube with three or four times its weight of strong hydriodic acid, sp. gr. 1·9, and heated for five hours to 130°, is almost wholly converted into ethyl iodide, according to the equation—

$$C_2H_5Cl + HI = C_2H_5I + HCl.$$

In like manner ethylated ethyl chloride (butyl chloride), and amyl chloride are converted by strong hydriodic acid into the corresponding iodides, without formation of secondary products. Ethyl-chlorinated ethyl oxide $\left.\begin{matrix}C_2H_3(C_2H_5)Cl\\C_2H_5\end{matrix}\right\}O$ is converted, by an excess of strong hydriodic acid, chiefly into ethyl iodide, and ethylated ethyl iodide (butyl iodide); but there are also some secondary products formed, viz. butyl chloride, alcohols, and a substance having a carbonaceous aspect, the quantity of these secondary products increasing as the hydriodic acid is less concentrated and present in smaller quantity.

To determine whether the action of hydriodic acid is a simple double decomposition or a case of the action of masses, the converse reaction was tried by heating ethyl iodide with a considerable excess of hydrochloric acid in a sealed tube to 130°. A small quantity of ethyl-chloride was thereby obtained, together with hydriodic acid and free iodine, showing that the inverse of the first-described reaction does really take place; but the quantity of ethyl chloride, which it yields, is very small, even when the action is continued for 50 hours. The result of the two supplementary experiments, namely, the decomposition of ethyl chloride by hydrogen iodide, and of ethyl iodide by hydrogen chloride, may be represented, though somewhat crudely, in the following manner—

$$\text{(Affinity of H for I)} + (\text{Affinity of } C_2H_5 \text{ for Cl})$$
$$< \text{(Affinity of H for Cl)} + (\text{Affinity of } C_2H_5 \text{ for I}).$$

The decomposition of ethyl chloride, and its homologues by the action of hydriodic acid, is analogous to the decomposition of silver iodide by the same reagent.

As an example of the action of hydriodic acid on organic chlorides of other series, *chloroform* $CHCl_3$ was introduced, together with 11 times its weight of hydriodic acid of sp. gr. 1·9, into a sealed tube, and heated for 7 hours to 125°. The principal results of this reaction were hydrochloric acid, free iodine, and methylene iodide CH_2I_2. Now, remembering the fact, demonstrated by Kekulé, that iodides, submitted to the action of hydriodic acid, undergo an inverse substitution, the reaction just described may be explained by supposing that the chloroform is in the first instance converted into iodoform, which is then converted into methylene iodide by the action of the hydriodic acid, thus—

$$CHCl_3 + 3HI = CHI_3 + 3HCl,$$
$$\text{and } CHI_3 + HI = CH_2I_2 + I_2.$$

In other cases, the action represented by the second equation goes so far as to remove all the iodine from the iodated product formed in the first instance, and convert it into the corresponding hydride. Such, indeed, is the case with compounds belonging to the aromatic series. Berthelot [Bull. Soc. Chim. (2) ix. 30] has shown that Julin's chloride of carbon, or perchlorinated benzene, C_6Cl_6, is converted into benzene, C_6H_6, when heated to 280° with a large excess of hydriodic acid; and Lieben finds that monochlorobenzene, C_6H_5Cl, heated to 235°, for 15 hours, with from three to five times its weight of hydriodic acid, likewise yields benzene.

The action of hydriodic acid on organic chlorine-compounds appears, then, to exhibit two cases:—(1.) The chloride is easily converted into the corresponding iodide by double decomposition, whereas the transformation of the iodide into the corresponding hydride is difficult, and takes place only at high temperatures. In this case, if the experiment is well conducted, an iodide is obtained without a trace of hydride. Such is the case in the action of hydriodic acid on the chlorides of the series $C_nH_{2n+1}Cl$. (2.) The chloride is attacked by hydriodic acid with difficulty, and only at a high temperature, whereas the conversion of the iodide into hydride takes place easily, and at a comparatively low temperature. In such cases, as with the chlorides of the aromatic series, the product of the reaction is a hydride without any trace of iodide. In some cases, as that of chloroform, intermediate products are obtained, only part of the iodine being removed by the inverse reaction. [Giornale di Scienze di Palermo, v. 130.]

SCIENTIFIC SERIALS

THE *Archives des Sciences Physiques et Naturelles* for December 15, contains a paper by Professor Heer, on the Miocene Flora of Spitzbergen. The writer gives a preliminary account of the fossil plants collected and sent to him by the Swedish Polar Expedition of 1868. The number of species found in the Spitzbergen Archipelago amounted to 131, of which 123 were phanerogamic, and 8 cryptogamic. Figures and a detailed description of these are promised to appear in the Memoirs of the Stockholm Academy. The next paper is an extract of Thomsen's Thermochemical Researches (taken from Poggendorff's *Annalen*), to which Marignac has appended some valuable comments. Prof. Marignac adds a paper of his own, on the influence of water on the double decompositions of salts, and on the thermal phenomena which accompany them. The author was induced to publish this preliminary memoir in consequence of the appearance of Thomsen's results. He points out some interesting cases of retardation of chemical equilibrium, and intends to investigate them further. The rest of this number—the last of the year—is occupied by the usual *Bulletin Scientifique*, Meteorological Observations, and an index to the volume (xxxvi. N. S.)

In Polli's *Annali di Chimica applicata alla Medicina* for December, we observe, among other papers, a note on the action of hydric sulphate on iodides, by Dr. Vitali. It is generally supposed that the action referred to terminates with the production of sulphurous oxide and iodine; but Vitali has noticed, in addition, the formation of hydric sulphide and sulphur—fresh instances, consequently, of the reducing energy of hydric iodide. In a paper on Ferric Albuminate, Peretti shows that albumen is capable of dissolving Ferric oxide. The filtered solution, if evaporated at a gentle heat, dries up to a rose-coloured pellicle, which can be again dissolved in water, and coagulates at 75°. Details are given as to some of the reactions of the solution. Bellini contributes an article on the therapeutic (pharmaceutical) formulæ of sulphur. There are also several papers on dietetics, hygiene, and pathology, &c., taken from other journals, and an index to the volume, of which the present is the concluding number.

THE last two numbers of the *Revue des Cours Scientifiques* (Dec. 25, 1869, and Jan. 1, 1870), contain an elaborate paper on Vaccination, by M. Brouardel; a translation of Dr. Bence Jones's Croonian Lectures; an account of Schimper's Researches in Vegetable Palæontology, by M. Ch. Grad; and a lecture given by M. Bouchardat at the Paris Academy of Medicine "On the Mortality of Foster-children."

SOCIETIES AND ACADEMIES

LONDON

Geological Society, December 22, 1869.—Prof. Huxley, LL.D., F.R.S., in the chair. Messrs. Hopkinson, J. Sanders, and Jabez Church, C.E., were elected Fellows of the Society. The following communications were read:—1. "On the Iron-ores associated with the Basalts of the North-east of Ireland." By Mr. Ralph Tate, Assoc. Linn. Soc., F.G.S., and John S. Holden, M.D., F.G.S. The authors introduced their account of the iron-ores of the Antrim basalts, by stating that since 1790 an iron band had been known in the midst of the basalt of the Giant's Causeway, but that only within the last few years have further discoveries been made, which have developed a new branch of industry in the north-east of Ireland. The iron-ore of the numerous exposures was considered to represent portions of one sheet extending uniformly throughout the basalt and over a very large area. Indeed everywhere the iron band and its associated rock-masses present identical features, from which the authors deduced the following generalised section:—The underlying basalt gradually passes upwards into a variegated lithomarge of about 30 feet thick, graduating insensibly into a red or yellow ochre or bole of about 5–6 feet in thickness, which passes into a dense red ochreous mass of about 2 feet, charged with ferruginous spheroids consisting chiefly of a protoxide and peroxide. The spheroids are of the average size of peas; they increase in number and size towards the upper part of the band, and not unfrequently constitute that portion of it. The line of junction between the iron band and the overlying, and usually more or less columnar basalt, is in all cases well defined, and in a few instances exhibits decided unconformability. The authors discussed the several theories that may be suggested to account for the origin of the present condition of the pisolitic ore, and proceeded to point out what appear to have been the several stages of metamorphic action by which the pisolitic ore had been elaborated out of basalt. From field observations and chemical analysis, they have been led to consider the bole and lithomarge as the resultants of aqueous action in combination with acidulated gases, which, dissolving out certain mineral substances, has effected the decomposition of the basalts; and to assume that the bole underlying the iron band was a wet terrestrial surface, and that the subsequent outflow of basalt effected, by its heat, pressure, and evolved gases, a reduction of the contained oxides of iron into the more concentrated form in which they occur in the pisolite, the aggregation of the ferruginous particles being a result of the same actions. The ferruginous series, with interstratified plant-beds at Ballypalidy, was next described, and demonstrated to be of sedimentary origin; the ferruginous conglomerate resulting from the degradation of the pisolitic ore, of which it is chiefly reconstructed, and of the underlying ochres. Many additions were made to the list of plant remains from these beds; and priority of discovery of plants in the Antrim basalts was accorded to Dr. Bryce, F.G.S. Mr. D. Forbes was not prepared to admit some of the theoretical conclusions of the authors, and objected to calling in metamorphism to account for all that was hard to be understood. He could not recognise the division of beds so similar in character into two classes. He wished to know, assuming that the iron-ore merely resulted from the decomposition of the basalt, what became of all the silica and alumina which constituted three-fourths of the mass. The origin of the pisolitic ores was in fact organic. In Sweden certain lakes were regularly dredged each year for the pisolitic ore still in course of formation by means of confervoid algæ. He therefore regarded the whole of these beds as in a certain sense sedimentary, and though due to organic agency, yet still deriving their original mineral matter indirectly from the basalt. The basalt contained a considerable amount both of phosphorus and sulphur; and if the ores had been derived directly from the basalt, both these substances would have been present in them. This was an argument against any direct metamorphism. The presence of venadium afforded additional reasons for regarding these ores as formed in the same manner as bog iron and similar ores. Sir Charles Lyell had observed in the basalts of Madeira red ochreous bands, which represented old land surfaces, in one of which Mr. Hartog and he had discovered a leaf-bed containing vegetation of much the same character as that of the island at the present day. Near Catania, in a recent lava-stream, he had seen the junction of the lava with the soil of the ancient gardens; and in character the soil now under the lava resembled the red beds in Madeira. Mr. W. W. Smyth was on the whole inclined to admit the power of metamorphism to produce such changes as had been here effected. He commented on the advantages of employing this Irish ore for admixture with hæmatitic ore, on account of the abundance of alumina present. Possibly there had been some difference in the chemical character of the different flows of basalt. Mr. Evans suggested that the Ballypalidy beds might be the littoral deposits of a lake in which the pisolitic ores of the other parts of Antrim were deposited farther from the shore, and subsequently buried under a basaltic flow. Mr. Etheridge inquired whether the pisolitic ore had been subjected to microscopic examination, with a view of finding traces of organic forms, such as *Gallionella.* Mr. Tate, in reply, defended his views as to metamorphic action. He thought the uniformity in thickness and character of the pisolitic ore band over so large an area showed that it could not be a lacustrine deposit. He had not as yet examined the spheroids under the microscope.

"Notes on the Structure of *Sigillaria.*" By Principal Dawson, F.R.S., F.G.S., Montreal. In this paper the author criticised the statements of Mr. Carruthers on the structure of *Sigillaria* (see Q. J. G. S. xxv. p. 248). He remarked that *Sigillaria,* as evidenced by his specimens, is not coniferous; that the coniferous trunks found in the Coal-formation of Nova Scotia do not present discigerous tissue of the same type as that of *Sigillaria;* that no conifer has a slender woody axis surrounded by an enormously thick bark; that *Calamodendron* was probably a gymnosperm, and allied to *Sigillaria*; that although *Stigmaria* may not always show medullary rays, the distinct separation of the wood into wedges is an evidence of their having existed; that the difference in minute structure between *Sigillaria* and *Stigmaria* involves no serious difficulty if the former be regarded as allied to *Cycadaceæ;* and further, that we do not know how many of the *Stigmariæ* belong to *Sigillaria* proper, or *Favularia,* or to such forms as *Clathraria* and *Leioderma,* which may have been more nearly allied to *Lepidophloios*; that the fruit figured by Goldenberg as that of *Sigillaria* is more probably that of *Lepidophloios,* or may be a male catkin with pollen; and that he has found *Trigonocarpa* scattered round the trunks of *Sigillariæ,* and on the surface of the soil in which they grew. He agreed with Mr. Carruthers in regarding Mr. Binney's *Sigillaria vascularis* as allied to *Lepidodendron.* Prof. Morris thought that *Clathraria* and *Lepidophlois* ought to be discriminated from the *Sigillariæ,* as being rather more nearly allied with cycadaceous plants, especially the former. He pointed out the manner in which certain vascular bundles communicating between the centre of the stem of *Sigillaria* and allied genera and their bark might be mistaken for medullary rays.

"Note on some new Animal Remains from the Carboniferous and Devonian of Canada." By Principal Dawson, F.R.S., F.G.S., Montreal. The author described the characters presented by the lower jaw of an Amphibian, of which a cast had occurred in the coarse sandstone of the Coal-formation between Ragged Reef and the Joggins Coal-mine. It measured 6 inches in length; and its surface was marked on the lower and posterior part with a network of ridges enclosing rounded depressions. The anterior part of the jaw had contained about 16 teeth, some of which remained in the matrix. These were stout, conical, and blunt, with large pulp-cavities, and about 32 longitudinal striæ, corresponding to the same number of folds of dentine. The author stated that this jaw resembled most closely those of *Baphetes* and *Dendrerpeton,* but more especially the former. He regarded it as distinct from *Baphetes planiceps,* and proposed for it the name of *B. minor.* If distinct, this raises the number of species of Amphibia from the Coal-measures of Nova Scotia to nine. The author also noticed some insect remains found by him in slabs containing *Sphenophyllum.* They were referred by Mr. Scudder to the Blattariæ. From the Devonian beds of Gaspé the author stated that he had obtained a small species of *Cephalaspis,* the first yet detected in America. With it were spines of *Machairacanthus* and remains of some other fishes. At Gaspé he had also obtained a new species of *Psilophyton,* several trunks of *Prototaxites,* and a species of *Cyclostigma.* The President objected to the term *Reptiles* being applied to Amphibia, from which they were totally distinct. He questioned the safety of attributing the jaw to *Baphetes,* of which no lower jaw had been previously found. Mr. Etheridge remarked that the *Cephalaspis* differed materially in its proportions from any in either the Russian or British rocks.

"Note on a Crocodilian Skull from Kimmeridge Bay, Dorset." By J. W. Hulke, F.R.S., F.G.S. The author described a large Steneosaurian skull in the British Museum, from Kimmeridge Bay, which had been previously regarded as Pliosaurian, and was recently identified with *Dakosaurus* by Mr. Davies, sen. From the agreement of their dimensions, and their occurrence near together, the author thought it probable that this skull and the lower jaw described by him last session belonged to the same individual. It differs from the *Steneosaurus rostro-minor* in the greater stoutness of its snout, in the presence of an anterior pair of nasal bones prolonged into the nostril, and in the number of its teeth. The author proposed to name it *Steneosaurus Manseli,* after its discoverer.

"Note on some Teeth associated with two fragments of a Jaw, from Kimmeridge Bay." By J. W. Hulke, F.R.S., F.G.S. The author described some small teeth associated with fragments of a long slender snout not unlike that of an Ichthyosaur, but too incomplete to be certainly identified. The teeth are peculiar in the great development of the cementum, which gives the base of the tooth the form of a small bulb. The exserted crowns are slightly curved, smooth, cylindrical, and pointed. The attachment to the dentary bone was probably by means of the soft tissues, and the teeth seem to have been seated in an open groove in the surface of the jaw-bone. Until additional material reveals the true nature of this fossil, the author proposes to place it alone, and to call it provisionally *Euthekiodon.* The following specimens were exhibited:—Fossils and Rock-specimens from Antrim; exhibited by Ralph Tate, Esq., F.G.S. Fossils from Kimmeridge Bay; exhibited by J. W. Hulke, Esq., F.R.S.

Photographic Society, Dec. 14, 1869.—J. Glaisher, F.R.S., president, in the chair. The Secretary read a paper by Dr. Van Monckhoven, "On a new artificial light suitable for the production of photographic enlargements," of which we give the following abstract:—In M. Kirchhoff's analysis of the sun, he has shown that there are incandescent upon the sun's surface large quantities of calcium, sodium, iron, magnesium, chromium, &c. Whether these metals exist in a free state on the sun's surface, or whether they are in the form of volatile compounds, the presence of a very high temperature, *i.e.* combustion, would be sufficient to yield not only an extremely dazzling light, but also one possessed of considerable chemical power. These conditions actually exist in the sun, the chemical action of whose rays is due mainly to the presence of chromium, titanium,* and magnesium. The author has found by experiment that nearly all the metals of the alkalies and alkaline earths, as likewise many of the metalloids, when burning in oxygen, give rise to a large emission of chemical rays, due to the production of an oxide at a high temperature, and that the same phenomenon is evident when the same oxides are produced by the decomposition of the metallic salts in a volatilised condition at a very high temperature. Magnesium produces oxide of magnesium heated to whiteness by the flame. If we direct the jet of an oxyhydrogen lamp upon the carbonate or the chloride of magnesium, we produce in either case oxide of magnesium (magnesia) at a high temperature, and moreover obtain in both instances flames rich in chemical rays. So long as the salt is not entirely decomposed the light is sustained in all its brilliancy, but when nothing but magnesia remains the light loses its brightness, and at the same time the greater portion of its chemical activity. If metallic oxides (such as lime, magnesia, alumina, zirconia) are employed and heated by the oxyhydrogen flame to a very high temperature, the illumination is very brilliant; but it is much less photogenic in its character than when the oxide in a nascent condition is produced at a high temperature, as in the case of chlorides, carbonates, &c. In the latter instance the coloured lines of the spectrum inherent to each metal may be observed, but not in the former, and this circumstance induces me to believe that the chemical action of the sun is due to the cause mentioned. Magnesium is well known to emit an abundance of actinic rays; chromium is possessed of far greater chemical intensity. If dry hydrogen gas is passed through chlorochromic acid and afterwards ignited in a current of oxygen, oxide

* It is only recently that this metal has been discovered in the sun.

of chromium is produced at a very high temperature, and at the same time, a flame of such extraordinary chemical power, that chloride-of-silver paper held at a distance of twenty centimetres (eight inches) blackens sensibly in thirty seconds, or about as quickly as in full daylight. The same experiment may be conducted with equal success with chloride of titanium, which gives a blue flame of extraordinary chemical power. Unfortunately, these chlorides can be manipulated only by persons well versed in scientific research, as they become decomposed under the influence of moist gases, and the lamp then emits a considerable amount of vapour, as in the case of metallic magnesium. Magnesium, chromium, and titanium, all of which exist in the sun, are the sources of light most suitable for the purpose. The author is at the present moment occupied in establishing the coincidence of the ultra-violet rays of the spectrum with those of these metals. For the purposes of photographic enlargement, the author uses the Drummond system, substituting for the cylinder of lime, one of very pure carbonate of magnesia, free from soda, baryta, and iron, either alone in a very compressed state, or containing titanate of magnesia obtained by a mixture of chloride of titanium and carbonate of magnesia. The pillars are square at their base, three centimetres in diameter, and eight in height; they burn for an hour and a half, and cost less than half a franc apiece. They emit a very brilliant and economical light. Instead of pure hydrogen gas, ordinary coal gas, or even alcohol, together with oxygen, may be used. The preparation of oxygen, on the author's plan, is very easy, and free from danger. He employs for the purpose calcined oxide of manganese; it is then finely powdered and passed through a sieve. The chlorate of potash he uses is also pulverised and sifted; 600 grms. of brown manganese and 1,200 grms. of chlorate are well mixed by hand in an earthen vessel and sifted, care being taken not to allow any organic matter to enter, and the whole is then introduced into the wrought-iron retort A (fig. 1). The cork stopper E, covered with tinfoil, is put into its place, and the junction F,

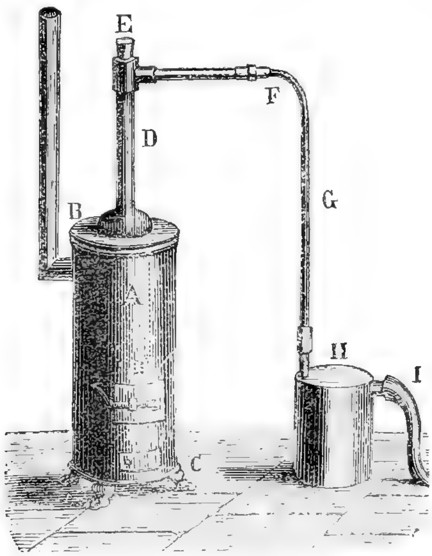


FIG. 1.

which places the retort, by means of the leaden pipe G and rubber tube I, in communication with the gas-bag, is adapted. The delivery tube (I) should be of at least half an inch internal diameter, and the wash-bottle H must be half filled with water. A small quantity of ignited charcoal is thrown into the little furnace B C, or a gas jet may be used, and after the lapse of a few minutes the india-rubber bag begins to inflate, and in twenty minutes it is full of oxygen; it is necessary during this operation to remove the weights and pressure-boards from the top of the bag. When the operation is finished and the retort somewhat cooled, the junction F is unscrewed, the cork E taken away, and warm water poured in until the retort A is filled. The water is allowed to remain for an hour, and the contents are then poured into a large jar, where, after the lapse of an hour or so, the oxide of manganese subsides. The clear water is decanted off, and the black deposit put upon a plate near the hearth to dry, after which it is again ready for repeated employment as often as desired. With ordinary native manganese a much higher temperature is necessary, the mixture having a tendency to puff up, and the operation becomes dangerous. For this reason it is advisable to use a cork stopper, E. A kilogramme of chlorate of potash yields 270 litres of oxygen, and this quantity will supply the lamp for two or three hours; thus the cost of our light, including coal-gas and the magnesia, amounts to two francs per hour. The oxyhydrogen burner used (shown in figs. 2 and 3) is very

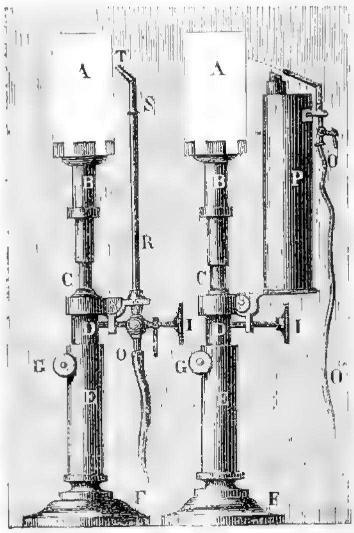


FIG. 2 FIG. 3

convenient. Those who have gas laid on in their houses will use the apparatus with two jets of gas (fig. 2); others will find it more expedient to employ the spirit-lamp arrangement (fig. 3). In both figures the same initials refer to similar details; A is the pillar of magnesia fixed upon a stem, B, which may be turned, lowered, or raised upon the rod C. E F is the stand or support, and G the pinion by means of which the light is adjusted in the centre of the apparatus. The jets for the two separate gases are formed by two concentric tubes, R, S T, sliding at S, so that the upper portion of the tube S T may be raised when it is desired to heat the top of the magnesia pillar A. Two stopcocks, O, P, lead the gases into the apparatus, the letters H and O being marked upon them to distinguish the oxygen supply-tube from that of the hydrogen or coal-gas. By means of a screw, I, the tubes R, S T, may be approached to, or removed from, the magnesia pillar. The coal-gas does not mix with the oxygen, excepting in the flame itself. The manner of employing the apparatus is exceedingly simple. The tube and stopcock marked H (connected with the supply of coal-gas), is first opened and the gas ignited; the stopcock marked O (in connection with the bag of

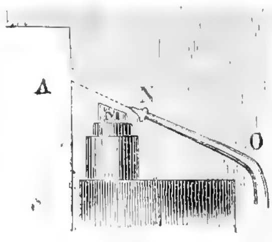


FIG. 4.

oxygen) is also opened, and the tube B then raised in such a manner that the top of the pillar A is heated by the flame, the extremity of the tube T being brought almost into contact with the magnesia. The heat soon indents the pillar, and *it is only when a cavity has been formed that the light attains its highest* *brilliancy;* at this stage the stopcock H is partially closed until the maximum amount of light has been secured. The apparatus (fig. 3) is very similar to the other. The lamp P is filled with alcohol, the wick being round and cut obliquely, as in fig. 4, the extremity of the jet N O being near enough to the wick to touch it lightly. The wick M should be almost in contact with the pillar A, which is brought about by the screw I (fig. 3). To this apparatus there is connected but one india-rubber tube, O O′, in communication with the oxygen bag. Fig. 4 shows the exact position that the jet N O should occupy in relation to the magnesia pillar. The enlarging-apparatus is shown in fig. 5. A case of

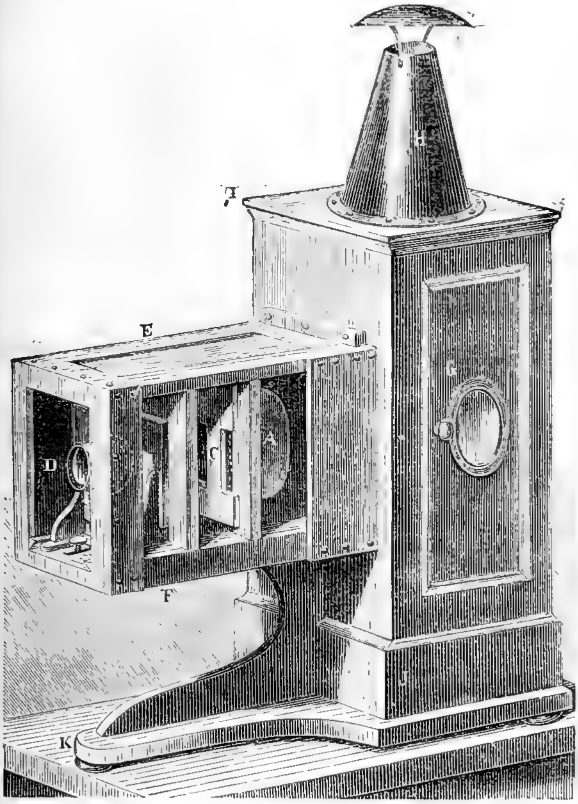


FIG. 5.

polished oak, I J, surmounted by a chimney, H, with doors at the sides, G, furnished with green glass, contains the lamp. The optical apparatus is contained in the box E; it is formed of two lenses of very white flint glass, of which one is seen at A. These two lenses condense the light and transmit it through another lens, D.* Between this latter and the lenses, A, is placed the negative to be enlarged (held in the frame C). The lenses which condense the light are prepared from very translucent flint glass rather than crown glass, which latter possesses to a considerable degree the power of absorbing chemical rays emitted at a low temperature, as is here the case. For further particulars, the reader is referred to the *Photographic Journal*, No. 212.

MANCHESTER

Literary and Philosophical Society, December 14, 1869.—J. P. Joule, LL.D., F.R.S., &c., president, in the chair. Sir Charles Lyell, Bart., LL.D., D.C.L., F.R.S., &c., and Henry Clifton Sorby, F.R.S., F.G.S., were elected honorary members of the society. Mr. R. Routledge was elected an ordinary member.—Mr. W. Boyd Dawkins, F.R.S., exhibited a stone-hammer and rude splinters of flint, brought over by Mr. Bauerman from the turquoise mines of the promontory of Sinai. These mines were worked, according to the evidence of the hieroglyphic inscriptions on the rock, by the Egyptians from the third to the thirteenth of the dynasties mentioned by Manetho. The tools and flint flakes found there in and around the workings, exactly coincide with the grooves in the rock made in the excavation, and evidently have been blunted by such use. There was no evidence that metal of any kind was used in the work. Mr. Bauerman also satisfied himself that the hieroglyphs were cut with implements similar to those used in the mining. This discovery is very important, because it opens up the question as to what tools the Egyptians used in working their wonderful monuments of granite and syenite. If it were worth their while to conduct turquoise mining with flint flakes in the Sinaitic promontory, and if they used the same tools in the hieroglyphs that fix the date of these mines—and of this there can be no reasonable doubt—it is very probable that they employed the same means for the same end elsewhere, and that, to say the least, a part of their marvellously minute sculpture in Egypt has also been wrought with flint. There is no evidence that they were acquainted with the use of steel. Iron and bronze are not hard enough for the purpose.—"On the Hades, Throws, Shifts, &c., of the Metalliferous Veins of the North of England," by Mr. J. Curry, of Boltsburn, Eastgate, County of Durham. Communicated by E. W. Binney, F.R.S., F.G.S. The new views, contained in this paper, are embraced under the consideration that the hades, throws, shifts, &c., may have been chiefly accomplished by peculiar modes of depositing of the sediments, during the contemporaneous building of the veins and strata. These modes were minutely described and illustrated by diagrams, which are requisite to convey a clear conception of the processes.

Physical and Mathematical Section, December 7, 1869.—E. W. Binney, F.R.S., F.G.S., president of the section, in the chair. "On the Mean Monthly Temperature at Old Trafford, Manchester, 1861 to 1868, and also the Mean for the Twenty Years 1849 to 1868," by G. V. Vernon, F.R.A.S., F.M.S.

PARIS

Academy of Sciences, December 27, 1869.—M. H. Sainte-Claire Deville called attention to the *Annuaire du Bureau des Longitudes* for 1870, and indicated that it contained a series of observations on the densities and co-efficients of dilatations of bodies which would render it useful in chemical laboratories.—M. C. Sainte-Claire Deville, in presenting a portion of the *Bulletin Météorologique de l'Observatoire de Montsouris*, noticed the progress of that establishment and the steps that are being taken for the cultivation of meteorology in France.—General Morin made a communication on some successful experiments which have been made on the acclimatisation of the *Cinchona officinalis* in the island of Réunion.—An extract from a letter of M. I. Pierre to M. Peligot, on the presence of potash and soda in various parts of plants, was read, in which the author stated that from his investigation of wheat, it appeared that where salt exists in the soil, both soda and potash occur in the plants grown on it, but that the latter increases in quantity up to the ear, whilst the soda is found especially in the lower parts of the plant. The amount of potash in different parts of the plant is in harmony with the amounts of nitrogen and phosphoric acid.—A note by M. S. Cloëz, on the disinfection of commercial sulphide of carbon, was presented. His process consisted in agitating the crude substance with ½ per cent. of its weight of finely-powdered corrosive sublimate, which throws down a semifluid compound of disagreeable odour. The supernatant liquid is then decanted and distilled. — Some chemical researches on copper, by Mr. T. Sterry Hunt, were communicated. The author referred to the resemblances existing between perchloride of silver and protochloride of copper, which also extend to the oxides. He described the behaviour of protoxide of copper with various chlorides, especially those of magnesium and iron, and also that of peroxide of copper with protochloride of iron.—M. Daubrée presented a note by M. Terreil on the modifications undergone by minerals by the action of saline solutions. It related to the action of the alkaline monosulphides upon the natural metallic sulphides, selenides, and tellurides, singly or in combination.—A note by M. J. Personne, on the preparation and properties of hydrate of chloral, was read. The author described the differences in the physical properties of the substances obtained by himself and M. Roussin as hydrate of chloral, and indicated that these are due to the fact that the

* In apparatus where the lenses, A, are ten inches in diameter, one of them may be removed, and the case, I J, also; then, by adjusting a reflector, it is possible to work by sunlight when the same is procurable.

compound prepared by the latter is not pure, but contaminated by the presence of a considerable amount of alcohol.—M. Dubrunfant continued the discussion on the nature of inverted sugar, by a description of his method of separating levulose from it. He effects the separation by the addition of hydrate of lime to a solution of inverted sugar, presses the crystalline magma produced, and removes the lime by treating both the solid residue and the expressed fluid with an acid. This process, according to the author, effects the nearly complete separation of the two forms of glucose, and he suggested that it might become of importance, as levulose possesses far higher sweetening powers than right glucose.—Mr. T. L. Phipson communicated a note on some substances extracted from the fruit of the walnut. From the green envelope of the fruit he obtained a yellow, crystalline substance, of little stability; this, in a few hours, produced a black, amorphous, resinous substance, $C_6 H_6 O_7$, which the author called *regianic acid*. With alkalies it forms soluble salts of a magnificent purple colour, and with oxide of lead a violet-brown insoluble salt. For the yellow body he proposed the name of *regianine*. A substance occurring in the episperm of the nut was called *nucitannine;* it is the cause of the harsh taste of that skin. From it, by treatment with mineral acids, the author obtained glucose, ellagic acid, and a red, insoluble body, which he named *rothic acid*. Its composition was said to be $C_{28} H_{12} O_{14}$. The green envelope, when fresh, absorbs oxygen with avidity from the air; when mixed with soda, it absorbs oxygen much more rapidly than phosphorus.—In a note on the simultaneous action of the intra-pilar current and nascent hydrogen upon organic acids, M. E. Royer described his treatment of oxalic acids by these agencies. Concentrated solution of that acid, placed in the porous cell of a Grove's battery, furnished a considerable quantity of formic acid in a few days, the oxalic acid having been split, and hydrogen having combined with each of the two half-molecules. No carbonic acid was set free.—M. Delafosse presented a report upon M. Kokscharow's contributions to the mineralogy of Russia, indicating the general character of that work.—M. Feil exhibited some specimens of heavy glass (Faraday's glass), prepared by a new process which enables it to be produced in large masses. He also sent in some examples of artificial gems.—A note by M. M. A. Gaudin, on the production of artificial gems, was also communicated; it was accompanied by a small collection of specimens.—A memoir was presented on the general movements of the atmosphere, by M. Peslin; also one on the graduation of galvanometers, by M. P. Blaserna; and another, containing the first part of a new method for the solution of problems in mechanics, by M. Piaron de Mondesir.—Of biological papers, M. Lacaze-Duthiers communicated a first memoir on the morphology of the mollusca, relating to the *Gasteropoda*. To this we may probably refer elsewhere.—M. P. P. Dehérain presented a paper on the metamorphoses and migrations of the proximate principles in herbaceous plants, in which the author traced the course of the more important vegetable compounds from one set of organs to another during the life of the plant, and indicated the changes which they undergo in different parts. He ascribed the transport of soluble materials from one part of a plant to another to the varying amount of aqueous evaporation from the surface. The accumulation of insoluble proximate principles in the seed was also accounted for by the author on the supposition (experimentally arrived at) that wherever in a system fully charged with liquids there is a point at which the dissolved elements become insoluble, they tend towards that point in order to maintain the equilibrium. Of the means by which the soluble elements are converted into insoluble ones, the author attempted no explanation.—M. Milne Edwards presented a note by M. Balbiani on the constitution and mode of formation of the ovum in the *Sacculinæ*, in which that author contests some of the points insisted on by M. E. van Beneden in a former paper (see NATURE, p. 246).—The question of the antiquity of the horse in Egypt formed the subject of notes by MM. F. Hément, F. Lenormant, and Faye. M. Lenormant disposes of the passage in Genesis in which *mules* are supposed to be referred to. He seems inclined to consider that the word translated mules (which occurs nowhere else in the Bible) really signifies hot springs. M. Faye, in opposition to all authority, holds fast by the ordinary modern version, and also cites the passage in the same book in which horses are mentioned among the animals taken by Joseph in exchange for corn during the years of famine in Egypt. From the fact that horses are here familiarly mentioned, M. Faye infers that their employment in Egypt as domestic animals must then have been of long standing.—M. E. Decaisne communicated a paper on suckling by mothers; and Mr. T. L. Phipson a note on the explosion and fall of meteorites. Papers were also presented by M. Bonjean, on the detection of hydrocyanic acid and cyanides in cases of poisoning; by M. Guyot, on the toxical effect of rosolic acid; by M. Trouvé, on the employment of electricity in seeking metallic bodies in wounds, &c.; by M. L. Colin, on telluric emanations and their connection with fevers; by M. Gouteyron, on the influence of the shell of iron vessels upon the compass; by M. Jouglet, on the production of an explosive powder by the action of coal-gas upon nitrate of copper; and by M. Dupuis, on a new hydraulic lever.

DIARY

THURSDAY, JANUARY 6.

ROYAL SOCIETY, at 8.30—Some Account of the Suez Canal: J. F. Bateman, F.R.S.—On the Mineral Constituents of Meteorites: N. Story Maskelyne.—On Fluoride of Silver: G. Gore, F.R.S.

ROYAL INSTITUTION, at 3.—On Light (Juvenile Lectures): Prof. Tyndall, F.R.S.

SATURDAY, JANUARY 8.

ROYAL INSTITUTION, at 3.—On Light (Juvenile Lectures): Prof. Tyndall F.R.S.

MONDAY, JANUARY 10.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.

MEDICAL SOCIETY at 8.

TUESDAY, JANUARY 11.

CIVIL ENGINEERS, at 8.

PHOTOGRAPHIC SOCIETY, at 8.

ETHNOLOGICAL SOCIETY, at 8.—On the Kitai and Kara-Kitai: Dr. Gustave Oppert.—On the Origin of the Tasmanians, geologically considered: J. Bonwick, Esq. —On some Prehistoric Remains discovered in New Zealand: Dr. Julius Haast, F.R.S.

WEDNESDAY, JANUARY 12.

MICROSCOPICAL SOCIETY, at 8.—On the Calcareous Spicula of the Gorgoniadæ: W. S. Kent, F.Z.S.—On an Undescribed Stage of Development of Tetrarhyncus Corollatus: Alfred Sanders, M.R.C.S.—On a New Method of Measuring Spectra Bands: John Browning, F.R.A.S.

GEOLOGICAL SOCIETY, at 8.—On the Superficial Deposits of Portions of the Avon and Severn Valleys and Adjoining Districts: T. G. B. Lloyd, Esq., C.E., F.G.S.—On the Geological Position and Geographical Distribution of the Reptilian or Dolomitic Conglomerate of the Bristol Area: R. Etheridge, Esq., F.G.S.

THURSDAY, JANUARY 13.

LONDON MATHEMATICAL SOCIETY, at 8.—Equations of Centres and Foci of certain Involutions: Mr. J. J. Walker.

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THURSDAY, JANUARY 13, 1870

GOVERNMENT AID TO SCIENCE

IN our present issue will be found a letter from Mr. Wallace on Science Reform, a subject which we lately brought before our readers, and which is attracting, at last, the attention which its immense importance demands.

We have the greatest respect for Mr. Wallace, and therefore willingly give him the opportunity of stating his views, though we entirely dissent from them, and though we regret to see such a question as this dealt with in what we must describe as a narrow spirit calculated to win only popular approval. Mr. Wallace's letter opens with a denunciation of the Education movement as a madness of the public mind, and with an imputation upon the Science Reform movement as a scramble for the loaves and fishes. It is only consistent with such an exordium that the benefits of Science should be depreciated, and that its cultivation should be spoken of as a matter more of personal than of national concern.

"The broad principle I go upon," says Mr. Wallace, "is this—that the State has no moral right to apply funds raised by the taxation of all its members to any purpose which is not available for the benefit of all." And further on he writes: "I maintain that all schools of art, or of science, or for technical education, should be supported by the parties who are directly interested in them or benefited by them." We understand Mr. Wallace to mean by these and many similar passages, that the main result of cultivating Science is merely the gratification of those directly engaged in the pursuit, and that they who do not take this personal interest in it derive little or no benefit from it; and hence, that it would be unjust to tax the bulk of the community to enable a few individuals to indulge their philosophical tastes. If that is not the position which Mr. Wallace desires to take up, we must declare our inability to understand the letter before us; if the position be tenable, we need hardly say that no greater error can be committed than that of seeking aid to Science from the State.

But is it tenable for a moment? Is it really necessary to tell any educated man of the nineteenth century that science, art, literature, with one or two other matters, are simply civilisation; and that civilisation affects, not particular classes, but whole communities? To confine ourselves to our own province, Science, does Mr. Wallace really believe that the discoveries of chemists, naturalists, astronomers, and physicists do not directly benefit even the ignorant masses who cannot appreciate them? Does he know of a single class, we might say a single tax-paying being in England, who does not derive direct advantages from contrivances and processes which place at his disposal properties of matter and laws of nature unknown to uncivilised people? The material results of scientific labour, such as superior clothing and dwellings, more varied food, better medical and surgical appliances, sanitary improvements, easier locomotion, are accessible to all in proportion to their means, however ignorant they may be of the scientific principles to which they are indebted for them,—as accessible to them as to the very philosophers by whom those principles were discovered and applied. Where, then, is the injustice of taxing all classes, in proportion to their means of commanding the results of science, for advantages which, if not so taxed, they would obviously gain at the cost of others? We are surprised to find it necessary to insist on truths of so elementary a character.

Justice to the taxpayer may be a good electioneering cry, but in such a discussion as the present it will command no hearing. The question for us to consider is whether the taxpayer shall possess greater material advantages than those he now enjoys, and by what agency they may be most efficiently conferred on him: whether, as a nation, we shall strive for a still higher civilisation, and how it is to be attained: whether these objects will come to us unsought, or whether, as a nation, we must exert ourselves vigorously and systematically to gain them. The resulting benefit to the taxpayer will, we need not doubt, far exceed the price he pays for it.

At present, the British taxpayer contributes to the maintenance of a Royal Observatory, of a School of Mines, of a Museum of Natural History, of a Museum of Art, of an Ordnance Survey. The advocates of the *status quo* are bound to show, not merely that catalogues of stars, collections of minerals, animals, statues, mosaics and paintings, and elaborate maps of the kingdom are useful to the taxpayer, but that no other institutions can be added to these with advantage to him, and that those we have named have attained to absolute completeness and perfection, admitting of no further development or improvement. The existence of these institutions settles, once for all, the principle that it is just to tax the community for Science. If not, abolish them. But if taxation for these particular objects be just—which even Mr. Wallace does not deny—then the question whether there are not other objects that should be added to them is one that may fairly be asked.

The examination of this question involves the passing in review of all existing, and all possible, scientific institutions, in order to select those which are properly matters of national concern; the principle of selection being that the nation should charge itself with those only which have the two-fold character of general utility and of being beyond the means of individuals to maintain; it also involves the consideration of the mode in which the scientific affairs of the nation should be administered.

A recent article in the *Pall Mall Gazette* powerfully exposes the failure of local, as contrasted with central, administration. The principles so ably contended for by our contemporary are perfectly applicable to the business of science. The time indeed is gone by for declamation against centralisation. The bugbear of the past has become the necessity of the present. Armies, fleets, railroads, telegraphs, commerce, literature, enterprise in every form, even well-ordered private households, as pointed out in the article to which we refer, are all examples of centralisation—and the tendency is daily to add to the catalogue. It might have been better that each man should suffice for himself, but as a matter of fact he does not. He relies on co-operation for the attainment of objects which he cannot compass alone, and however small the number who so unite for a common purpose, one usually directs the operations. What is true of individuals is true of a nation. Nothing that concerns the well-being of the community can be, or is, left to the chance efforts of individuals; an organisation is formed with a directing, a centralised authority, to which the whole body defer.

This is now wanted in England for Science, which cannot be cultivated without system, nor can it be governed without system. In a former number of this journal an article from the pen of Prof. Roscoe gave an interesting picture of the scientific organisation of Germany, which may be taken as typical of the Continent. Their arrangements, which carry Government intervention to a point not as yet contemplated by anyone in England, so far from having the deadening effect imputed to Government aid, has produced in large numbers men of the highest attainments and the largest and most original views, and is developing a continuity of results of the greatest practical and theoretical value. The physical education and intelligence of the people is confessedly ahead of that which the same classes in England can boast. The arts in which we once justly claimed pre-eminence are in many instances now more advanced with them than with us mainly because the principles on which they depend are, more assiduously studied, and the artisans by whom they are practised more thoroughly instructed by them than by ourselves. Many branches of trade in England already painfully attest their superiority. As a matter of fact, individual enterprise, which it is so easy glibly to pronounce the incarnation of vigour, has not borne the fruit at home which Government support, with its supposed emasculating tendency, has yielded abroad.

Are we, then, to fall back in the race of nations, to see our trade and our manufactures dwindle away, and our naval and military systems take second rank, because there is an apparent noble independence in the attempt to do single-handed what single hands are proved incapable of doing? We assert that, other things being as nearly equal as variations in religion, customs, and form of government will admit, the degree of cultivation of Science by nations will ultimately determine their places in the human family. No nation on earth has a greater abundance of natural resources and of accumulated wealth than we; no people have higher gifts or nobler aspirations; none need less fear despotic interference from its Government; no nation, therefore, is better qualified to carry out a system which has proved so successful in less-favoured countries.

The question that presses for decision is, What shall we call on the Government to contribute to scientific advancement, and in what manner shall the scientific administration of the future be constituted? The present Government is ready, we doubt not, to perform its part, if only the necessity be shown by competent testimony to exist. It is the duty of men of science, who alone can speak on the subject with authority, to give this testimony, and to help the Legislature to place on a footing worthy of a great nation a department of its duties which has hitherto been, to a most injurious extent, overlooked.

THE THAMES SUBWAY

SEVERAL attempts have been made to pass under the Thames. The chalk and alluvial deposits of the valley at Gravesend would even now offer formidable, if not insurmountable, difficulties to the attempt, once made, to tunnel through strata with water sources so unmanageable. The Thames bed at Limehouse had hidden dangers, which, however, did not succeed in stopping the bold attempt, made some forty years since, to pass beneath the river—an attempt carried in fact to a successful issue in spite of innumerable difficulties, but at an overwhelming expense. The skill and ingenuity displayed were equal to the occasion, but the object attained was not commensurate with the magnitude of the work, and for years it served rather as a warning than an example to be followed.

A better geological knowledge of the Thames valley has, however, been gradually acquired during the last half-century; and it has become evident that while some parts of the valley present the greatest difficulties to the execution of any such work as a tunnel under the river, other parts present conditions singularly favourable for such works. It is found that the chalk *e*, Fig. 2, which disappears at Croydon and reappears at Watford, passes under London at a depth of from 200 to 300 feet; that next over the chalk come beds of sand, shingle, and clay, from 80 to 100 feet thick taken together, *c* and *d*; next above these is a single massive formation of clay, in round numbers from 100 to 200 feet thick under London, and acquiring a still greater thickness—as much as 450 feet—at places not far distant. This clay is so compact and tenacious, that, except in a few places, it is perfectly impervious to water. The various railways in the neighbourhood of London, as at Primrose Hill, Copenhagen Fields, Norwood, and elsewhere, show how readily tunnels can be made through it. It has also been ascertained that this clay, known to geologists as the London Clay, though thin and uncertain at Limehouse, dips westward from that place and gradually acquires a greater thickness, until at London Bridge it forms a mass 129 feet thick. It therefore became evident that while, at and below Limehouse, any tunnel passing under the Thames would have to pass through the soft and permeable beds of sand and shingle lying between the London Clay and the chalk—beds charged with water—forming in fact originally the great water-bearing beds under the London Clay at London, and therefore almost impassable to any tunnel under the Thames; above Limehouse, and thence to London Bridge, the gradually increasing mass of London Clay presents ground more and more favourable for the execution of such a work. If a place could be found where, on the one hand, without going to too great a depth, the alluvial beds on the surface and any accidents in the Thames bed itself, and on the other hand the beds of sands and shingle below the London Clay, could be avoided, while at the same time the intermediate London Clay was thick enough to allow of the passage of a tunnel and for a sufficient thickness of roof and floor, it was clear that at such a place the conditions for the construction of a tunnel would be as favourable as could be desired.

The first to apply this knowledge was Mr. P. H. Barlow, C.E., F.R.S., who fixed upon a spot intermediate between London Bridge and Limehouse (where the thickness of London Clay must be about 80 ft.), and at a sufficient distance below London Bridge to render an underground passage of the Thames a work of great public utility. A space of vacant ground near the western entrance to the Tower was obtained from the Crown; and on the Middlesex side a small wharf offered sufficient width for the tunnel to pass under, and be carried to the shaft in Vine Street. Allowing for any likely greater depth of a former channel, or for any effect the river might have had on the clay, Mr. Barlow considered he would be safe in allowing a minimum thickness of 20ft. of London Clay to exist between the river and the top of the tunnel—a conjecture, the correctness of which has been fully proved in the execution of the tunnel; for not the slightest percolation of water from the river was detected during any part of the work. It is a question, in fact, whether a less depth might not have sufficed. Greater difficulties were apprehended in the making of the two shafts, as the gravel on either side of the river was known to be charged with water—that on the Middlesex side especially. On the north side of the river the ground rises at Tower Hill, and thence towards the City, to a height of about 40ft. above Thames high-water mark; and the London Clay is capped by a thick bed of gravel, the spring at the base of which supplies so many of the City pumps. This gravel, however, does not slope down to the river, but is cut off at the sloping ground. When the shaft on the north side came to

FIG. 1

be made, it was found, after passing this 14ft. of made ground, that the site of it was exactly on this intermediate hill of clay, and that the gravel which thinned out only a few feet higher had therefore been escaped. The shaft consequently was carried without difficulty through the 14 feet of made ground and 44 feet of London Clay to a depth of 58 feet. On the south side, the gravel, alluvial, and made soils, *a*, were found to be 35 feet thick, and charged with water, which rose and fell with the tide (highest just before low water) in the river, to the extent of 3 feet. By the use of iron-tubing, a passage through has been effected, although with more difficulty, and the shaft carried to a depth of 17 feet in the clay *b*, or a total depth of 52 feet. Between these two points Mr. Barlow laid the tunnel at a slight curve, so as to have a depth in the centre 18 feet greater than at the ends. The shafts have a diameter of 10 feet at top and 8½ feet at bottom. The tunnel is 7 feet in diameter, and is formed by cast-iron tubing in lengths of 1½ feet each, each ring being composed of thin segments with a key piece. An iron shield, devised by Mr. Barlow, was pushed on in advance of the work, and the tubes fixed in as soon as the requisite length of excavation had been completed, and the small space left between the clay and tube filled in at once by concrete. The work was carried on day and night, and advanced without interruption. No subsidence occurred in any part, and a regular and steady progress of 9 feet daily was made. Mr. Barlow, junior, is the engineer of the work, and Mr. Greathead the contractor; and the whole plan and execution of the work does very great credit both to the projector, Mr. Barlow, and to the engineer and contractor. With the exception of a slight leak in the iron tubing of the shaft on the south side, and which has been remedied after but a short delay, not the slightest mishap has occurred in the execution of the work, nor has a single fatal or even serious accident happened to any of the men. Last month the junction between the north and south side was effected, and the error of direction from the two ends was found not to amount to one inch. The passage under the river will be made in an omnibus, by means, probably, of a stationary engine; and lifts on either side will take the passengers up and down. A few minutes will suffice for the journey, and it is hoped that the work may be opened to the public in a few weeks. A remarkable feature of this interesting work has been its small cost. Mr. Barlow's estimate was 16,000*l.*, and it is now tolerably certain that the entire cost will be under 18,000*l.* Another feature has been the rapidity of execution. The shaft on the north side was commenced on the 16th of February last. On the 26th of April the tunnel, which is 1,320 feet long, was commenced, and on the 8th of October the passage under the river was safely effected. Before the public at large was aware that another Thames Tunnel was completed, the old London wonder has been duplicated.

As the object has been chiefly to speak of the geological problem, a section is annexed to show the structure of the ground at this part of the river.

FIG. 2

Very few fossils were found, and these chiefly in the clay of the north shaft. They consist of *Cryptodon angulatum*, *Corbula globosa*, *Pinna affinis*, *Dentalum nitens*, *Fusus*, and column of *Pentencrinite*. In the tunnel pieces of wood pierced by the *Teredo*, and some teeth of Shark, were met with. As the London Clay thickens to the west and north-west, and extends uninterruptedly to Windsor on the one hand and to Watford on the other, covered in places near London by beds of gravel and sand, which never, however, exceed thirty to forty feet in thickness, and rarely exceed fifteen feet, there is thus in this area a formation which lends itself singularly well to the construction of subways and tunnels.

J. PRESTWICH

THE MAMMALIA OF SWITZERLAND.

Faune des Vertébrés de la Suisse. Par Victor Fatio Dr. Phil. Vol. I. *Histoire Naturelle des Mammifères.* (H. Georg, Genève et Bale, 1869.)

M. FATIO'S book is one which will be valuable to all Swiss naturalists, and to those who take an interest in the productions of the mountainous region of central Europe. It fulfils its function admirably as far as it goes, but, like all works treating of local Faunas or Floras, its general interest is diminished in proportion to the diminution of the area investigated. It has not, for example, the importance or value to a distant reader which such a volume as the "Naturgesch. der Säugethiere Deutschlands und Mitteleuropas" of Blasius possesses; but to local naturalists it will be as useful as are the various volumes on British Zoology published by Mr. Van Voorst, to British zoologists. At the same time, there is always a gain where there is a loss in these matters: what we lose in comprehensiveness we gain in detail; and accordingly in M. Fatio's book we find much that is valuable on account of the great care which he has taken in *personal* investigation; whilst the interest of the whole subject is enhanced by the peculiar and varied conditions of the ice-ploughed Switzerland, to which it relates. Such a valley as that of the Rhone in the Valais presents conditions of climate and vegetation comparable with those of the southern shores washed by the Mediterranean; whilst an extensive region of perpetual snow is within a few hours' walk of this favoured spot. The Alpine valleys of the Grisons, again, present peculiar conditions in their great elevation. M. Fatio finds, however, that the encroachments of man, and his destruction of forest, have a more powerful influence on the distribution of animals than mere circumstances of altitude.

M. Fatio gives the number of mammals inhabiting Switzerland in the wild state—that is, excluding the cat, dog, horse, ass, ox, sheep, and goat—as fifty-eight, or as sixty-one, if the rabbit (which is not indigenous, but has been imported of late years) be reckoned, and the two minute forms, *Sorex pygmæus* and *Mus minutus*, which have been said to occur, but which M. Fatio has not himself succeeded in finding. This list does not include the ibex, the stag, or the *Mus agrarius*, which have become extinct. Some mammals which occur in adjoining countries are remarkable for their absence in Switzerland: thus, the two bats *Rhinolophus clivosus* and *R. Euryale*, which occur in Lombardy, *Mus agrarius*, occurring near the Rhine on the north, and by Como to the south, *Arvicola subterraneus*, also found near the Rhine, and *A. Savii*, found in Lombardy, are not met with in Switzerland.

M. Fatio has increased the catalogue of Swiss mammals, as given by some of his predecessors, by the addition of nine species of bats, two insectivora, and four rodents, one of which is considered a new species altogether.

This new species of M. Fatio, is a little black mouse, very much like the common house mouse (*Mus musculus*), but having a very dark black-coloured fur; the two presenting much the same contrast as do the *Mus rattus* and *Mus Alexandrinus*, which M. Fatio agrees with M. Arthur de l'Isle in considering one and the same species. The new mouse, however, which is called *Mus Poschiavinus*, from the locality where it was observed, presents more important differences when compared with *Mus musculus* than those of colour and proportion only, The palatine ridges in *M. Poschiavinus* are *four* in number, in place of *five* in the common species, and the anterior simple ridges are of a different form.

The strange thing about this little black mouse, which is found at Poschiavo in the Grisons, is that it lives on tobacco. It was first noticed in a tobacco-factory, and was found to make great ravages among the stores of the nicotian weed. When first caught, M. Fatio thought he had possibly got hold of young specimens of the black rat, but subsequently he obtained specimens bearing evident signs of maturity. It does not appear to have suggested itself to M. Fatio's mind, that his *Mus Poschiavinus* may be only a sample of the deleterious effect of indulgence in the noxious herb to which these rodents are addicted. What if this new black mouse is but a stunted race of the black rat? It would furnish an invaluable argument to the anti-tobacconists.

A very pretty coloured plate, representing two Poschiavinian mice helping themselves to cigars, illustrates the description of this species. It is not a little remarkable that an animal should normally feed on tobacco. Monkeys, as is well known to the frequenters of menageries, are exceedingly fond of the end of a cigar, and an elephant has been seen gravely to accept such an offering; but one would have supposed that the amount of nicotine in a pinch of snuff was enough to make a mouse unwell. The indifference of these mice to the toxic action of tobacco, calls to mind the similar indifference on the part of pigeons (rodents are like birds in many things) to the toxic action of opium in the largest doses, as lately noticed by Dr. Weir Michell.

Among the rarer and more interesting forms noticed by M. Fatio as still existing, or as having existed—for he notices the contents of the quaternary deposits in Switzerland—are the Bear (*Ursus arctos*), the Wolf (*Canis lupus*), the Wild Cat (*Felis catus*), the Lynx (*Felis lynx*), the Bouquetin or Ibex (*Capra ibex*), the Chamois (*Capella rufricapra*), and the Stag (*Cervus elaphus*). With regard to this last, it appears that, eighty years since, very fine specimens inhabited the Swiss valleys; now it only appears when driven from the German forests lying to the north; its remains are found in quaternary deposits. The fallow-deer is represented neither in the present nor in the quaternary fauna; the Roebuck, or Chevreuil, is the only cervine species still inhabiting the country. Wolves, lynxes, and wild cats are not uncommon in the forests of the Jura; but the lynx has not been found in the quaternary deposits, which is noteworthy, since Dr. Ransom, of Nottingham, has found it in England in such beds.

The bear is commonest in the Grisons; every year there is some bear-hunting to be done in these wild and elevated valleys. The ibex, though no longer found in the Swiss Alps, occurs in the immediately adjacent territory of Lombardy; where, however, it is now strictly preserved. The ibex of the Alps, of the Pyrenees, of Siberia, and of Crete, each have very distinctive characters, in the direction and length of their horns, but are hardly to be considered as distinct species. Some naturalists, however, distinguish a second species in Spain, as *Ægyceros Hispanicus*, occurring farther south than the so-called *Ægyceros Pyrenaicus*. The domesticated *Capra hircus*, has no doubt largely taken the place of the indigenous ibex; natural hybrids between the two are not uncommon. The industrious Swiss have sometimes exhibited to curious tourists an eccentric specimen of the common goat as a living ibex. M. Fatio mentions such an instance, which may put naturalist travellers on their guard. A specimen presented by the King of Italy may be seen in the Zoological Gardens, Regent's Park. The chamois are still very numerous in Switzerland, though the large herds of eighty and a hundred, which used to be seen in past times, are not now met with. A certain amount of care is exercised now in regard to the time of hunting, and the animals are allowed to breed in security, so that they are on the increase in localities where they had become scarce. M. Fatio mentions an old hunter who boasted of having killed as many as 3,000 chamois.

The Alpine marmot, which is so common and so well known to Alpine tourists, is not the mammal which attains the highest elevation of habitat in Switzerland; another little rodent, the *Arvicola nivalis*, has that distinguished honour, living at a greater altitude than any other European mammal.

Both this species and the marmot live among the oases of rock and herbage which stand out amidst the vast masses of mountain ice. The Bobac marmot does not occur in Switzerland, being confined to the north-eastern districts of Europe. The Alpine marmot inhabits the Carpathians and the Pyrenees, as well as the Alps.

M. Fatio's book is illustrated by eight plates, giving figures of new or rare forms. Synoptical tables of the families and genera are also given, so as to enable the least experienced naturalist to determine with facility the species which may come before him. A second volume, to include the reptiles, batrachia, and fishes, and a third, treating of the birds, are soon to be brought out by the same careful and enthusiastic observer.

E. RAY LANKESTER

OUR BOOK SHELF

Mining Geology.—*Die Lagerstätten der nutzbaren Mineralien.* Von Johann Grimm. (Prague: J. G. Calve).

THE author of this volume is an Oberbergrath, and also Director of the Imperial Mining Academy at Pribram. During the last seventeen years he has from time to time published notices of the mineral veins and other mining features of Transylvania, Hungary, and Bohemia; and he now presents to the public a general treatise or handbook of the useful minerals. His experience has not been wide enough to enable him to write a book that fully justifies the title he has chosen for it, and his acquaintance with the literature of his subject appears to be limited to the German language. But the book is the work of a practical man, is well arranged, and contains much useful information. Fresh illustrations even of well-known facts are always interesting, more especially when they carry with them some little features that are novel. In this respect, mining geologists in this country will find it worth their while to hear what Herr Grimm has to say of the minerals, veins, beds, faults, and other mining features of various parts of the Austrian Empire. A. G.

Practical Astronomy and Geodesy.—*Geographische Ortsbestimmungen mit Hülfstafeln.* 4to. pp. 88. By W. Valentiner. (Leipzig: 1869. London: Williams and Norgate.)

THE purpose of the author was to afford the astronomers engaged in the great European Triangulation tables for facilitating the reduction of the observations made for finding azimuths and the altitude of the pole. The work is, however, of more than a transient merit, for it will probably be of much assistance to our Indian officers engaged in the great trigonometrical survey of the Peninsula, and some of the tabular matter might henceforth in a modified form be well included in works on higher geodetic operations generally.

The author, by differentiating some of the fundamental equations which connect the latitude of a place with the altitude of a heavenly body above the horizon, its declination, azimuth, hour-angle, and parallactic angle, shows the influence which the errors in the observed quantities exert upon those that are dependent upon them, and comes to the conclusion that circumpolar stars are best adapted for azimuth determinations. He especially recommends to the observers engaged in the arc measurement the star *Ursæ minoris*, which is seen at all hours with telescopes of about $1\frac{3}{4}$ to 2 inches aperture, and the succeeding formulæ have been calculated with special reference to that star. Thus, taking the fundamental equations, in which z, a, δ, t, ϕ, are the well-known symbols for zenith distance, azimuth, declination, hour-angle, and latitude respectively, the author obtains by division, transformation, and expansion, and substituting p for $90^\circ - \delta$, the following elegant expression for the azimuth:—

$$a = p \sin t \sec \phi + M \sin 2t + N$$

The values of M and N being essentially dependent on t and ϕ alone; admit of tabulation with t and ϕ as arguments, and are given by the author for all latitudes between 36° north and 64°, this being the extent of the arc to be measured; t is given from ten to ten minutes.

The formulæ for the altitude of the pole are discussed very carefully on the same principles. The whole is the result of much labour, and M. Valentiner well deserves the sincere gratitude of the numerous computers whose work he has facilitated. B. L.

Manual of Physics.—*Lehrbuch der Physik, einschliesslich der Physik der Luft (Meteorologie), des Himmels (Himmelkunde), und der Erde (Physikalische Geographie).* Von Dr. Paul Reis. Erste Hälfte, pp. 256. (Leipzig: Quandt und Händel. 1870.)

THIS is the first half of a treatise on Elementary Physics from a highly scientific point of view. Dr. Reis considers that the principle of the conservation of force—as he puts it, "Die energie des Weltalls ist constant" (the energy of the universe is constant)—is at the root of all science, and that it is possible to deduce a large part of physics as a mathematical consequence of this principle. We confess to a little doubt whether it is advisable to introduce it in this form in the first instance in an elementary text-book. The attempt is one, however, that must be made no doubt at an early date, in some form or other.

The first instalment of the work contains an introduction of considerable length on the elementary ideas at the root of physics—such as space, time, matter, rest and motion, matter and force—the forces which appear in all phenomena, molecular, chemical, cohesion, adhesion, gravitation—and the fundamental axioms of physics, which he gives us in six statements not materially differing from Newton's three laws. After 80 pages out of 500 have been occupied in this way, we confess that we doubt whether sufficient room is left for the adequate treatment of the enormous range of subjects which is to follow. The mechanics of solids, fluids, and gases occupy the author for the next 100 pages, and the last 70 of this first part are given to wave-motions and acoustics.

The book is carefully worked, and full of examples for the student. The new form in which familiar things are presented makes it interesting to those who are acquainted with the subjects it treats of. It appears to be conscientiously brought up to the science of the present day, but we must reserve our opinion as to the question whether it accomplishes the task it proposes to itself, or whether, in its present form, it will be valuable as a text-book till the appearance of the second half, which completes the work. It claims to possess a plan of its own, and it must be estimated according to that claim.

W. J.

Meteorology.—*Die Theorie und Das allgemeine geographische System der Winde.* (Göttingen, 1869. London: Williams and Norgate.)

THE author is an opponent of Dove's school of meteorologists. The facts discussed by him are well known, and far more concisely stated in any recent work on meteorology. The theories founded by the author on those facts are too fanciful, and of his speculations—founded on no facts at all—the least said about them the better.

ON THE PERIODICITY OF THE SOLAR SPOTS

MOST of our readers are aware that the Kew observers, Messrs. De la Rue, Stewart, and Loewy, have for some time past been engaged in investigations, which, as far as they have already extended, go to show that there is an intimate and, as yet, unexplained connection between the configuration of the planets and the position and number of the spots on the sun. This result, which at once seems to land us in a sort of modern astrology, and which is so extraordinary, is, we suppose, on that ground, for we know of no other, questioned by many European astronomers. In this state of the case, no apology is needed, then, for reproducing, from the *Proceedings* of the American Philosophical Society, the results of a recent independent investigation of this subject by Dr. Kirkwood, together with some historical matter of some interest.

Dr. Kirkwood commences by reminding us that the most ancient observations of sun-spots of which we have any record, are those of the Chinese in the year 321 A.D.; the first notice of their detection by Europeans being found in the annals of the Frankish kings. A black spot, according to Adelmus, was seen on the sun's disc, March 17th, 807, and continued visible 8 days. Similar phenomena were again observed from the 28th of May to the 26th of August, A.D. 840. The year 1096 was also signalised by the appearance of spots so large as to be visible to the naked eye. The next date, in chronological order, is that of 1161, when a spot was seen by Averroës. Finally, on the 7th, 8th, and 16th of December, 1590, "a great blacke spot on the sunne," apparently "about the bignesse of a shilling," was observed at sea by those on board the ship "Richard of Arundell." The foregoing are, we believe, the only undoubted instances in which these phenomena were observed previous to the invention of the telescope.

From 1610 to 1750 the sun was frequently observed through instruments of various optical power, and the sparseness, or even the entire absence of spots, during considerable intervals of time, as well as their great number and magnitude at other epochs, were noticed by different astronomers. We come now to a most interesting and most remarkable epoch in the history of solar physics—an epoch in which the periodicity of the spots gradually come out.

The 11-Year Period of Schwabe.—In 1826, Hofrath Schwabe, of Dessau, commenced a series of sun-spot observations, which have been continued without interruption to the present time (1869).

Schwabe has shown a very marked periodicity in the spots; the interval between two consecutive maxima or minima being, according to him, about 10 years. Soon after the announcement of this interesting discovery, Dr. Lamont, of Munich, detected a corresponding decennial period in the variation of the magnetic needle; the epochs of maxima and minima in the latter coinciding with those in the former. These results have also been confirmed by other observers in places quite remote from each other; so that the decennial *magnetic* cycle may be regarded as well established. The equality of this period with that of the solar spots naturally suggested the hypothesis of their intimate relationship. Such a causal connection may be difficult of explanation; the fact, however, is placed beyond doubt by the researches of Wolf and Sabine.* The former, besides carefully observing the sun-spots since 1847, has discussed all accessible recorded observations, both solar and magnetic, bearing on the subject. He had thus ascertained a number of epochs of maxima and minima anterior to those observed by Schwabe,—from all of which he has determined the period of the spots to be 11·11 years. He undertakes to show, moreover, that this period coincides more exactly with that of the magnetic variation than the 10-year cycle of Lamont.

The 56-Year Period.—Besides Schwabe's period of 11 years, Wolf finds a larger cycle of 55 years, in which the solar activity passes through a series of changes. It is not, however, so distinctly marked as the cycle of Schwabe. Its last maximum was about 1837, and that preceding, about 1780.

The 233-Day Period.—Professor Wolf, after carefully discussing his own and Schwabe's observations, claims to have discovered two or three minor periods of solar activity. "By projecting all the results in a continuous curve, he finds in it a series of small undulations succeeding each other at an average interval of 7·65 months," or 233 days.

The 27-Day Period.—The same astronomer thinks he has detected a short period of variation corresponding to the sun's time of rotation with respect to the earth, or about 27 days.

The 584-Day Period.—De la Rue, Stewart, and Loewy, have found a period varying between 18 and 20 months; the mean being about 584 days. Other periods of maxima and minima will probably be detected; but those we have enumerated are perhaps the only ones sufficiently well established to justify any attempt at explanation.

That the solar spots are produced in some way by the planetary disturbance of the photosphere, is now generally admitted. As yet, however, the manner in which this influence is exerted can be little more than matter of conjecture. If the action is analogous to that of the moon on the earth, the relative disturbing power of the different members of the system will be as follows:*

Name.	Mass.	In Aph.	At M. Dist.	In Perih.
Mercury	$\frac{1}{4865751}$ (Encke)	63	111	219
	$\frac{1}{3000000}$ (Leverrier)	102	180	355
Venus	$\frac{1}{401211}$	203	207	211
Earth	$\frac{1}{314760}$	95	100	105
Mars	$\frac{1}{2994790}$	2	3	4
Jupiter	$\frac{1}{1047}$	194	214	236
Saturn	$\frac{1}{3508}$	8	10	12
Uranus	$\frac{1}{24605}$	0	0	0
Neptune	$\frac{1}{18780}$	0	0	0

The connection between the number of sun-spots and the positions of the planets was noticed by Wolf as long since as 1858. In the interesting memoir of De la Rue, Stewart, and Loewy, the causal connection between the positions of Venus and Jupiter and the behaviour of sun-spots seems to be clearly established. An inspection of the Table shows that writers generally have given undue weight to Saturn's influence. Again, although Mercury's action at aphelion is but feeble, and even, at his mean distance, less than that of Venus or Jupiter, his perturbing power at *perihelion* is the greatest of all planets—a fact which certainly demands consideration in any theory which refers the origin of solar spots to planetary agency. After giving the subject much study and attention, Dr. Kirkwood deems it impossible, *without the introduction of any modifying cause*, to establish a general correspondence between the different sun-spot periods and those of regularly recurring planetary configurations.

But the hypothesis that a particular portion of the sun's surface is more favourable to spot formation—or, in other words, more susceptible to planetary influence—than others, will, he believes, obviate all difficulty. Is

* These magnetic variations, which will not be discussed in the present paper, are mentioned to give completeness of view to the phenomena under consideration. It is also worthy of remark that the Aurora Borealis is believed to exhibit a corresponding periodicity. [We believe that Sir E. Sabine was the first to remark the connection between sun-spots and magnetic disturbances.—ED.]

* The table is derived from the formula $\delta = \frac{m}{a^3}$, where δ represents the disturbing power of a planet, m its mass, and a its distance.

there, then, any independent probability of the truth of this hypothesis? It is well known that the formation of spots occurs chiefly between particular parallels of *latitude*, and that the numbers are greater in the northern than in the southern hemisphere. It seems, therefore, at least not improbable that a like difference may exist in regard to *longitude*. "Sömmering directs attention to the fact, that there are certain meridian belts on the sun's disc, in which he had never observed a solar spot for many years together." * Buys-Ballot, of Utrecht, has found, from an elaborate discussion of a great number of meteorological observations, that there is a short period of variation in the amount of solar heat received by our planet; the period from maximum to maximum coinciding, at least approximately, with that of the sun's rotation with respect to the earth. Sir William Herschel also believed that one side of the sun, on account of some peculiarity in its physical constitution, was less adapted to radiate light and heat than the other.

On Dr. Kirkwood's hypothesis, the sun-spot period would be equal to the interval between two conjunctions of the disturbing planets on the heliographic meridian (designated by M) of that part of the surface most susceptible to their influence. It would depend, therefore, on the ratio of the sun's period of rotation to the interval between two consecutive conjunctions of such planets. Or, as Mercury's influence is extremely variable, a maximum would be produced by this planet's perihelion passage, when the most susceptible part of the sun's surface had the same, or nearly the same, heliocentric longitude. In order, then, to test this hypothesis, we must first inquire what is the most probable period of the sun's rotation?

On account of the *proper* motion of the solar spots, the time of the sun's rotation as determined by their *apparent* motion across the disc, varies from about 25 to 29 days. The *proper* motion of the spots has recently been discussed with great labour and ability by Professor Spörer, of Anclam, and Mr. Carrington, in England, who have shown conclusively that the rapidity of movement varies regularly with the latitude. The equatorial portions have the greatest angular velocity; in other words, the proper motion of the spots is in a direction contrary to that of the sun's rotation. The formulæ by which the astronomers named expressed the law for the dependence of the sun's apparent period of rotation on the latitude are as follows:—

According to Carrington, $\xi = 865' - 165' \sin \frac{7}{4} l$. . . (1)

" " Spörer, $\xi = 16{\cdot}8475° - 3{\cdot}3812° \sin (41° 13' + l,)$ . . . . (2)

where ξ is the arc described in a solar day. The true time of rotation is supposed to be that indicated by an equatorial spot; and on this assumption, (1) gives

$$P = 24{\cdot}9711 d. = 24 d.\ 23 h.\ 18 m.\ 23 s. \quad . . . . . . \quad (3)$$

or, (2) gives

$$P = 24{\cdot}62447 d. = 24 d.\ 14 h.\ 59 m.\ 0 s. \quad . . . . . . \quad (4)$$

The true value is probably between the results here given.

But will this modifying element in the theory of planetary action afford a satisfactory explanation of the periodic recurrence of maxima and minima of solar spots? Let us consider.

(*a.*) *The* 11-*Year Cycle.*—The anomalistic period of Mercury is 87·9702*d.*, and

$$87{\cdot}9702 d. \times 46 = 4046{\cdot}6292 d. = 11{\cdot}077 y. = T_1 \quad . . \quad (5)$$

This is very nearly equal to Wolf's value of the cycle, and agrees at least equally well with recorded facts.†

Again, $\frac{T_1}{163} = 24{\cdot}82594 d. = 24 d.\ 19 h.\ 49 m.\ 21 s.$ . . . (6)

which is nearly a mean between Spörer's and Carrington's values of the sun's period of rotation. With this, therefore, as the time of the sun's axial revolution, we have 46 times the period of Mercury—equal to 163 times that of the sun's rotation. The recurrence of maxima at mean intervals of 11·077 years would thus be accounted for.* Again, the epochs at which sun-spots were seen before the invention of the telescope may be presumed, with much probability, to have been nearly coincident with the maxima epochs of Schwabe's cycle. Now, it is a remarkable fact that all of those dates, except perhaps the last, harmonise with the value which we have adopted for Schwabe's period of variation. Thus:

From	321, A.D.	to	1860,	we have	139	periods of	11·072 +	yrs. each.
"	321	"	807	"	44	"	11·045	"
"	807·22	"	840·5	"	3	"	11·093	"
"	840·5	"	1096	"	23	"	11·109	"
"	1096	"	1161	"	6	"	10·833	"
"	1161	"	1590·9	"	39	"	11·024	"
"	1590·9	"	1750·0	"	14	"	11·367(?)	"
"	1750·0	"	1829·0	"	7	"	11·286	"
"	1829·0	"	1860·5	"	3	"	10·500	"

The variability of the period will be hereafter considered.

(*b.*) *Wolf's Cycle of* 56—57 *Years.*—The synodic revolution of Mercury is 115·87748*d.*, and

$$115{\cdot}87748 d. \times 177 = 20510{\cdot}31396 d. = 56{\cdot}15324 y. = T_2 \ (7)$$

In this period the line of conjunction of Mercury and the earth advances 56·15324 revolutions. Now,

$$\frac{T_2}{826{\cdot}15324} = 24{\cdot}82628 d. = 24 d.\ 19 h.\ 49 m.\ 50 s. \quad . . . \quad (8)$$

This value of the sun's period of rotation differs from that in (6) by only 29 seconds. Adopting it, therefore, we find that Mercury and the earth will be in conjunction on the same heliographic meridian at regularly recurring epochs of 56 years and 56 days.

(*c.*) *The* 233-*Day Period.*—The mean interval between the consecutive conjunctions of Venus and Jupiter is 236·992*d.* The close agreement of these periods leaves little room to doubt that the latter is the true period of spot variation.

(*d.*) *The* 27-*Day Period.*—This is at once satisfactorily accounted for.

(*e.*) *The* 584-*Day Period.*—The identity of this period with that of the synodic revolution of Venus has already been indicated by De la Rue, Stewart, and Loewy.

Remarking that Dr. Kirkwood advances other facts in support of his argument, we pass at once to his conclusions.

1. A connection between the behaviour of sun-spots and the configurations of certain planets has been placed beyond reasonable doubt.

2. The theory, however, of spot formation by planetary influence is encumbered with anomalies and even inconsistencies, unless we admit the co-operation of a modifying cause.

3. The hypothesis that a particular part of the solar surface is more susceptible than others to planetary disturbance is rendered probable by the observations of different astronomers.

4. The 11-year cycle of spot variation is mainly dependent on the influence of Mercury.

5. The marked irregularity of this period from 1822 to

* Humboldt's Cosmos, vol. iv., p. 378.

† The following astronomical cycles are also nearly equal to this period of variation:—

1. 18 periods of Venus = 11·074*y.*	4. $17 t_1 = 11{\cdot}030 y.$
2. 35 syn. per. of Mer. = 11·104	5. $28 t_2 = 11{\cdot}082$
3. 1 period of Jupiter = 11·860	6. $45 t_3 = 11{\cdot}063$

where t_1 = the syn. per. of Venus with respect to Jupiter; t_2 = syn. per. of Mercury with respect to Venus; and t_3 = that of Mercury with respect to Jupiter.

* It is not probable that Mercury is on the meridian M precisely at the epoch of perihelion passage. It is only necessary to suppose this coincidence to occur when the planet is *near* the perihelion point. Even at the distance of 20° the diminution of the disturbing power would be extremely small.

1867, is in a great measure due to the disturbing action of Venus.

6. Wolf's 56-year cycle is determined by the joint action of Mercury and the Earth. And,

Finally, *the hypothesis proposed accounts, as we have seen, for all the well-defined cycles of spot-variations.*

NOTE ON THE CORRELATION OF COLOUR AND MUSIC

WHILST engaged in the preparation of an article on the Analogy of Light and Sound for the current number of the *Quarterly Journal of Science*, I was led to examine the grounds of the frequently-assumed relationship between the colours of the solar spectrum and the notes of the musical scale. It is well known that Newton found a connection between the relative spaces occupied by each colour and the relative vibrations of the notes of the scale. But this, I presume, cannot be more than an accidental coincidence. The common basis of comparison is obviously the ratio of the wave-lengths in the two cases. Although according to the tables given in text-books no satisfactory connection can be found, yet many considerations appear to justify a stricter comparison of these natural scales of colour and sound.

The ratio of wave-lengths of the two extremes of the spectrum is usually taken as 1 : 0.57, or corresponding to the interval of a seventh in music.

But this statement is only true when a glass prism is employed; the ultra-violet rays are then suppressed. Substituting quartz for glass, light of higher refrangibility is seen: the limits of the spectrum can thus be extended from the solar line A to the solar line L.* Now, the wave-length of A (according to Ångström) is 760 millionths of a millimetre, and the wave-length of L (according to Mascart) is 381 millionths of a millimetre, or as the ratio of 1 : 0·50, exactly corresponding to the interval of an octave in music.

The ratios of the extreme colours of the spectrum and the extreme notes of an octave are coincident.

The next object is to compare the ratio of wave-lengths giving rise to the intermediate colours of the spectrum with the ratio of wave-lengths giving rise to the intermediate notes of the scale.

The most careful localisation of the colours of the spectrum with which I am acquainted is that by Prof. Listing.† In his recent memoir on the wave-lengths of the spectra of the metals, M. Thalén gives Prof. Listing's estimation of the extreme limits of each colour as follows:‡

TABLE I.

Name.	Limiting Wave lengths in ten-millionths of a millimetre.
Red	7234 to 6472
Orange	6472 to 5856
Yellow	5856 to 5347
Green	5347 to 4919
Blue	4919 to 4555
Indigo	4555 to 4241
Violet	4241 to 3967

Taking the *mean* of the two limits to represent the average wave-length of each colour, we have the following series:—

TABLE II.

Name.	Mean wave-lengths in ten-millionths of a millimeter.	Ratio.
Red	6853	100
Orange	6164	89
Yellow	5601	81
Green	5133	75
Blue	4737	69
Indigo	4395	64
Violet	4104	60

* Mr. Crookes informs me that on favourable occasions he has even seen beyond L.

† Poggendorff's "Annalen," 1868, vol. 131, p. 564.

‡ Trans. Roy. Soc. Upsal, third series, vol. vi.: also Annales de Chimie et de Physique, October 1869, and NATURE, No. 2.

Calling the wave-length of the mean red 100, the numbers in the third column express the corresponding ratios of the mean wave-lengths of the other colours.

In the next table is given the similar data as regards sound. The *first* column contains the names of the musical notes; the *second* their actual wave-lengths starting from the middle C; the *third* column gives the relative wave-lengths in fractions of C; and the *fourth*, the ratio without fraction, C being taken as 100.

TABLE III.

Name.	Wave-length in inches.	Ratio of wave-lengths.	
C	52	1 or	100
D	46⅓	8/9	89
E	42	4/5	80
F	39	3/4	75
G	35	2/3	67
A	31	3/5	60
B	27½	8/15	53
C_2	26	1/2	50

Placing together the ratio given in the last columns of Tables II. and III., the following remarkable correspondence comes out:—

TABLE IV.

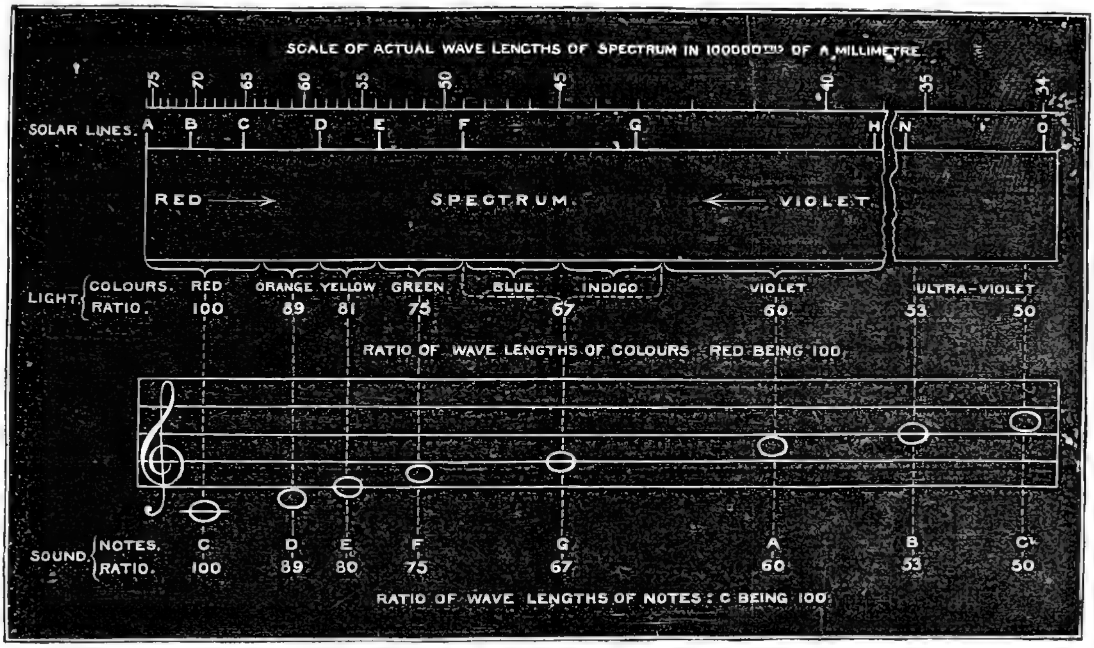
Colour.	Ratio.	Notes.	Ratio.
Red	100	C	100
Orange	89	D	89
Yellow	81	E	80
Green	75	F	75
Blue . 69 } Indigo 64 } mean,	67	G	67
Violet	60	A	60
[Ultra-Violet	53]	B	53
[Obscure	50]	C_2	50

Assuming the colour *red* to correspond to the note C, then we find *orange* exactly corresponds to D; *yellow* is almost exactly the same as E; and if we take the wave length of E from observation and not from theory, we have 52 : 42 = 100 : 80·8, a still closer approximation to yellow. The ratio of green is identical with that of F. *Blue*, however, does not correspond to G, nor *Indigo* to A; but blue and indigo are practically one colour in the spectrum,—the line of demarcation, difficult to fix between any other colours, is impossible to be established here. I think, therefore, I am justified in putting them together, and if we do so we find their mean ratio exactly corresponds to G. Violet now exactly corresponds to the ratio given by A. Here all distinct colour ends. But beyond this region Sir John Herschel detected a lavender colour, which finally shades away into a dusky grey. The wave-length of this ultra-violet region is not given by Prof. Listing; hence the ideal position is calculated and inserted in the table within brackets. As the lower C is placed at the *mean* red, the upper C would then correspond to a region in the spectrum altogether obscure: viz., at the solar line O. But as already stated above, if we place the lower C at the *extreme* red, then its higher octave would fall on the line L, or within the range of vision.* The great difference of position thus produced at the violet extremity by a slight movement at the other end of the spectrum, is caused by the crowding together of the colours at the red end. This is shown, together with the correspondence of the ratios of sound and colour, in the accompanying diagram.

The musical scale is thus literally a rainbow of sound. Harmony in colour and music may thus, probably, be found to have a common physical basis. There are many indications that this is the case. For example, the juxtaposition of two colours nearly alike is bad, and so also two adjacent notes of the scale sounded together produce discord. The succession of colours in the spectrum

* A suggestion, made, I believe, by Sir J. Herschel, that the colours of the spectrum would probably repeat themselves if we could see beyond the lavender, both supports, and gains support from, this analogy.

and of notes in the scale is the most harmonious that can be found; any disturbance of the order in either case makes the succession less pleasant. Discord or harmony may be the result of the combination of certain notes, and so also with colours. A pleasant effect is produced by the juxtaposition of red and blue, or of red and green: the former combination corresponds to the ratios given by C and G, or the harmonious interval of a fifth; the latter combination corresponds to C and F, or the slightly less pleasant interval of a fourth.



This apparent correlation of music and colour suggests many other speculations, but at present I would only venture to submit the foregoing considerations to the opinion of physicists.

W. F. BARRETT

THE SLAVONIANS IN TURKEY

A VERY careful and complete account of the result of the latest researches in the ethnology and geography of the Turkish Slavonians is given in the new number of Petermann's *Mittheilungen* by Professor Francis Bradashka, of Agram. The author is himself a member of that branch of the great Slavonic race to which the Turkish Slavonians belong, and evidently takes a strong political as well as scientific interest in their position; but his work is on the whole singularly free from political bias, and may be safely referred to by those who desire to increase their knowledge of the subject. The facts of Turkish ethnology are scattered in a variety of books and articles in periodicals, most of which are very difficult of access, and the only place where they could hitherto be found in a condensed form is an appendix to the fourth number of the *Mittheilungen* by M. Lejean, published in 1861. M. Lejean's paper, however, though full of valuable information and accompanied by an excellent ethnological map, gives little more than a bird's-eye view of the subject; and Professor Bradashka, besides correcting some important errors in it, has added much statistical and geographical detail which throws a new light on some of the most interesting questions of Turkish ethnology. One of these is the origin and development of the Albanian (Shkipetar) settlements in Turkey. Herr von Hahn, one of the best known authorities on this subject, holds that the Shkipetars were the original inhabitants of old Servia and the districts between Albania and the Vardar river; and that while these countries were under the Servian rule, the Shkipetars were compelled by their conquerors to take refuge in the hills, whence they afterwards descended when the Servians were beaten in their turn by the Turks. Professor Bradashka, on the other hand, shows, as we think, conclusively, that the countries in question were originally inhabited by Servians, and that the Shkipetars who now occupy them are the descendants of immigrants from Albania who settled there after the break-up of the Servian Empire. A very interesting and important fact brought out by the Professor in connection with this subject is, that the Shkipetars are gradually edging out the Slavonians from many districts which were formerly occupied almost exclusively by the latter race. This is especially observable in the towns. In Vuchitrn, Novo Brdo, and Dyakova, nearly all the inhabitants are now Shkipetars; and in Matochia, the ancient residence of the Servian kings, there are more Shkipetars than Servians. Old Servia was almost entirely Servian when Shafazyk wrote in 1849; it is now predominantly Shkipetar. There are also now Shkipetar settlements, not mentioned by M. Lejean, at the mouth of the Maburitza, and on the eastern and western shores of the lake of Scutari (Skodra).

The acceptance of the Mahometan religion by many of the Slavonians in Turkey has led to great confusion as to the Turkish population of the country. Some unscrupulous partisans of the Ottoman rule have not hesitated to state that there are six millions of Turks in European Turkey—an absurd exaggeration which can only impose on people who are totally ignorant of the facts. Professor Bradashka agrees with the best authorities in estimating the Turkish population at under a million, and points out a singular blunder made by M. Lejean, in his otherwise very accurate map, as to the Turkish inhabitants of Bulgaria. According to his map the whole of Eastern Bulgaria, or about a third of the whole province, is Turkish. This the Professor shows to be impossible, for there are only 375,000 Turks in the province, most of whom reside in the towns in all parts of Bulgaria, while the total population is between four and five millions. Evidently M. Lejean reckoned among his Turks the Mahometan Bulgarians, who reside for the most part in the eastern districts.

The whole of this valuable little pamphlet is contained in seventeen pages, and its usefulness is considerably increased by a good map. The map embraces all the country occupied by the Southern Slavonians, from Galicia to the Ægean Sea, and seems to be very accurate; but it is a pity that Dr. Petermann did not leave out the shading of the mountains. This, in a map on such a small scale, is totally useless for topographical purposes, and only occupies space which would be much more profitably employed by the insertion of more names of places, besides obscuring the names which already exist. The districts inhabited by Slavonians are painted green, thus showing at a glance their geographical position. It would have been better to distinguish by a different colour the Bulgarians—who, like the Russians, are Slavonians grafted on a Turanian stock, from the pure Slavonians, such as the Servians, Croats, and Ruthenians.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Government Aid to Science

I VENTURE to hope that you will allow me space in your columns to express opinions on this subject which are not popular with scientific men, and which are evidently opposed to your own views as indicated in your recent article on Science Reform.

The public mind seems now to be going mad on the subject of education; the Government is obliged to give way to the clamour, and men of science seem inclined to seize the opportunity to get, if possible, some share in the public money. Art education is already to a considerable extent supplied by the State,—technical education (which I presume means education in "the arts") is vigorously pressed upon the Government,—and Science also is now urging her claims to a modicum of State patronage and support.

Now, sir, I protest most earnestly against the application of public money to any of the above specified purposes, as radically vicious in principle, and as being in the present state of society a positive wrong. In order to clear the ground let me state that, for the purpose of the present argument, I admit the right and duty of the State to educate its citizens. I uphold national education, but I object absolutely to all sectional or class education; and all the above-named schemes are simply forms of class education. The broad principle I go upon is this,—that the State has no moral right to apply funds raised by the taxation of all its members to any purpose which is not directly available for the benefit of all. As it has no right to give class preferences in legislation, so it has no right to give class preferences in the expenditure of public money. If we follow this principle, national education is not forbidden, whether given in schools supported by the State, or in museums, or galleries, or gardens, fairly distributed over the whole kingdom, and so regulated as to be equally available for the instruction and amusement of all classes of the community. But here a line must be drawn. The schools, the museums, the galleries, the gardens, must all alike be *popular* (that is, adapted for and capable of being fully used and enjoyed by the people at large), and must be developed by means of public money to such an extent only as is needful for the highest attainable *popular* instruction and benefit. All beyond this should be left to private munificence, to societies, or to the classes benefited, to supply.

In art, all that is needed only for the special instruction of artists, or for the delight of amateurs, should be provided by artists and amateurs. To expend public money on third-rate prints or pictures, or on an intrinsically worthless book, both of immense value on account of their rarity, and as such of great interest to a small class of literary and art amateurs and to them only, I conceive to be absolutely wrong. So, in science, to provide museums such as will at once elevate, instruct, and entertain all who visit them is a worthy and a just expenditure of public money; but to spend many times as much as is necessary for this purpose in forming enormous collections of all the rarities that can be obtained, however obscure and generally uninteresting they may be, and however limited the class who can value or appreciate them, is, as plainly, an unjust expenditure. It will, perhaps, surprise some of your readers to find a naturalist advocating such doctrines as these; but though I love nature much I love justice more, and would not wish that any man should be compelled to contribute towards the support of an institution of no interest to the great mass of my countrymen, however interesting to myself.

For the same reason I maintain that all schools of art or of science, or for technical education, should be supported by the parties who are directly interested in them or benefited by them. If designs are not forthcoming for the English manufacturer, and he is thus unable to compete with foreigners, who should provide schools of design but the manufacturers and the pupils who are the parties directly interested? It seems to me as entirely beyond the proper sphere of the functions of the State to interfere in this matter as it would be to teach English bootmakers or English cooks at the public expense in order that they may be able to compete with French *artistes* in these departments. In both cases such interference amounts to protection and class legislation, and I have yet to learn that these can be justified by the urgent necessity of our producing shawls and calicoes, or hardware and crockery, as elegantly designed as those of our neighbours. And if our men of science want more complete laboratories, or finer telescopes, or more expensive apparatus of any kind, who but our scientific associations and the large and wealthy class now interested in science should supply the want? They have hitherto done so nobly, and I should myself feel that it was better that the march of scientific discovery should be a little less rapid (and of late years the pace has not been bad), than that Science should descend one step from her lofty independence and sue *in formâ pauperis* to the already overburthened taxpayer. So if our mechanics are not so well able as they might be to improve the various arts they are engaged in, surely the parties who ought to provide them with the special education required are the great employers of labour, who by their assistance are daily building up colossal fortunes; and that great and wealthy class which is, professionally or otherwise, interested in the constructive or decorative arts.

I maintain further, not only that the money spent by Government for the purposes here indicated is wrongly spent, but also that it is in a great measure money wasted. The best collectors are usually private amateurs, the best workers are usually home students or the employés of scientific associations, not of governments. Could any Government institution have produced results so much superior to those produced by our Royal Institution, with its Davy, Faraday, and Tyndall, as to justify the infringement of a great principle? Would the grand series of scientific and mechanical inventions of this century have been more thoroughly and more fruitfully worked out, if Government had taken science and invention under its special patronage in the year 1800, and had subjected them to a process of forcing from that day to this? No one can really believe that we should have got on any better under such a *régime*, while it is certain that much power would have been wasted in the attempt to develop inventions and discoveries before the age was ripe for them, and which would therefore have inevitably languished and been laid aside without producing any great results. Experience shows that public competition ensures a greater supply of the materials and a greater demand for the products of science and art, and is thus a greater stimulus to true and healthy progress than any Government patronage. Let it but become an established rule that all institutions solely for the advancement of science and art must be supported by private munificence, and we may be sure that such institutions would be quite as well supported as they are now, and I believe much better. If they were not, it would only prove more clearly how unjust it is to take money from the public purse to pay for that which science-and-art-amateurs would very much like to have, but are not willing themselves to pay for.

The very common line of argument which attempts to prove the wide-spread uses and high educating influences of art and of science, are utterly beside the question. Every product of the human intellect is more or less valuable; but it does not therefore follow that it is just to provide any particular product for those who want it, at the expense of those who either do not want, or are not in a condition to make use of it. Good architecture, for instance, is a very good thing, and one we are much in want of; but it will hardly be maintained that architects should be taught their profession at the public expense. The history of old china, of old clothes, or of postage stamps, are each of great interest to more or less extensive sections of the community, and much may be said in each case to prove the value of the study; but surely no honest representative of the nation could vote, say, the moderate sum of a million sterling for three museums to exhibit these objects, with a full staff of beadles, curators, and professors at an equally moderate expenditure of £10,000 annually, and a like sum for the purchase of specimens. But if we once admit the right of the Government to support institutions for the benefit of any class of students or amateurs however large and respectable, we adopt a principle which will enable us to offer but a feeble resistance to the claims of less and less extensive interests whenever they happen to become the fashion.

If it be asked (as it will be) what we are to do with existing institutions supported by Government, I am at once ready with an answer. Taking the typical examples of the National Gallery and the British Museum, I maintain that these institutions should be reorganised, so as to make them in the highest degree entertaining and instructive to the mass of the people;—that no public money should be spent on the purchase of specimens, but what they already contain should be so thoroughly cared for and utilised as to make these establishments the safest, the best, and the most worthy receptacles for the treasures accumulated by wealthy amateurs and students, who would then be ready to bestow them on the nation to a much greater extent than they do at present. From the duplicates which would thus accumulate in these institutions, the other great centres of population in the kingdom should be proportionately supplied, and from the Metropolitan centres trained officers should be sent to organise and superintend local institutions, such a proportion of their salaries being paid by Government as fairly to equalise the expenditure of public money over the whole kingdom, and thus not infringe that great principle of equality and justice which I maintain should be our guide in all such cases.

This communication will doubtless call forth much opposition, but I trust it will also elicit the support of some of those eminent scientific men, who I know hold similar general views, and who are so much better able than I am to explain and support them.

ALFRED R. WALLACE

Kant's View of Space

IN the very remarkable contribution by Professor Sylvester, (NATURE, No. 9) this sentence occurs: "It is very common, not to say universal, with English writers, even such authorised ones as Whewell, Lewes, or Herbert Spencer, to refer to Kant's doctrine as affirming space to be a 'form of thought' 'or of the understanding.' This is putting into Kant's mouth (as pointed out to me by Dr. C. M. Ingleby) words which he would have been the first to disclaim."

It is not on personal grounds that I wish to rectify the misconception into which Dr. Ingleby has betrayed Professor Sylvester. When objections are made to what I have written, it is my habit either silently to correct my error, or silently to disregard the criticism. In the present case I might be perfectly contented to disregard a criticism which any one who even glanced at my exposition of Kant would see to be altogether inexact; but as misapprehensions of Kant are painfully abundant, readers of Kant being few, and those who take his name in vain being many, it may be worth while to stop *this* error from getting into circulation through the channel of NATURE. Kant assuredly did teach, as Professor Sylvester says, and as I have repeatedly stated, that space is a form of intuition. But there is no discrepancy at all in also saying that he taught space to be a "form of thought," since every student of Kant knows that intuition without thought is mere sensuous *impression*. Kant considered the mind under three aspects, Sensibility, Understanding, and Reason. The *à priori* forms of Sensibility, which rendered Experience possible, were Space and Time: these were forms of thought, conditions of cognition. It was by such forms of thought that he reoccupied the position taken by Leibnitz in defending and amending the doctrine of innate ideas, namely, that knowledge has another source besides sensible experience,—the *intellectus ipse*.

While, therefore, any one who spoke of space as a "form of the understanding" would certainly use language which Kant would have disclaimed, Kant himself would have been surprised to hear that space was not held by him as a "form of thought."

January 3 GEORGE HENRY LEWES

Transcendent Space

As my name has been mentioned by Prof. Sylvester, at p. 238 of NATURE, in connection with this subject, I must ask you to allow me to make a brief remark thereupon. With the late Prof. Donkin I have not the least doubt as to this notion being "only a disguised form of algebraical formulisation." I observe that Prof. Sylvester, while *hypothetically* mentioning his own blindness, backs up his belief by the names of seven great mathematicians, who are *hypothetically* assumed to have "an inner assurance of the reality" of space of four dimensions. A roll-call of great names is no evidence of a strong position, and in the present case the citation is somewhat unfortunate. My old friend Dr. Salmon, who is one of the seven mathematicians cited, would, I am sure, disclaim any such "inner assurance." Without any breach of confidence I may quote his own reply to a question which I put to him long before the delivery of Prof. Sylvester's address. It was in these words: "I do not profess to be able to conceive *affairs* of four dimensions. . . . I advise you to believe whatever Sylvester tells you, for he has the power of seeing things invisible to ordinary mortals."

It would be more satisfactory to unbelievers like myself if the gifted author of the address were to assure the world that he had an insight into, or clear conception of, this transcendent space, According to my own view, *space cannot have more or less than three dimensions;* but if a form of extension having four dimensions were once revealed to us, tridimensional space (in which we now "live and move and have our being," and which is for us one of *two only universal forms of sense*), together with all that it contains, would become zero, and thenceforward we should only be able to conceive tridimensional space as a limit to the finite contents of quadridimensional space. Nay, more, the new space would be inevitably fatal to the law of gravitation, which is a transcendental deduction from the three only dimensions of space. Of course I see plainly enough that the Hamiltonian theory of "quinaries" (which is at present concretely interpretable only in time, *i.e.* as applied to sets of five points in time) might be developed into a rectorial system of *Quinions*, where the four symbols of operation would express the rotation of a straight line about four symmetrical axes; but the form of extension required for the interpretation of such a system is not only inconceivable, but is seemingly opposed to the very intellect itself.

Ilford, January 8 C. M. INGLEBY

The Cyclone

IN answer to the request of your correspondent, F.R.A.S., of Plymouth, in No. 8 of NATURE, I venture to send the following observations of the storm of Dec. 16, in West Suffolk. The barometer is reduced to sea level and 32° Fahr.

Dec. 16—2 p.m.: bar. 29·598, having fallen about ·15 since the morning: air temp. 44° max. of day hours; wind fresh, S., sky overcast.

5 p.m.: bar. 29·334, air temp. 42°; wind S.S.E. high, with heavy rain, which had begun about 4.

10 p.m.: bar. 28·821, a fall of ·5 in 5 hours; wind S.W. gale; rain stopped. The rainfall amounted to ·53 in. During this gale the temp. rose to 54°. The wind veered, at times blowing with great violence, attaining its maximum a little before 11 p.m. Direction nearly W. After 11 the force began to abate.

12 mid.: bar. 29·031, a rise of ·2; wind high from W.N.W.

Dec. 17.—Bar. 29·625, wind still very fresh from W.N.W.

The movement of the barometer from 2 to 10 p.m. of 16th, was 0·78 in., and on morning of 17th the pressure returned to the same point as on 2 p.m. of 16th. The maximum of the wind force occurred a little after the minimum of air pressure, when barometer was rising (compare Capt. Toynbee's "Isobaric Curves" pp. 6, 7). The veering of the wind shows that the track of the centre of the storm passed to the N. of this latitude (52° N.) M.A.

Haverhill, Suffolk, Dec. 28

I ONLY noticed this morning a request of one of your correspondents, who wishes some one in the north or east of England to give an account of the storm which occurred on the 17th instant, as he considers it a remarkable instance of a cyclone.

I enclose the hourly readings of the barograph and anemograph at Stonyhurst during the storm that occurred on the 17th and 19th, but I doubt whether they will be found very confirmatory of the supposed nature of the storm. The fall and rise of the barometer agree remarkably with the complete circuit through which the wind veered from W.S.W. through S. and N. back to W.S.W., but the storm, as is usually the case, began about four hours after the barometer had passed its minimum: the storm lasted 14 hours 30 minutes. The rainfall was moderate. I have given you the readings on the 16th on account of the interesting coincidence between the veering completely round of the wind, and the gradual fall and rise of the barometer. On the 19th a greater storm occurred, but with a less marked connection between barogram and anemogram.

Stonyhurst, Whalley, Dec. 29 S. J. PERRY

G.M.T.	Barom.	Wind. Direction.	Wind. Force.
Dec. 16...2 a.m.	29·244	WSW	7
3	·240	..	7
4	·235	..	12
5	·235	..	15
6	·229	..	12
7	·226	SW	16
8	·213	..	14
9	·194	..	15
10	·184	..	14
11	·161	..	15
Noon	·126	..	15
1 p.m.	·066	..	9
2	·005	S	17
3	28·946	..	17
4	·860	..	16
5	·784	..	15
6	·690	SE	4
7	·608	ENE	7
8	·570	NE	10
9	·581	NNE	10
10	·629	NW	13
11	·664	WNW	17
Mid.	·713	W	11
Dec. 17...1 a.m.	28·738	W	22
2	·804	..	30
3	·853	..	28
4	·894	..	25
5	·930	WNW	28
6	·980	..	26
7	29·014	W	26
8	·064	..	31
9	.090	..	32
10	·134	..	31
11	·170	..	31
Noon	·212	..	30
1 p.m.	·250	..	26
2	·288	..	19
3	·328	..	17
4	·360	WSW	10
5	·368	..	13
6	·382	W	10
7	·391	WSW	6
Dec. 18...8 a.m.	28·964	SSW	5
9	·952	SW	7
10	·938	WSW	10
11	·912	SW	14
Noon	·888	..	13
1 p.m.	·872	..	16
2	·867	..	16
3	·836	..	15
4	·822	..	16
Dec. 18...5 p.m.	28·803	SW	17
6	·770	..	22
7	·740	SSW	22
8	·721	..	24
9	·706	SW	26
10	·683	..	26
11	·684	..	27
Mid.	·722	WSW	24
Dec. 19...1 a.m.	28·759	W	20
2	·783	SW	13
3	·800	..	11
4	·808	..	12
5	·809	..	13
6	·810	..	12
7	·792	..	17
8	·786	SSW	17
9	·769	..	23
10	·743	..	23
11	·704	SW	18
Noon	·681	..	16
1 p.m.	·676	WSW	26
2	·694	..	24
3	·713	W	23
4	·740	WSW	20
5	·740	..	23
6	·748	SW	23
7	·758	..	23
8	·765	WSW	25
9	·794	SW	25
10	·833	W	27
11	·898	WNW	27
Mid.	·937	W	24
Dec. 20...1 a.m.	·960	..	23
2	29·001	WSW	15
3	·001	W	22
4	·021	WSW	21
5	·041	..	16
6	·040	..	16
7	·044	..	14
8	·063	..	16
9	·079	..	14
10	·088	WNW	14
11	·088	WSW	15
Noon	·090	..	14
1	·081	..	14
2	·081	..	15
3	·089	..	10
4	·081	..	13
5	·079	..	6
6	·068	..	2

The Suez Canal

SINCE I last addressed you I have had an opportunity of inspecting the Suez Canal under the most favourable circumstances. After a careful personal examination, and having heard the various opinions of others differing in every conceivable respect, I think that, considering all things, M. de Lesseps and his staff have much cause to feel proud of the success they have attained. To return to my previous letter, I may say, without fear of any objections which may hereafter be raised, that not only do I think the suggestions I then made are sound and practical, but that to carry them out would be most economical to the shareholders of the Canal, while to the Egyptian Government it would add probably 25 per cent. to the land revenue, by reclaiming a vast extent of desert that only requires water to make it most productive.

From inquiries also into the land settlement question of Egypt, I believe that this project of raising the canal-levels by fresh water could be carried out without any complaint being raised by the cultivators, who do the earth work, and would be repaid by title-deed to the land to be reclaimed; for, after all, the work would not be great, simply widening the present sweet-water canal some 30 metres. By a set of locks just before entering Lake Ballah from the south, and a similar set of locks before entering the bitter lakes from the north, the surface level of the water in Lake Timsah could be held up 2½ metres. Thus much of the expensive deepening and widening of the canal would be saved, which is all the more important as it is in this division of the canal that rock has been found.

It may be said that the Nile could not supply sufficient water, but with a weir or "anicut" across the Nile at Cairo, where stone is plentiful, not only could a supply of water be obtained, but I believe the whole system of irrigation in Egypt would be greatly improved.

So much for the interests of the shareholders and the people of Egypt, but what would the ship captains say at being detained by having to pass two sets of locks?

In reply to this objection I may say, that as the passage from the Timsah Lake takes seven or eight hours of daylight either way, half an hour's detention is of no consequence, for all sea-going ships must remain a night in Lake Timsah; so that as the ship would thus be some eighteen hours in *fresh* water, the marine animals and weeds would most probably all drop off the ship's bottom, and so the hour's loss of time by lockage would be more than compensated by the days saved on the voyage.

I have not time at present to speak of the deposits at Port Said, or the currents at the Suez end of the Canal, but will address you on these interesting questions on some future occasion after I arrive in India. In conclusion, I must add, that the Canal authorities have one and all been most civil and obliging, showing and explaining everything.

T. LOGIN, C.E.
Late of the Ganges Canal

P. & O. Co.'s Ship *Nubia*,
Suez, November 29, 1869

NOTES

PROFESSOR HELMHOLTZ, of Heidelberg, has been elected a corresponding member of the Physical Section of the Paris Academy of Sciences in the room of M. Marianini. Votes:—Helmholtz 37, Kirchhoff 3, Sir W. Thomson 2, Ångström 1, Mayer 1. At the same meeting the Secret Committee appointed to nominate candidates for the place of corresponding member vacant owing to the death of M. Matteucci, announced the following list:—In the first rank,—M. Mayer of Heilbronn. In the second rank,—M. Ångström of Upsala, M. Billet of Dijon, M. Dove of Berlin, Mr. Grove of London, Mr. Henry of Philadelphia, M. Jacobi of St. Petersburg, Mr. Joule of Manchester, M. Kirchhoff of Heidelberg, M. Riess of Berlin, Mr. Stokes of Cambridge, Sir W. Thomson of Glasgow, Mr. Tyndall of London, M. Volpicelli of Rome. The election takes place at the next meeting of the Academy.

HER MAJESTY has been pleased to signify her desire that the Historical and Archæological Association of Ireland be henceforth called the Royal Historical and Archæological Association of Ireland, and that the members of the Association be styled "Fellows."

AT the meeting of the Paris Academy held on the 29th ult., the death of M. Erdmann, the Swedish geologist, was announced. M. Erdmann was chairman of the commission for the Geological Survey of Sweden.

MR JAMES NICOL and Dr. G. Dickie, the Professors of Natural History and Botany in the University of Aberdeen, have addressed a joint letter to the *Aberdeen Free Press*, defending the science-teaching of the university from some remarks made by Professor Geddes in his pamphlet on Classical Education in the North of Scotland. They show that the students have given the greater part of their school life to the classics; that the time allowed for scientific work at the university is only one-sixth of that assigned to classical studies; that the 3,000*l.* a-year given as bursaries were until recently confined solely (and still are chiefly) for merit in classics; and that a considerable sum is devoted to Classical prizes, whilst the highest honours in Natural Science have been rewarded for the last two years with the magnificent sum of 10*l.* Notwithstanding these disadvantages, and in spite of the deliberate endeavour of the commissioners appointed "for the advancement of religion and learning in the universities" to suppress the teaching of Natural Science in the university, Professors Nicol and Dickie are able to point with justifiable pride to the list of honours in Natural Science, a list "including the names of the two Murray scholars, the chief prize now given for general proficiency in the university."

WE have received the report of the Council of the Birmingham Midland Institute, presented at the annual meeting on Monday last. It is altogether of a satisfactory character. Additional accommodation is required, and an appeal to the town is about to be made, which we hope will be heartily responded to. The following statistics of the use made of the Science Classes by students, will show the gradually increasing utility of this single side of the Institution:—1857, 578 students; 1862, 717 students; 1866, 1,371 students; 1869, 1,538 students.

WE learn from the *British Medical Journal* that the following courses of lectures will be given at the Royal College of Surgeons during the present year:—1. Six Lectures "On Dermatology," by Prof. Erasmus Wilson, F.R.S., commencing on the 31st inst. 2. Eighteen lectures by Prof. Flower, F.R.S., "On the Anatomy of the Mammalia," commencing February 14th. 3. Six lectures "On the Nature and Treatment of New Growths," by Prof. Birkett. 4. Three lectures "On the Minute Anatomy of the Eye," by Mr. Hulke, F.R.S. Professors Wilson and Flower will lecture on Mondays, Wednesdays, and Fridays, at 4 o'clock. The third and fourth courses will be given in the month of June.

THE following course for the Experimental and Natural Science Gold Medals in Trinity College has been agreed on for 1870. Physics: Jamin, Cours de Physique; Lloyd, Elementary Treatise on the Wave-Theory of Light. Chemistry: Regnault, Cours de Chimie; Naquet, Principles of Chemistry, Second Edition by Cortis; Fresenius, Chemical Analysis, Fourth Edition. Mineralogy and Geology: Dana, System of Mineralogy; Rose, Elements de Crystallographie, Edit. par Regnault; Dana, Manual of Geology, Parts I. II. and IV. Botany, Zoology and Palæontology: Henfrey, Elementary Course of Botany, Parts I. and III.; Lindley, Descriptive Botany, 1858; Bentham, British Flora; Haughton, Three Kingdoms of Nature, Part III.; Greene, Manual of Protozoa and of Cœlenterata; Huxley, Lessons in Elementary Physiology; Dana, Manual of Geology, Part III.

THE Erasmus Smith Professorship of Natural and Experimental Philosophy in Trinity College, Dublin, is now vacant. The second half of the examination for candidates will be held on the 21st. The examiners are the Provost (Dr. Lloyd) and Professors Apjohn, Galbraith, and Jellett. The emoluments of the office are, to a Fellow, if elected, about 600*l.* a year; to the Professor not being a Fellow, 200*l.* a year.

THE Horticultural Society of Cologne is about to extend its original scheme so as to include a school for the scientific teaching of horticulture. It is stated that a range of buildings, to include halls, lecture-rooms, chemical laboratory, dwelling-rooms, &c., is to be immediately erected; and that the society intends to enlarge or rebuild the present orangeries, conservatories, and forcing-houses.

THE *Pall Mall Gazette* of Monday last reports at great length a lecture "On the Forefathers and Forerunners of the English People," given by Professor Huxley, at a meeting held on the preceding evening, under the auspices of the National Sunday League. The lecturer, referring to the arguments now commonly brought forward, upon the assumption that the Irish and English nations belong essentially to different races, denied that there was sufficient proof of the existence of any difference whatever between Celt and Anglo-Saxon, except that of language. He thinks it probable, moreover, that Ireland as a whole contains less Teutonic blood than the eastern half of England, and more than the western half. Our readers may remember that the question of the amount of the Celtic element in the existing English nation was prominently brought before the public in a recent Chancery suit. The claims to originality put forward by the plaintiff in that suit are now disputed by Dr. Daniel Wilson, of Toronto, who communicates to the last number of the *Canadian Journal* a somewhat verbose article pointing out that the results obtained by the plaintiff from craniological investigations were anticipated in all essential particulars in earlier writings of Dr. Wilson's.

THE pressure on our space is so great that we have been unable to lay before our readers the communications on the Suez Canal, presented to the Royal Society by Mr. Bateman, and to the Geographical Society by Lord Houghton; they have, however, been given at some length in the daily press. One point of great scientific interest came out in the discussion at the Geographical Society. Mr. Fowler stated that the evaporation from the Bitter Lakes would require a supply of 250,000,000 cubic feet daily, *i.e.*, a flow in the Canal of $1\frac{1}{2}$ miles per hour. On all hands the Canal is acknowledged to be a complete success, and its probable influence on the trade of Mediterranean ports may be estimated from the fact mentioned by Lord Houghton, that the Emperor of Austria said that "he was there to represent Trieste."

WE are glad to learn from the *Architect* that it has been decided to establish a School of Science and Art at Dover.

THE Swiss are about to supplement, or supersede, their great "Dufour" Map, by another upon a much larger scale. The "Dufour" Map, on a scale of $\frac{1}{100000}$ (about $\frac{5}{8}$ of an inch to a mile), is in twenty-five sheets, and is printed in black only; but the new map is to be on a scale of $\frac{1}{25000}$ for the plains, and $\frac{1}{50000}$ for the mountainous districts. It is to be printed in three colours, and will contain no less than 540 sheets. Roads, towns, and trees are inserted in black, and rivers and glaciers in blue: the third printing, in red, is devoted to contour lines. The distance between each contour line expresses a height of 100 Swiss feet in the mountains, and 33·3 Swiss feet in the plains. It was intended at first to have a fourth printing, in green, for the forests, but this has been abandoned on account of the expense. Several sheets of this map, all admirably executed, have already been issued. At the same time they are reducing the "Dufour" Map to the scale of $\frac{1}{250000}$. This reduction will be in four sheets, and for tourists or for general use will be much more handy than the larger map. It is said that it will be even superior to the original map in the picturesque relief, for which the latter is so remarkable. Three years more will be required to finish the reduced map, of which two sheets are already published.

M. BOUIS has been appointed Professor of Toxicology at the Upper School of Pharmacy in Paris.

WE cull the following notes from the last number of the *Journal of the Society of Arts*:—

The Royal Agricultural Society has been giving its attention to the adulteration of manures and feeding cakes, and is conducting some analyses.

The oxy-hydrogen light is now largely used in Paris for illuminated advertisements and theatrical purposes. Carts with metal reservoirs containing the compressed oxygen for the supply of customers may be seen in the streets. At the Gaieté Theatre, which is one of the largest consumers, cylinders of magnesia or zirconia take the place of the lime cylinders ordinarily used for this light.

In connection with the systematic destruction of timber in Australia, it is mentioned that in the Ballarat district this destruction has been accompanied by a corresponding diminution in the rainfall, and that since 1863 there has been a more or less regular reduction from 37·27in. in 1863 to 14·23in. in 1868. The Government has recently appointed an Inspector of State Forests, whose duty it will be to prevent the waste of timber, and establish nurseries of forest trees in various parts of the colony.

THE BESSEMER PROCESS UNDER PRESSURE

MR. BESSEMER has lately patented a method of conducting his process of converting cast-iron into steel *under pressure*, in order to raise the temperature of the metal during the process of conversion, and to obviate the inconvenience experienced when certain of the purer qualities of Swedish pig-iron made with charcoal, and also some of the less grey and the white hematite pig-irons of this country, when treated by the ordinary process, do not produce sufficient heat in the converting vessel to allow all the steel made from them to retain complete fluidity until it is poured into moulds.

The following description of the apparatus is extracted from *Engineering*, to the editor of which journal we are indebted for the use of the woodcuts.

In the annexed engravings, Fig. 1 is a vertical section of a Bessemer converter constructed on this plan, *a* being the upper part of the converting vessel; *a* ×, the lining of ganister; and *q*, the strong riveted iron shell or vessel on the inside of the mouth of which the iron hoop, *c*, is riveted; while *d* is a flanged iron ring bevelled on the inside, and secured by screwed studs or cotter bolts to the hoop, *c*. A moulded ring, *e*, of fire-brick or other suitable refractory material, forms the escape opening or mouth of the vessel; it is retained in place by means of the flanged ring, *d*.

The aperture in the movable mouth of the vessel thus formed may in some cases be made small enough to retain the gaseous products resulting from the combustion of the carbon or other matter contained in the pig-iron under a pressure much above that of the surrounding atmosphere, so that the combustion going on in the converting vessel may be under "high pressure," and by reason of the combustion so taking place under a pressure much greater than that of the external atmosphere a more intense heat would be produced and imparted to the metal. As a guide to the workmen, Mr. Bessemer states that for the conversion of the purer kinds of Swedish charcoal pig-iron and for mottled or white hematite pig-iron mixed with grey a back pressure in the vessel from 8 to 15 lb. on the square inch will give good results, and in but few cases will a pressure of 20lb. per square inch be necessary. It will be understood that the pressure of the blast of air forced into the converting vessel must be increased in proportion to the back pressure caused by the penning up of the gases within the vessel.

Another arrangement is illustrated in Fig. 2, which represents a vertical section of the upper portion of a converting vessel or chamber in which molten pig or other carburet of iron is to be treated either by the injection of the fluid nitrate into the molten metal, as patented by Mr. Bessemer in March last, or in which vessel the nitrates or other oxygen-yielding salts or substances are so brought in contact with the hot metal as to be decomposed. The outer shell, *h*, of the vessel or chamber is made of thick plates of iron or steel securely riveted and caulked at all joints, and capable of withstanding safely a pressure of from five to ten or more atmospheres. For the convenience of lining the vessel, the upper part may be removed by unbolting the stout flanges, h^1, and one or more hoops, h^2, are riveted to the exterior of the vessel to strengthen it. A lining of fire-brick, ganister, or other refractory material, *i*, is used to defend the outer shell from the high temperature generated within; and previous to its use for conversion, Mr. Bessemer prefers to make a fire in the interior, so as to highly heat the lining and lessen its power of absorbing heat from the metal.

FIG. 1.

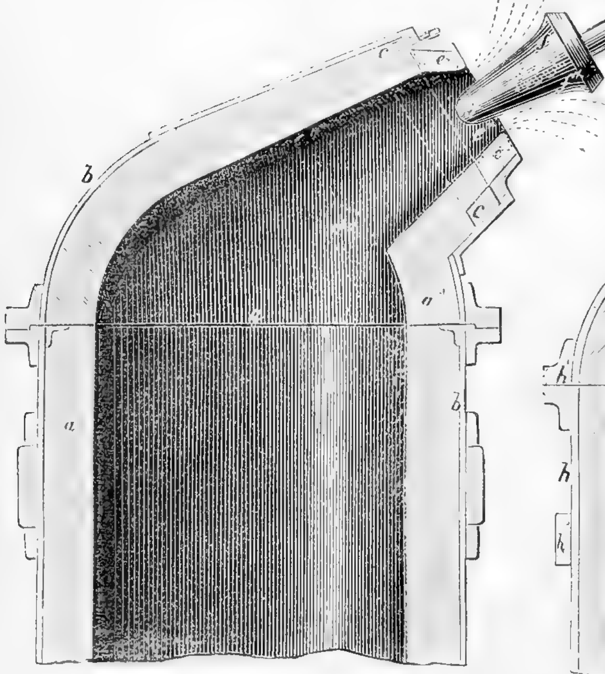
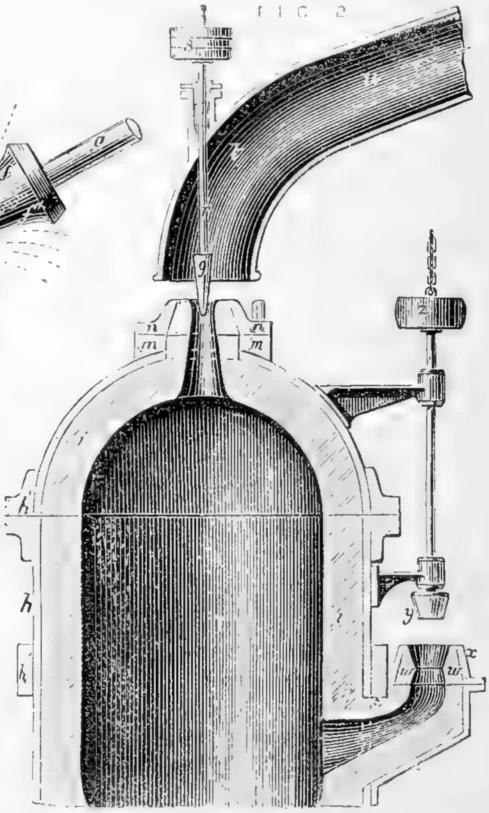


FIG. 2



On the upper part of the dome an iron ring, *m*, is riveted, to which a flanged ring, *n*, is fitted. The inside of this ring is conical, and is made to embrace the conical fire-clay ring, *p*, through which the gaseous matters evolved during the process are allowed to escape. A cone of fire-clay or of iron, *g*, is attached to the guide rod *r*, for the purpose of closing or diminishing the area of the outlet opening in the fire-clay ring *p*, and on the upper end of the rod *r* are placed weights, *s*, to regulate the pressure. The rod *r* is guided vertically upward and downward by passing through the tubular guides and stuffing-box formed at *t t*, on the curved exit passage *u*, which leads to a chimney and conveys away the gaseous products escaping from the converting chamber. On one side of the vessel or chamber is a projection, *v*, on the upper part of which a ring of fire-brick, *w*, is retained in place by a conical flanged iron ring, *x*. The opening in the ring *w* serves for the admission of the molten metal to the vessel, after which the cone *y* smeared with fire-clay is lowered down into the opening of the moulded fire-brick *w*, and by means of the weight *z* is retained in place and prevents the escape of gaseous matters during the converting process.

The cone, *y*, and its rod and weight, *z*, are suspended by a chain in the position shown during the period of running in the metal. When the metal so run in comes in contact with the nitrate or other oxygen-yielding materials, large volumes of gaseous matters are evolved, these matters instead of escaping freely from the converter rapidly accumulating in the vessel until the pressure within it is sufficient to raise the cone *g*, and escape by the small annular opening thus made, the pressure being regulated by the weight *s*. Hence the combustion of the carbon contained in the molten iron by reason of its union with oxygen derived from the decomposition of the nitrates or other oxygen-yielding materials will be effected under considerable pressure; and the gaseous products, instead of expanding freely as under the ordinary conditions of combustion, will be in a highly condensed state, by which means their temperature will be considerably raised, and the intense heat so generated will be imparted to the metal and cause it to retain its fluidity.

It will be extremely interesting to watch the working of this new process.

BOTANY

[We have been favoured by the Count Marshal of Austria with the following abstracts of Botanical papers read at the Innspruck Congress.]

Prof. Hildebrand on the Impregnation of Plants

PLANTS intermediate between *Papaveraceæ* and *Fumariæ* gave the greatest quantity of seeds when impregnated with the pollen of another individual of the same species, less when the pollen was taken from another flower of the same individual, and least when the impregnation took place within the flower itself. For *Eschscholtzia Californica*, the proportion of seeds in these three cases was as 24 to 9 to 6. Professor Fenzl says that he obtained abundance of seeds from two species of *Abutilon* by fecundation with pollen from other individuals, and that these operations are best performed between 8 and 9 A.M.

Prof. Fenzl on the Genus Lupinus

SEEDS are with difficulty obtained from plants of this genus in the gardens of Vienna, probably on account of the unfavourable condition of the soil. The species of this genus are still very far from being duly determined, and two-thirds of them, at least, may be eliminated. Professor Koch observes, that the greatest amount of seeds is to be obtained in sandy soil, and that the great number of hybrids are merely varieties in form; the different colours of blossoms being a result of external agents, in the same way as *Nymphæa* gives us lengthened leaves when impregnated with the pollen of *Magnolia*.

Bail on Androgynous Inflorescence

SUCH inflorescences have been found on *Zea*, *Populus*, *Fagus*, *Carpinus*, *Betula humilis* and *Betula alba*, as also on *Pinus nigra*, the small scale, considered as a part of the female blossom, developing itself into an anther.

Prof. Koch on Transformations of Parts of Flowers

IN a fruit of *Solanum melongena*, the five anthers have been transformed into five smaller capsules. A capsule of poppy offers, in the centre of its cavity, a small elevation (the continuation of the axis), bearing a number of smaller capsules.

Prof. Bail on Parasitic Fungi on Insects

Empusa, attacking especially the larvæ of the Fir-Moth, invades also those of *Bombyx Caja*, which were found, sitting on branches of oaks, birches, and firs, killed by this parasite. Larvæ of *Cossus ligniperda*, of all sizes, all thickly covered with the white mucor issuing from their bodies, were found beneath the bark of a completely dried-up birch. These larvæ being kept in moist pots, *Penicillium glaucum* broke out first from their bodies, and was soon superseded by *Isariæ*, the larvæ being covered with moist moss. Those of *Melolontha majalis* are, as well as the perfect insect, destroyed by fungi. The destructive action of the fungi has, however, been exaggerated by the periodical press. Of more than 4,000 larvæ from about ten forest-districts of Prussia and Pomerania, scarcely 29 to 30 per cent. have been destroyed by fungi. The chief morbific fungi were *Isaria farinosa*, identical in all details of structure with *Penicillium*, and *Cordiceps militaris*. The *Melanospora parasitica* Tulasne, found (1858) on all specimens of *Isaria* in the environs of Meran, and on those which had come to their full development, is considered by Dr. Bail to be the higher form of fructification of *Botrytis Bassiana*. *Cordiceps militaris*, with thick, carneous, orange-yellow fructiferous clubs, differs altogether from *Isaria*.

Prof. Koch on the Formation of the Germen

THIS is not, as generally supposed, a concretion of so-called "Fruit-leaves." The germen is part of an axis, supporting the parts of a flower; it may be longer or shorter, as these parts are more or less distant from each other. The apex of the receptacle, or of the axis in general, may become suddenly stationary, and be wrapped up in plastic cellular tissue, a cavity open above, including the ovules (inferior germen), being thus formed; or this cavity includes the germina, either non-connate with the inner wall (*Rosa*, *Calycanthus*, *etc.*), or connate with it (*Cotoneaster*, many *Leptosperms*), or mutually connate, as in the Pomaceous fruits. Such a fruit-receptacle not infrequently includes whole blossoms (*Ficus*). The development of the genuine apex proceeds in two ways. Either the formation of cellules proceeds from the apex itself (as generally in inferior germens), and then its basis is the newest and the apex the oldest portion; or the new formations proceed from the margin of the wall, enlarging upwards, the increase ending in the uppermost portion, as in the fig. Professor Schuler observes, that this takes place only in figs ripened in the second half of the year, whenever the refrigerating action of the north wind has retarded their growth. Professor Koch replies, that the same increase of the margin is observable in the fruit of the *Leguminosæ*. Probably the germina of *Papayaceæ*, *Passifloreæ*, *Capparideæ*, and genuine *Liliaceæ*, likewise take their origin from the axis. The abnormal growth often observed on roses, a sudden prolongation of the axis through the cavity of the fruit-bearing blossoms (sometimes 3 above each other) and leaves, proves the new formations to proceed from the included centre of the extreme apex.

Prof. Martins on the Flora of Southern France

MANY genera of the miocene and pliocene deposits of this and other countries are represented in the living flora of South France. Such are *Laurus nobilis*, L. (= *Laura canariensis*), *Ficus carica*, *Punica granatum*, *Pinus Aleppensis* (found fossil in Unalaska), *Cercis siliquastrum* (near Aix), and *Nerium oleander*, in some localities near Toulon and Nice. All these species have lived through the glacial period; they exist now, however, only on the banks of rivers and rivulets, in localities protected against cold. It must be observed that severe cold is not the necessary consequence of extensive glaciers. A decidedly Indian form, not yet found fossil, is *Anagyris fœtida* (*Piptanthus Nepalensis*, Don.), which brings forth its leaves in October, and its blossoms in January and February. Other extraneous forms are: *Myrtus communis* (represented in Peru by *Myrtus myricoides*), *Chamærops humilis* (near Villefranche and Toulon, represented in the Caroline Islands by *Cham. serrulata*, Pursh, and *Cham. hystrix*), and *Ceratonia siliqua*, whose native country is still doubtful. *Cham. humilis* is now extirpated by the avidity of collecting botanists. Professor Koch says that *Anagyris fœtida* belongs rather to the Cytiseæ, or Genisteæ, than to any exotic family, and doubts *Ceratonia silliqua* being a leguminose. Professor Martins replies that he thinks *Anag. fœtida* to be closely related to *Thermopsis*, and observes that about 200 Lapland species occur in South France; that the littoral plants are partly the same as those on the coasts of the Atlantic, except *Spartina versicolor*, an exclusively American form, and hints at the importance of the study of fossil plants for the thorough knowledge of those existing in the present period.

Prof. Hildebrand on Marsilia

SPECIMENS of this plant, growing beneath the surface of water, regularly produce leaves which spread over its surface, and follow its level, while, if kept dry, they never produce such leaves. The leaves grown in air have stomata on both their surfaces; those grown in water have stomata only on their upper surface. Dr. Reichardt observes, that wild specimens of *Marsilia* have constantly been found provided only with large floating leaves. Professor Hoffmann says, that abundant fruits are obtained from *Marsilia* by cultivating it in slimy soil. Professor Hildebrand remarks, that specimens grown in water, and not bearing fruit, propagate themselves with astonishing rapidity without any fecundation.

SCIENTIFIC SERIALS

THE January number (N.S., No. 37) of the *Quarterly Journal of Microscopical Science* opens with an article entitled "Notes on Sponges," by Prof. E. Perceval Wright. In this the author indicates some peculiarities of the structure of the sponge-body of *Hyalonema mirabilis*, and describes two new species of deep-sea sponges, namely *Aphrocallistes Bocagei*, which is exquisitely figured by Mr. Ford, and the type of a new genus which the author names *Wyvillethomsonia Wallichii*. We cannot help protesting against this new generic name, as being barbarous in the highest degree. Mr. William Archer, of Dublin, continues his valuable descriptions of new or imperfectly-known fresh-water Rhizöpoda, and Mr. W. S. Kent describes and figures a curious new form of Polyzoön, from the Victoria Docks, where the animal lives attached to the surface of specimens of the *Cordylophora lacustris*. For this Polyzoön, which the author regards as the type of a new family (*Homodiœtidæ*) of the Ctenostomata, he proposes the name of *Victorella pavida*. A singular crustacean parasite found on *Nereis cultrifera* is described and figured by Dr. W. C. McIntosh. Besides these, we have a paper on the distribution of nerves to the vessels of the connective tissue in the hilus of the pig's kidney, and on the ganglia connected with these nerves, by Dr. James Tyson, of Philadelphia; an abstract of a dissertation on the minute structure of the human umbilical cord, by Dr. Köster; a translation of Dr. E. Van Beneden's description of his *Gregarina gigantea* (with a plate); and an abstract of an important memoir, by Dr. Kowalewsky, on the relationship of Ascidians and Vertebrates. The only original article on the microscope itself is one by Dr. G. W. Royston-Pigott, on certain imperfections and tests of object-glasses. This number also contains a review of Mr. Hincks's "History of British Hydroid Zoophytes."

IN the *Geological Magazine* for the present month (No. 67), the most important paper is the first part of a memoir on the sequence of the Glacial Beds, by Mr. Searles V. Wood, jun., in which the author indicates his views as to the best classification to be adopted in the treatment of these difficult deposits, and discusses the characters of the beds and evidence attainable as to the sequence of the phenomena attending their deposition. Mr. David Forbes publishes some remarks on the contraction of igneous rocks in cooling, in which he again maintains, chiefly from his own experiments, that the amount of this contraction is much less than is generally believed, on the authority of Bischof. His paper is really a vindication of himself from some remarks in a memoir by the Rev. O. Fisher. Mr. John Rofe describes some peculiar perforations observed in the lower surfaces of slabs of mountain limestone, at considerable elevations, in various localities, which have already been noticed by several writers, and ascribed by some to lithodomous marine mollusca. Mr. Rofe regards them as produced by snails, either by the rasping action of their odontophores alone, or by this aided by an acid salivary fluid. Mr. Ruskin continues his notices of banded and brecciated concretions. Mr. J. Clifton Ward remarks upon the denudation of the lake-district, which he ascribes chiefly to subaërial action. In a paper on the formation of the Chesil Bank, Mr. T. Codrington maintains, in opposition to Messrs. Bristow and Whitaker, that the streams coming from the land have had nothing to do with the production of this bank, or the excavation of the channel by which it is separated from the mainland. He ascribes the formation of this and similar banks solely "to the heaping-up action of waves breaking when they reach a depth of water about equal to their own height."

THE *Revue des Cours Scientifiques* for the 8th inst. contains a lecture, by Prof. Lorain, on the application of the graphic method to the clinical study of disease. Translations are likewise given of Prof. Helmholtz's address to the meeting of German Naturalists and Physicians at Innspruck, and of Mr. Geikie's account of the same meeting, published in the first number of NATURE.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, December 16, 1869.—The following were among the papers read:—"On the Thermodynamic Theory of Waves of Finite Longitudinal Disturbance," by Prof. Rankine, F.R.S.; "On Approach caused by Vibration," by Prof. Guthrie. The author observes that when a vibrating tuning-fork is held near to a piece of cardboard, the latter has a tendency to approach the fork. Starting from this experiment, a series of experiments is described, having for their object the determination of the cause and conditions of the fundamental observed fact. It is shown that no sensible permanent air-currents, having their source at the fork's surface, are established; and hence that the approach of the card to the fork is not due to the expansion of such currents, as in M. Clement's experiment. The modifications are examined which Mr. Faraday's surface-whirlwinds on a vibrating tuning-fork undergo when the fork vibrates in the neighbourhood of a sensibly rigid plane. It is shown that a delicately-suspended card approaches the fork when either of the three essential faces of the fork is presented to the card, and that the approach takes place from distances far exceeding the range of Mr. Faraday's air-current. That the action between the card and fork is mutual, is shown by suspending the latter. Also one vibrating fork tends to approach another in whatever sense their planes of vibration may be towards one another. The mean tension of the air surrounding a vibrating fork is examined by enclosing one limb of the fork in a glass tube. It appears that the vibrating fork displaces air. The question whether the equilibrium between two equal and opposite forces acting on a body is disturbed by submitting one of the forces to successive rapid, equal, and opposite alterations in quantity, is answered in the negative by an experiment which shows that the equilibrium of a Cartesian diver is not disturbed by submitting the water in which it floats to vibration. Various modifications are introduced into the nature of the surface which receives the vibrations, such as making it a narrow cylinder with one end closed, making it of cotton-wool, &c. It is found that in all cases the suspended body approaches the vibrating one. The author concludes that the effect of apparent attraction is due to atmospheric pressure, and that this pressure is due to undulatory dispersion. It is suggested that the dispersion of the vibrations which constitute radiant heat may cause bodies to approach, being pushed, not dulled.—"On Abstract Geometry," by Prof. Cayley. "I submit to the society the present exposition of some of the elementary principles of an abstract m-dimensional geometry. The science presents itself in two ways: as a legitimate extension of the ordinary two-and three-dimensional geometries; and as a need in these geometries and in analysis generally. In fact, whenever we are concerned with quantities connected together in any manner, and which are, or are considered as, variable or determinable, then the nature of the relation between the quantities is frequently rendered more intelligible by regarding them (if only two or three in number) as the co-ordinates of a point in a plane or in space; for more than three quantities there is, from the greater complexity of the case, the greater need of such a representation; but this can only be obtained by means of the notion of a space of the proper dimensionality; and to use such representation, we require the geometry of such space. An important instance in plane geometry has actually presented itself in the question of the determination of the curves which satisfy given conditions; the conditions imply relations between the co-efficients in the equation of the curve; and for the better understanding of these relations it was expedient to consider the coefficients as the co-ordinates of a point in a space of the proper dimensionality. A fundamental notion in the general theory presents itself, slightly in plane geometry, but already very prominently in solid geometry; viz., we have here the difficulty as to the form of the equations of a curve in space, or (to speak more accurately) as to the expression by means of equations of the twofold relation between the co-ordinates of a point of such curve. The notion in question is that of a k-fold relation,—as distinguished from any system of equations (or onefold relations) serving for the expression of it,—and giving rise to the problem how to express such relation by means of a system of equations (or onefold relations). Applying to the case of solid geometry my conclusion in the general theory, it may be mentioned that I regard the twofold relation of a curve in space as being completely and precisely expressed by means of a system of equations ($P=0$, $Q=0$, . . $T=0$), when no one of the functions, P Q, . . . T as a linear function, with constant or variable *integral* coefficients, of the others of them; and when *every surface whatever* which passes through the curve has its equation expressible in the form $U=AP+BQ$ . . . $+KT$, with constant or variable integral coefficients, $A+B$ . . . K. It is hardly necessary to remark that all the functions and coefficients are taken to be rational functions of the co-ordinates, and that the word integral has reference to the co-ordinates."

January 6.—"Some account of the Suez Canal in a letter addressed to the president," by J. F. Bateman, F.R.S.

Entomological Society of London, January 3.—Mr. H. W. Bates, president, in the chair. The fifth part of the "Transactions for 1869" was on the table. A splendid collection of butterflies was sent for exhibition by Mr. Hewitson; it included 135 new species, and many other rarities, the whole having been captured by Mr. Buckley in South America. Observations thereon were made by Mr. Buckley, the President, Mr. Higgins, and Mr. Wallace.—Professor Westwood, Mr. Bond, Mr. Pascoe, Mr. Albert Müller, and Mr. Quaritch, also exhibited various objects, and made remarks thereon.—Papers were read on *Ephemeridæ*, by the Rev. A. E. Eaton; on *Callidryas*, by Mr. A. G. Butler; on *Catasarcus*, by Mr. F. P. Pascoe; and on the genera of *Coleoptera*, studied chronologically (Part I., from 1735 to 1801), by Mr. G. R. Crotch.

Royal Horticultural Society, December 21, 1869.—*Scientific Committee*.—Mr. W. W. Saunders in the chair. The secretary, Rev. M. J. Berkeley, exhibited a leaf of Aerides "Foxbrush" with a peculiar form of spot, differing from any he had previously seen.—Mr. Laxton sent specimens of peas of the most varied character, the result of a single cross.—A very interesting paper "On the Fertilisation of Grasses," from Dr. R. Spruce, from which the following are extracts, was communicated through Dr. Masters. The paper had reference to the statement of M. Bidard that grasses are usually self-fertilised while in the bud: it will be published *in extenso* in the Journal of the Society:—

"In gently-flowing rivers of tropical America grow many fine aquatic grasses, species of *Luziola*, *Oryza*, *Leersia*, &c. The following note is from my journal, under date December 1849, when threading in my canoe among the islands of the Trombetas:—'This channel was lined on both sides by a beautiful grass—a species of *Luziola*—growing in deep water, and standing out of it two or three feet. The large male flowers, of the most delicate pink, streaked with deep purple, and with six long yellow stamens hanging out of them, were disposed in a lax terminal panicle; while the slender green female flowers grew on the bristle-like branches of much smaller panicles springing from the inflated sheaths of the leaves that clothed the stem. As the Indians disturbed the grassy fringe with the movement of their paddles, the pollen fell from the anthers in showers,' and would, doubtless, some of it, attain the female flowers disposed for its reception. A parallel case to the above is that of the common maize (*Zea Mays*, L.), where the male flowers are borne in a long terminal raceme or panicle, and the female flowers are densely packed on spikes springing from the leaf-axels.. Here the male flowers must plainly expand before the pollen contained in their anthers can be shed on the female organs below, whether of the same or of a different plant. That there are frequent cross-marriages in maize is evidenced by the numerous varieties in cultivation in countries where it is a staple article of food, as in the Andes of Ecuador, where nine kinds, varying in the colour of the grain (through white, yellow, and brown, to black), in its size, consistence, and flavour, are commonly cultivated; besides many others less generally known. In *Phærus scaber* (H. B. K.) another tall broad-leaved grass, the spikelets stand by twos on the spike—a sessile female spikelet, and a stalked male spikelet. In the same forest grasses of the genus *Olyra*, whereof some species, such as *O. micrantha* (H. B. K.), rise to 10 feet high, and have lanceolate leaves above 3 inches broad, and a large terminal panicle, with capillary branches, like those of our *Aria cæspatosa*: it is the lower flowers that are male, with large innate (not versatile) anthers, and the upper that are female, with two large stigmas, that are either dichotomously divided, or clad with branched hairs, thus exposing a wider surface to the access of the pollen. And as the panicle is often pendulous, many of the male flowers, although placed lower down the axis, are actually suspended over the terminal female flowers. It is generally to be remarked of diclinous grasses, that either the male flowers are very numerous, as in *Zea Mays*, or the stamens are multiplied in each male flower, as in *Pariana*, *Leersia*, *Guadua*, &c.; or the stigmatic apparatus of the female flowers is enlarged, so as almost to insure impregnation, as in *Olyra* and *Tripsacum*. In the *Bambuseæ* I have gathered belonging to the genera *Guadua*, *Merostachys*, and *Chusquea*, the flowers are more or less polygamous, and the stamens of the male flowers often doubled. But there is scarcely a genus in the whole order which is not described as having some flowers by abortion, neuter or male, and especially those that have biflorous spikelets, such as the *Paniceæ*. Some grasses, of normally hermaphrodite genera, are not unfrequently truly unisexual, such as certain species of *Andropogon*. I have occasionally seen panicles of *Orthocladus rariflorus* (Nees), a grass peculiar to the Amazon, quite destitute of stamens, and therefore purely female. To come home to our own country: is all the pollen wasted that a touch or a breath sets free from the flowers of grasses in such abundance? Watch a field of wheat in bloom, the heads swayed by the wind, lovingly kissing each other, and doubtless stealing and giving pollen. Consider, too, that throughout Nature, heat or moisture, or both, are essential to the emanation of the impregnating influence. In all our *Festuceæ*, as well as in *Cynodon*, *Leersia*, and some other genera, the stigmas are protruded from the side or from the base of the flower at an early stage, often before the stamens of the same flower are mature—thus as it were inviting cross-fertilisation from the more precocious stamens of other plants which are already shedding their pollen. All who have gathered grasses will have remarked that some have yellow anthers, others pink or violet anthers; and that anthers of both types of colours may co-exist on distinct individuals of the same species. The same peculiarity is just as noticeable in tropical grasses, and (without professing to give a complete physiological explanation of it) this is what I have observed respecting it. The walls of the anther-cells are usually of some shade of purple, but are so very thin and pellucid, that when distended with mature pollen the yellow colour of the latter is alone visible. When the pollen is discharged, the anthers resume their original purple colour, shortly, however, to take on the pallor or dinginess of decay. Where the anthers emerge of a purple hue, and change from that to brown, it will probably be found that they have discharged their pollen while still included in the flower. These observations, made without any reference to the question now in hand, require to be renewed and tested; and in them, as in all that precedes, I am open to correction. Of grasses with bisexual flowers, there are two ways in which the ovary may be fertilised, viz., either by the pollen of its own flower (closed or open), or by that of other flowers, after the manner of the diclinous species. In the latter case, the pollen may be transported by the wind, or in the fur of animals (as I have observed the seeds of *Selaginellas* in South America), or in the plumage of birds. The agency of insects has not been traced in the fertilisation of grasses, but may exist. The little flies I have seen on the flowers of grasses seemed bent on depositing their eggs in the nascent ovaries, but may also have aided in cross-fertilisation. In the Amazon Valley grasses are often infested by ants, who, indeed, leave nothing organic unvisited throughout that vast region; and they also, I think, cannot help occasionally transferring grains of pollen from one flower to another. The flowers of palms and grasses agree in being usually small and obscurely coloured, but contrast greatly in the former being in many cases exquisitely and strongly scented, whereas in the latter they are usually quite scentless. The odour of palm-flowers often resembles that of mignonette; but I think a whole acre of that 'darling' weed would not emit more perfume than a single plant of the fan palm of the Rio Negro (*Mauritia Carara*, Wallace). In approaching one of these plants through the thick forest, the sense of hearing would perhaps give the first notice of its proximity, from the merry hum of winged insects which its scented flowers had drawn together, to feast on the honey, and to transport the pollen of the male to the female plants; for it is chiefly diœcious species of palms that have such sweet flowers. The absence of odoriferous flowers from the grasses seems to show that insect aid is not needed for effecting their fecundation, but does not render its accidental concurrence a whit less unlikely. That grasses, notwithstanding their almost mathematical character, vary much as other plants do, is plain from the multitude of osculating forms (in such genera as *Eragrostis*, *Panicum*, and *Paspalum*), which puzzle the botanist to decide when to combine and when to separate, in order to obtain what are called 'good species.' Hence the conclusion is unavoidable that in grasses, as in other plants, variations of surrounding conditions induce corresponding modifications of structure, and that amongst the former must be enumerated cross marriages, however brought about. If the flowers of grasses be sometimes fertilised in the bud, it is probably exceptional, like the similar cases recorded of orchids and many other families. To conclude: the more I ponder over existing evidence, the more I feel convinced that in its perfect state every being has the sexes practically separated, and that natural selection is ever tending to make this separation more complete and permanent; so that the hypothesis of Plato, that the prototype even of man was hermaphrodite, may one day be proved to be a fact!"

—Mr. Saunders alluded to the circumstance that the dead bodies of a species of fly might occasionally be found imprisoned in the flowers of *Lolium perenne*, as if the plant exerted some poisonous influence on the insect. Mr. A. W. Bennett stated, as a result of his observations, that it is impossible to predicate of any given family, whether its members are self or cross-fertilised. In the same group some species may be cross-fertilised, others self-fertilised. Many winter-flowering plants are self-fertilised, and amongst them the common *Poa annua*. Mr. Horne stated that in India different varieties of maize remain constant, even though grown in adjacent fields, so that it would seem as if no crossing took place in this instance.—A conversation then ensued as to the best method of conducting in future the meteorological observations at Chiswick, when Mr. Glaisher stated that he would be willing to reorganise the system of observation in such a manner as to introduce the requisite changes, without impairing the value of the record kept at Chiswick for upwards of forty years. In reference to ground temperature, he stated that at a depth of twenty-five feet the ground was coldest in July, and warmest in January.

Institution of Civil Engineers, December 21.—Annual General Meeting. Charles Hutton Gregory, Esq., president, in the chair. Referring to the business at the ordinary general meetings, of which there were twenty-two during the past session, attention had been directed by the papers read, and by the discussions upon them, to the use of machinery in lieu of gunpowder for "getting" coal; to cylinder foundations for bridges and other similar structures; to the Midland line of the Mauritius railways, where exceptionally steep gradients and sharp curves were necessarily adopted; to some of the chief peculiarities of American locomotives and rolling stock; to works carried out in connection with the river Witham and estuary, for the drainage of the fens and the improvement of the outfall of the navigation; to the past and present condition of the outfall of the river Humber, and of its peculiar feature, Spurn Point; to the New Ferry and the New Brighton piers and landing-stages on the river Mersey; to the Low-water Basin at Birkenhead, and the extensive sluicing operations for maintaining the basin at its proper depth; to the lagoons and marshes on certain parts of the shores of the Mediterranean; to the mechanical details of construction of lighthouse apparatus and lanterns; to the Roman Rock lighthouse, Cape of Good Hope; to the standards of comparison for testing the illuminating power of coal-gas; and lastly, to an able summary, by a foreign engineer, of the present state of knowledge as to the theory of the strength and resistance of materials of construction. The originality, labour, and ingenuity displayed in these communications, had led to the award of Telford Medals and Premiums of Books to Messrs. Jules Gaudard, W. Shelford, T. N. Kirkham, J. Ellacott, and D. T. Ansted, F.R.S.; of a Watt Medal and a Telford Premium of Books to Mr. Z. Colburn; of Telford Premiums of Books to Messrs. W. H. Wheeler, J. R. Mosse, I. Bell, J. Milroy, S. P. Bidder, jun., and C. J. Chubb; and of the Manby Premium of Books to Mr. D. M. Henderson.

In addition to the ordinary general meetings, there were six supplemental meetings, for the reading and discussion of papers by the students. For the papers read at these supplemental meetings, Miller Prizes had been awarded to the following students: Messrs. E. Bazalgette, F. H. Mort, T. J. Ellis, T. R. Gainsford, C. H. G. Jenkinson, and G. H. Roberts.

After a statement of the financial condition of the institution, it was announced that the council had recently taken vigorous measures to vindicate the honour of the profession, which had been unjustifiably assailed by the Government of India, in a notification, the plain intention of which could only be to charge civil engineers with recognising as legitimate the receipt of commissions from others than their immediate employers, and in addition to their salaries, where so remunerated. The Secretary of State for India had put on record "that he regards with implicit confidence the indignant repudiation by the institution of the recognition of any such practice as that referred to," and that he would call upon the Governor-General in Council for an explanation of the circumstances which led to the issue of the objectionable notification. A sufficient time had not yet elapsed for an answer to be received from India to the remonstrance of the institution. In the meantime, the council felt assured that the steps they had taken would meet with cordial approval. In inviting attention to this report, the presentation of which terminated the trust confided to them by the last annual general meeting, the council observed that they had laboured so to direct the affairs entrusted to them, that the discharge of their duties might be attended with advantage to the institution.

The following gentlemen were elected to fill the several offices in the Council for the ensuing year:—Charles Blacker Vignoles, President; Joseph Cubitt, Thomas Elliot Harrison, Thomas Hawksley, and George Willoughby Hemans, Vice-Presidents; James Abernethy, William Henry Barlow, John Frederic Bateman, Joseph William Bazalgette, Nathaniel Beardmore, Frederick Joseph Bramwell, James Brunlees, John Murray, George Robert Stephenson, and Edward Woods, Members; and Edward Middleton Barry and Lieut.-Col. Andrew Clarke, C.B., R.E., Associates.

EDINBURGH

Royal Physical Society, December 22.—Professor Duns, president, in the chair. The following gentlemen were elected members:—Messrs. Gibson and Durham. The office-bearers for the sessions were elected as follows:—Presidents, Professor John Duns, D.D., R. F. Logan, C. W. Peach; Council, E. W. Dallas, T. S. Wright, M.D., James M'Bain, M.D., R.N., R. Brown, Stevenson Macadam, A. Wilson; Secretary, John A. Smith, M.D.; Treasurer, G. Logan, W.S.; Assistant Secretary, J. Boyd Davies; Honorary Librarian, A. Taylor.—Notice of the occurrence of *Gonoplax angulata* off the coast of Mull, by M. Watson, M.D. This rare crab was taken in September last by Dr. Watson, when dredging in "Bloody Bay," on the north coast of Mull, in about twenty-five fathoms water. The dredge was filled with soft mud, along with a great quantity of the *Pennatula* and *Virgaelaria*. As far as he could learn, it was the first time it had been taken on the Scottish coasts. Mr. Bell, in his "Brit. Crustacea," says it is not known to have been taken in Scotland. This species has not been taken on the east coast of Scotland nor in Shetland. Mr. Peach stated it was got on the south coast of England, on the Welsh coast, and also in Ireland. It is a Mediterranean species. The specimen was a young male, and was an interesting addition to the list of Scottish crustacea. Dr. Duns exhibited a fine species of Gurnard (*Trigla*), which had been forwarded to the New College Museum by the Rev. Walter Wood, Elie, to whom it had been brought as a novelty by a fisherman. He pointed out a number of features in which the specimen differs from those described by Yarrell, Fleming, Gunther, and others, but was inclined to regard it as a variety of *Trigla pini* (Block).

DUBLIN

Natural History Society, January 5.—The Rev. Professor Haughton, M.D., F.R.S., in the chair. Mr. W. Andrews read a paper "On the inhabitants of rockpools and caves, Dingle Bay." The rockpools of Dingle Bay had been examined in October 1868, and were teeming with animal life. After reminding the members of the pleasure of being naturalists, Mr. Andrews said that in the present paper he would speak of the Actinozoa that he had met with in Dingle Bay, and among the species that he mentioned the following appear to be of most interes as being apparently unrecorded as Irish:—*Aiptasia couchii; Cerianthus*, a species near *C. Lloydii*, *Stromphia churchiæ*, *Balanophyllia regia*. Living specimens of *Caryophyllia smithii* were dredged in fifty fathoms of water. Mr. Jeffrey's paper "On Deep-sea Dredging" (*Vide* NATURE, p. 135), was referred to, as proving that this coral was a deep-sea species, whereas Mr. Gosse and Professor Wright twelve years ago described it as being a littoral zone species. Great quantities of *Nullipora compressa* were met with, and many beautiful coloured specimens of the egg-cases of *Pyrpura lapillus* with the young shell in them. The author then proceeded to refer to coral-reefs, and stated that he now believed that the *Millepora alcicornis* Linn. was not a coral. It was a true *Eschara*, and took the place in these seas of the *Pœcillopora* of the tropics. At another time he would refer again to the stony corals met with in Dingle Bay, and enter into the full history of their affinities and structure.—Dr. A. Macalister read a paper "On the Mode of Growth of Univalve Shells." Referring to Canon Moseley's memoir on the geometrical forms of turbinated and discoid shells, he stated that he had made a large number of measurements to determine the logarithmic spiral of the different families of Gasteropods, with the hope that the number found to express the ratio of the geometrical progression of the dimensions of their whorls might be of use in classification. In this he had to a certain extent succeeded, as the tables exhibited showed. Mr. Lalor was glad to see the result of Dr. Macalister's work, as it quite corroborated some investigations that he had made on this interesting subject several years ago.—The Rev. Professor Haughton then read a paper "On the Geometrical Characters of Muscles." He alluded to the researches of J. A. Borelli, as given in his "De Motu Animalium," published at Rome in 1680, and stated that the classification of muscles therein mentioned was surprising for its accuracy. Dr. Haughton had modified and added to it as follows:—I. Muscular fibres being on same plane: 1. The fibres parallel; 2. The fibres intersect; 3. The fibres curved (sphincter). II. Muscular fibres being on curved surfaces: 1. Where the fibres formed right lines; 2. Where no line on the surface was a right line.—Mr. Lalor read a paper, not containing any original matter, "On the Anatomy of the Oyster."

MANCHESTER

Literary and Philosophical Society, December 28, 1869.—J. P. Joule, LL.D., F.R.S., &c., president, in the chair. "On Pollen considered as an aid in the Differentiation of Species," by Charles Bailey. The author, having recently examined the pollen of several thousand species of plants, is led to think that the characters presented might prove useful as a means of differentiation in allied species; the following notes are thrown out as indications of some of the more noticeable distinctions to be drawn:—

1. FORM.—It has long been noticed that certain types of pollen are characteristic of the natural order to which the plants which produce them belong, as, for instance, the peculiar pitted polyhedral pollen of the *Caryophyllaceæ*, the spherical spiny pollen of the *Malvaceæ*, the large triangular pollen of the *Onagraceæ*, the peculiar pollen of the *Coniferæ*, or the elliptical pollen of the *Liliaceæ* and other monocotyledonous orders; in fact, most orders possess a type sufficiently marked to be characteristic of each. This statement, however, must be accepted with limitations; the *Compositæ*, for instance, have three or more well-marked types, represented by the beautifully sculptured pollen of the Chicory, the minute oval spiny pollen of the Asters, Calendulas, Cacalias, &c., and another form wholly destitute of spines, as in the *Centaurea Scabiosa*. There are, besides, other natural orders where similar variety occurs. But differences of form are met with in plants of the same genus, by which the one species or the other is readily marked off by its pollen; thus, the pollen grain of *Anemone sulphurea* is roundish, but that of *Anemone montana* is elliptic; the pollen of *Aronicum Doronicum* is much more elongate than that of *A. scorpioides*; and while the grains of *Ranunculus philonotis* are round and yellow, those of *R. platanifolius* are elliptic, white, and smaller.

2. MARKINGS.—The pollen of the *Geraniaceæ* and *Campanulaceæ* is for the most part globular, but while some of the grains are quite smooth, others are covered with spines; thus, the pollen of *Campanula Media* has a number of short spines sparsely scattered over the surface of the grain, but *C. rapunculoides* is wholly destitute of them. In other plants these spines are replaced by tubercles, and both spines and tubercles vary greatly in length and number; for example, in *Valeriana tuberosa* the spines are only half the length of those on the pollen of *V. montana*, the grains being also slightly smaller. The pollen of the *Liliaceæ* is often covered with a more or less prominent reticulation, which is subject to much variation; compare, for example, the coarse network which invests the pollen of *Lilium croceum* with the finer reticulation of *L. canadense*, the grains of the latter species being much more globose and smaller.

3. DIMENSIONS.—Some instances of the differences observable in the size of pollen grains have already been published by Professor Gulliver, whose measurements of the pollen of various species of *Ranunculus* show the help that may be derived from this character; *R. arvensis* is nearly twice the size of *R. hirsutus* their dimensions being respectively $\frac{1}{470}$ and $\frac{1}{888}$ of an inch. For some noticeable differences, compare the smaller pollen of *Epilobium brachycarpum* with the larger pollen of *E. Fleischeri*, or that of *Senecio gallicus* with *S. incanus*, the spines on the latter species being also much coarser. Again, the pollen of *Silene acaulis* is but half the size of that of *S. alpina*, the latter having some beautiful markings in addition; the pollen grains of this genus differ from the usual caryophyllaceous type in not having the pits or depressions common in the order, so that the grains become spherical rather than polyhedral.

4. COLOUR.—This is not so reliable a character for differentiation as the others noticed, since species differ amongst each other according to the soil, &c. The pollen of *Ajuga genevensis* is yellow, but of *A. pyramidalis* is usually white; again, while the grains of *Ornithogalum umbellatum* are large and yellow, those of *O. nutans* are small and white. In regard to the mounting of these objects for the microscope, they show to the best advantage when put up perfectly dry; the cells should be sufficiently shallow to admit of no more than a single layer, and at the same time deep enough to permit the grains to move about. If pollen is mounted soon after it has been discharged from the fresh anthers, the fovilla is apt to condense on the covering glass, and the slide soon becomes useless. The stamens taken from an unopened flower-bud furnish the best and cleanest pollen, and these should be selected in preference to those taken from the fully-developed flower. Canada balsam, glycerine, and other media are occasionally helpful in making out structure; thus the pores of *Campanula rotundifolia*, *Phyteuma Halleri*, and other allied species are made much more distinct when mounted in balsam.

Microscopical and Natural History Section.—December 6, 1869.—J. Watson, Esq., president of the section, in the chair. Mr. W. Boyd Dawkins, M.A., F.R.S., was elected a member of the section. Mr. J. B. Dancer, F.R.A.S., read a short paper on some of the new Hydro-carbon Compounds from which he had obtained very beautiful polarising objects for the microscope.

PARIS

Academy of Sciences, January 3.—M. Coste was elected vice-president, and MM. Chasles and Decaisne members of the general administrative committee. The outgoing president, M. Claude Bernard, gave an account of the present condition of the publications of the Academy, and announced the changes among the members and correspondents during the past year. The following memoirs and communications were then presented: "On the demonstration relative to the sum of the angles of a triangle," by M. Bertrand; "On the nascent state," by M. H. Sainte-Claire Deville; "On the constitution of the solar aureola, and on some peculiarities of Geissler's tubes," by Father Secchi. The publication of Father Secchi's letter is delayed on account of some illustrations which accompanied it not being ready. The memoirs presented to the Academy were as follows:—"On the poinçonnage (piercing) of metals and plastic substances," by M. Tresca; "On a postulate of Euclid," a note by M. Lionnet, and a note on the same subject by M. Fleury. Of the correspondence addressed to the Academy, the more important were a note by M. Tréve on the action of magnetism on gases, a communication by M. Houzeau "On the origin of nitrogen gas in oxygen supposed to be pure," one by M. Gaudin indicating the process employed in the fabrication of artificial precious stones, and one by M. Prillieux on the movements of grains of chlorophyll under the influence of light. Some account of M. Tréve's note, which is of very great interest, will be given subsequently. The other elections are referred to elsewhere.

BERLIN

German Chemical Society, Dec. 27.—The following papers were read:—Ed. Schaer: "On some relations shown by Coppersalts in the presence of Cyanides."—Th. Zincke: "On the Synthesis of Aromatic Acids." (The author treated the ether of monochloroacetic acid with bromide of phenyle and molecular silver thus producing botaylic ether).—Kempf: "On Chlorocarbonate and Carbaminate of Phenyle."—Vogel: "On recognising Sulphuret of Carbon in Gas."

ITALY

Reale Instituto Lombardo di Scienze e Lettere.—"Report of Researches in the Class of Mathematical and Natural Sciences." (Session, 1868-69.) By Professor Schiaparelli.

Mathematics.—In a memoir "On the Equations which determine the points of contrary flexure of Elliptic Curves," Prof. Brioschi gives the methods of determining the points of flexure of those curves of the n'th order which have $\frac{n(n-3)}{2}$ double points or cusps. Prof. Cremona has studied "The Transformation of Hyperelliptic Curves," that is to say, of those curves whose co-ordinates may be expressed rationally by means of a parameter λ, and the square root of an integral function of even order of this same parameter. The "Number of Moduli of the Equations and Algebraic Curves of a given genus" has been investigated by Professors Cremona and Casorati, whose results tend to support the rule given by Riemann for determining the said number, also the different rule proposed for the same purpose by Cayley. A memoir by Prof. Boltrami of Bologna contains "Researches on a new element introduced by Christoffel into the Theory of Surfaces," which is nothing else than the quantity by which it is necessary to multiply the infinitesimal angle between two geodetics proceeding from the same point, in order to obtain the length of the arc of any orthogonal trajectory to the two geodetic lines in question, comprised between the same lines. Prof. Geiser of Zurich has generalised, for any number of dimensions, or translated into an analytical fact for any given number of variables, "A theorem of Steiner relating to properties common to all the Maximum Triangles inscribed in a given Ellipse." A communication from the illustrious Clebsch, professor at Göttingen, refers to those "Surfaces which have the property of being representable point by point above a plane." Such representations are known to afford an extremely powerful instrument of geometric analysis. Prof. Bardelli has collected and demonstrated all the formulæ proposed by various geometers (Euler, Monge, Rodrigues Broschi), for the very useful problem of the "Transformation of Co-ordinates in Space," showing the relation and the geometric significance of the several systems of auxiliary variables adopted by those authors. Finally, amongst the mathematical researches may also be included a note by Schiaparelli on "The principle of the Arithmetic Mean in the calculation of Observations," and one by Prof. Porro, "On the new Cleps-cyclic Theodolite," an instrument invented by the author for rapid surveying.

Hydraulics.—The memoirs presented to the Institute under this head were chiefly of local interest, relating to the rivers and canals of Upper Italy. There is also one by Senator Lombardini, entitled "Geographical and Hydrological Researches in the Regions of the Upper Nile and Central Africa."

Astronomy, Meteorology, and Terrestrial Physics.—In a memoir entitled the "Variations of the Eccentricity of the Earth's Orbit, and of Terrestrial Climates in the Geological Epochs," Schiaparelli endeavours to prove that the changes of eccentricity in the orbit cannot be the cause of the great oscillations of temperature which have taken place in geologic epochs, and that the origin of the glacial periods must be sought elsewhere.—Prof. Cantoni, speaking of "The Rains of the Autumn of 1868 in Upper Italy," discusses the cause of the terrible inundations of that year. Cavalleri communicates an "Observation on the Aurora Borealis of the 13th of March, 1869," which was visible over a large part of Europe; and lastly, Prof. Rialti of Forli communicates a note "On the Cause of the Incandescence of Bolides," which gave occasion to Prof. Cantoni to make a calculation respecting the heat developed in bolides by the resistance of the air, analogous to those which had been made on the same subject by Reichenbach in Germany and Marsh in America.

Physics.—Prof. Cantoni has made a series of researches on "Frictional Electrical Machines," and especially that of Holtz; the "Theory of the Electrophorus and of Electro-static Induction," respecting which the author modifies essentially the ideas hitherto generally received; "The application of the Galvanometer to the study of electric phenomena," in which part of the research Cantoni was assisted by Prof. Brusotti of Pavia; "The relations between the variations of intensity of a current, and those of the temperature in a voltaic circuit;" and other subjects connected with the preceding.—The memoirs of Prof. Vilari relate to "The Influence of Magnetisation on the Electric Conductivity of Iron and Steel; the Currents induced between Iron and other Metals; the Heat developed by Caoutchouc when submitted to Traction;" and in association with Dr. Marangoni, on "The limits of perception of Sounds with respect to their duration."

Chemistry.—Prof. Polli, in examining the intimate mode of action of Sulphurous Acid and Alkaline Sulphites on Fermentable Organic Matters, has endeavoured to show that the mode of action of these preparations consists in an isomeric modification of the molecular aggregation, without alteration of the elementary chemical composition.—Prof. Selmi, of Mantua, has communicated his experiments on the miasmatic air of Mantua.

Natural History and Geology.—Under this head there are two botanical memoirs by Prof. Gorovaglio: one on a New Species of Sensitive Plant, cultivated in the Botanic Garden of the University of Pavia; the other containing a project for the establishment of a laboratory of Cryptogamic Botany, with the view of studying the maladies of plants and animals produced by cryptogamic parasites.—In connection with zoology, there is a note by Crivelli and Maggi on the *Corpora fimbriata* of the Frog, and another by Tigri, on the Silkworm Disease.—In Geology, Paolo Garini communicates a paper on a method of producing experimentally the phenomena of Glaciers.—Leopold Maggi communicates his researches on Lacustro-glacial Deposits; and, lastly, Negri and Spreafico have presented a memoir on the Geology of the Environs of Varese and Lugano.

DIARY

THURSDAY, JANUARY 13.

ROYAL SOCIETY, at 8.30.—On the Mineral Constituents of Meteorites: Mr. N. S. Maskelyne.—On Fluoride of Silver: Mr. G. Gore, F.R.S.—Approximate Determination of the Heating Powers of Arcturus and α Lyræ: Mr E. J. Stone, F.R.S.

MATHEMATICAL SOCIETY, at 8.—Equation of Centres and Foci of certain Involutions: J. J. Walker.

ZOÖLOGICAL SOCIETY, at 8 30.

LONDON INSTITUTION, at 7.30.

FRIDAY, JANUARY 14.

ROYAL ASTRONOMICAL SOCIETY, at 8.

QUEKETT MICROSCOPICAL CLUB, at 8.

MONDAY, JANUARY 17.

ROYAL ASIATIC SOCIETY, at 3.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.

MEDICAL SOCIETY at 8.

TUESDAY, JANUARY 18.

STATISTICAL SOCIETY, at 8.—On the Statistics of Joint Stock Companies from 1814 to the present time, and of Companies with Limited and Unlimited Liability formed since 1856: Prof. Levi.

ANTHROPOLOGICAL SOCIETY, at 4.—Anniversary Meeting.

ROYAL INSTITUTION, at 3.—On the Architecture of the Human Body: Prof. Humphry.

PATHOLOGICAL SOCIETY, at 8.

INSTITUTION OF CIVIL ENGINEERS, at 8.

WEDNESDAY, JANUARY 19.

METEOROLOGICAL SOCIETY, at 7.

SOCIETY OF ARTS, at 8.

THURSDAY, JANUARY 20.

LINNEAN SOCIETY, at 8.—On the Flora of Iceland: Prof. Babington.—On New British Spiders: Rev. O. P. Cambridge.

ROYAL INSTITUTION, at 3.—On the Chemistry of Vegetable Products: Prof. Odling.

ZOOLOGICAL SOCIETY, 8.30 P.M.—Descriptions of a new genus and of eighteen new species of Eand and Marine Shells, Henry Adams. "On the geus Pelargopsis of the family Alcedinidæ," R. B. Sharpe. Description of a new Fish from the vicinity of Aden, Lieut.-Colonel R. L. Playfair.

BOOKS RECEIVED

ENGLISH.—Wonders of the Deep: M. Schele de Vere (Sampson and Low).—Anatomy of the Blowfly: B. T. Lowne (J. Van Voorst).—Journal of the Scottish Meteorological Society, 10 numbers.—Ancient Classics, Homer's Iliad: Rev. W. L. Collins (W. Blackwood and Sons).—Cups and their Customs (J. Van Voorst).—Geology and Revelation: G. Mulloy (Longman and Co.).—Across America and Asia: R. Pumpelley.—The Andes and the Amazon: James Orton (Sampson Low).

AMERICAN.—Farming for Boys.—Our own Birds of the United States: W. L. Bailey (through Trübner and Co.).

FOREIGN.—Die Technisch verwendeten Gummi-arten, Harze and Balsame: Dr. Julius Weisner.—Lehrbuch der Chemie: Dr. J. Moser.—Untersuchungen über die theorie und das allgemeine Geographische System der Winde: Dr. Adolph Mühry.—Anatomische Studien: Dr. C. Hasse.—Auffassung der Organischen Natur: Prof Wilhelm His.—Untersuchungen über die microscopische Zusammensetzung und Structur der Basalt-gesteine: Dr. F. Zirkel.—Recherches pour servir a l'histoire naturelle des Mammiéres; Livraison 5, feuilles 13 à 15: H. Miln-Edwards.

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ERRATUM.—The word "practical," in the 37th line on page 267, should have been "partial."

DECEMBER 1869] [PART II

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

"To the solid ground
Of Nature trusts the mind that builds for aye."—WORDSWORTH

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No. 6

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No. 9

Publishing Office—16, BEDFORD STREET, STRAND

PRICE ONE SHILLING AND EIGHTPENCE

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & Co., at the Office, 16, Bedford Street, Covent Garden.—THURSDAY, January 13, 1870.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH

No. 12] THURSDAY, JANUARY 20, 1870

THURSDAY, JANUARY 20, 1870

THE PROJECTED CHANNEL RAILWAYS

II.

To connect England and France by a railway through a submarine tunnel is not a novel idea. From time to time English and French engineers have revived the plan of tunnelling under the Straits of Dover with some modification or other. Among these the latest and most carefully considered proposition is that by Messrs. Hawkshaw, Brunlees, and Low, in connection with Messrs. Talabot, Chevalier, and Gamond. The scheme of these engineers will be best understood from their report to a committee of promoters, and we will give those passages of the report which are essential for the clear comprehension of the plan :—

"The undersigned engineers, some of whom have been engaged for a series of years in investigating the subject of a tunnel between France and England, having attentively considered those investigations and the facts which they have developed, beg to report thereon jointly for the information of the committee.

"These investigations supported the theory that the Straits of Dover were not opened by a sudden disruption of the earth at that point, but had been produced naturally and slowly by the gradual washing away of the upper chalk ; that the geological formations beneath the Straits remained in the original order of their deposit, and were identical with the formations of the two shores, and were, in fact, the continuation of those formations.

"Mr. Low proposed to dispense entirely with shafts in the sea, and to commence the work by sinking pits on each shore, driving thence, in the first place, two small parallel driftways or galleries from each country, connected at intervals by transverse driftways. By this means the air could be made to circulate as in ordinary coal-mines, and the ventilation be kept perfect at the face of the workings.

"Mr. Low laid his plans before the Emperor of the French in April 1867, and in accordance with the desire of his Majesty, a committee of French and English gentlemen was formed in furtherance of the project.

"For some years past Mr. Hawkshaw's attention had been directed to this subject, and ultimately he was led to test the question, and to ascertain by elaborate investigations whether a submarine tunnel to unite the railways of Great Britain with those of France and the Continent of Europe were practicable.

"Accordingly, at the beginning of the year 1866 a boring was commenced at St. Margaret's Bay, near the South Foreland ; and in March 1866 another boring was commenced on the French coast, at a point about three miles westward of Calais ; and simultaneously with these borings an examination was carried on of that portion of the bottom of the Channel lying between the chalk cliffs on each shore.

"The principal practical and useful results that the borings have determined are, that on the proposed line of the tunnel the depth of the chalk on the English coast is 470 feet below high water, consisting of 175 feet of upper or white chalk and 295 feet of lower or grey chalk ; and that on the French coast the depth of the chalk is 750 feet below high water, consisting of 270 feet of upper or white chalk and 480 feet of lower or grey chalk ; and that the position of the chalk on the bed of the Channel, ascertained from the examination, nearly corresponds with that which the geological inquiry elicited.

"In respect to the execution of the work itself, we consider it proper to drive preliminary driftways or headings under the Channel, the ventilation of which would be accomplished by some of the usual modes adopted in the best coal mines.

"As respects the work itself, the tunnel might be of the ordinary form, and sufficiently large for two lines of railway, and to admit of being worked by locomotive engines, and artificial ventilation could be applied ; or, it might be deemed advisable, on subsequent consideration, to adopt two single lines of tunnel. The desirability of adopting other modes of traction may be left for future consideration."

This, then, is the great Tunnel scheme, which a committee of promoters and engineers submitted to his Majesty the Emperor of the French in June 1868 ; and we are informed "His Majesty was pleased to refer the matter to the favourable consideration of his Excellency the Minister of Public Works, who appointed a special commission to inquire into the subject in all its bearings." This special commission reported in March 1869 ; and a summary of this report on the main question is contained in the following three resolutions, viz.—

"I. The commission, after having considered the documents relative to the geology of the Straits, which agree in establishing the continuity, homogeneity, and regularity of level of the *grey chalk* between the two shores of the Channel,

"Are of opinion that driving a submarine tunnel in the lower part of this chalk is an undertaking which presents reasonable chances of success.

"Nevertheless, they would not hide from themselves the fact, that its execution is subject to contingencies which may render success impossible.

"II. These contingencies may be included under two heads : either in meeting with ground particularly treacherous—a circumstance which the known character of the grey chalk renders improbable ; or in an influx of water in a quantity too great to be mastered, and which might find its way in either by infiltration along the plane of the beds, or through cracks crossing the body of the chalk.

"Apart from these contingencies, the work of excavation in a soft rock like grey chalk appears to be relatively easy and rapid ; and the execution of a tunnel, under the conditions of the project, is but a matter of time and money.

"III. In the actual state of things, and the preparatory investigations being too incomplete to serve as a basis of calculation, the commission will not fix on any figure of expense or the probable time which the execution of the permanent works would require."

Having laid before our readers the Channel Tunnel Scheme in the words of the originators, we shall now proceed to analyse it, and for the purpose we also publish a map forming part of the engineers' report, and which we reduce to a scale of six miles to one inch.

The first important statement with which we meet in the engineers' report is that under section 2, viz., on the theory of the formation of the Straits of Dover. We admit that in all probability the Dover Channel was not produced "by a sudden disruption of the earth at that point," but we cannot endorse the hypothesis that it has been formed by gradually washing away the upper chalk.

In order that the chalk may be washed away more at that point than at others, it is necessary that the current should be stronger. To begin with the operation of washing away, we must have a current, a strong current, which could only flow in a valley or channel, previously formed either by depression of the surface or by the elevation of the land adjoining that surface. Whichever way we take it, the original channel of Dover must, it would seem probable, have been formed by a geological disturbance of the earth's crust.

The current within that geologically-formed channel may have further deepened it, although this is not probable, because at the bottom of a channel from 100 to 200 feet deep, the speed of a current can be but a small fraction of its superficial velocity, and this fraction is assumed to have abraded chalk rock.

Looking at the chart attached to the report of the engineers, we find a series of lines running from the English to the French coast, which are assumed to indicate the position of the strata of various rocks—of the same rocks which compose the hills on either side: so, for example, the district A between the dotted lines is assumed to be that of the upper or white chalk; B, the lower or grey chalk; C, to be the place of a series of strata, such as the upper green sand; the gault, the Folkestone, Sandgate, and Hythe beds; Atterfield clay, &c., &c.

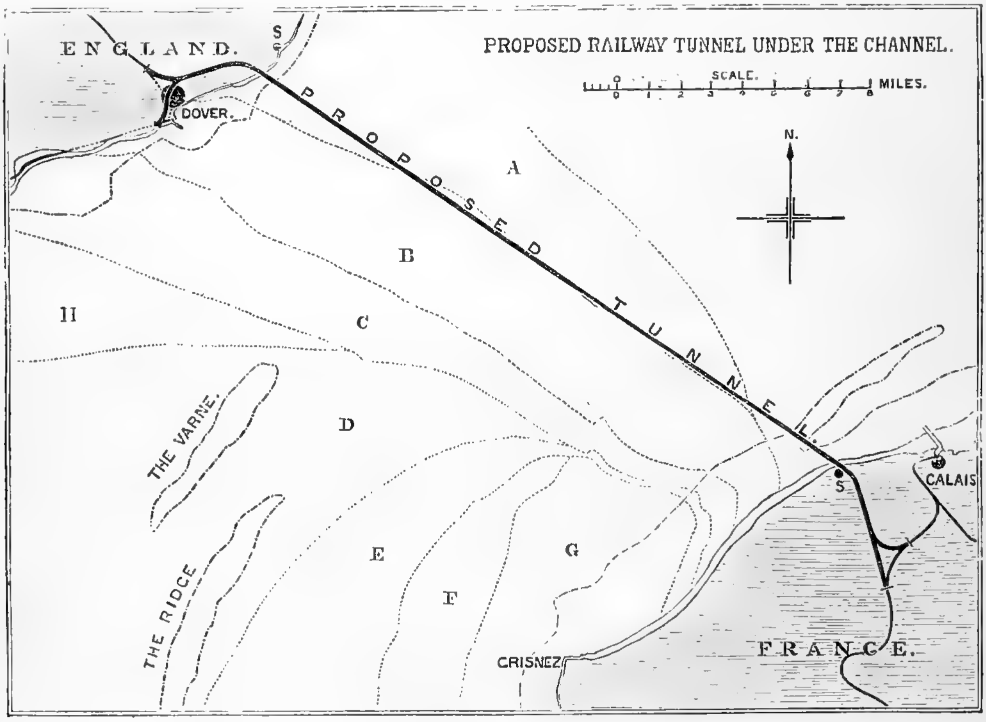
The only question that presents itself to our mind is, whether this chart be correct; whether the geological lines there indicated are the result of test and observation, or whether those lines are based on the theory of the engineers, that the strata of the hills on either side of the Channel pass "undisturbed" in plane surfaces across the Channel, assuming that the strata which formerly occupied the Channel were cut away or carried off; and whether the lines indicated on the map may not principally have been produced by constructing the intersections of those inclined surfaces with the present bottom of the Channel. We fear the geological lines of the diagram were mainly obtained on the above theory of the engineers, and will therefore in a great measure be imaginary.

It is probable that the strata which form the hills on either side will also form the bottom of the Channel, at a different elevation; but it would be rash to say how much the difference might be. It will probably vary across the Channel, the thickness of the strata remaining nearly the same; so it may be presumed that chalk will be found within the Dover Straits at certain depths below the bed of the Channel. If this be so, it would not be necessary to divert the tunnel as indicated on the plan. Nothing short of an actual test across the Channel on the line selected for a tunnel could, however, settle the question of stratification, and determine at what depth a special kind of rock, suitable for tunnelling, would be met with.

The operation of driving the tunnel would have to be carried on many hundred feet below the mean level of the Channel, and, apart from other difficulties attending the execution of such an immense tunnel, for which we have no precedent even on a small scale—the first question would be, whether it may be reasonably expected that tunnelling would be practicable under such circumstances without meeting with an insurmountable influx of water.

That we should meet with many fissures and cracks is a matter of course, for it would be difficult to select on a rocky surface a few square yards without indications of fissures. That water will find its way along cracks we know from experience, and as in this instance no water-tight strata intervene between the sea and the rocky material through which it is proposed to drive the tunnel, so, consequently, we must expect that the work of driving the driftways and the tunnel would be "wet." Although the work may be very wet, it will still remain a question of quantity, and not only one of quality; and, accordingly, we must ascertain whether the quantity of water that might find its way into the workings would be unmanageably large.

On this point a great deal of misconception may be found in "professional" papers. It is asserted, that the



.... Geological Line.
— — — — — — Ten Fathom Line.

A, upper or white chalk. B, lower or grey chalk. C, upper green sand, gault, Folkestone, Sandgate, and Hythe beds. D, region probably occupied by the Hastings sands. E, Neocomian sand. F, Portland stone and sand. G, Kimmeridge clay. H, Weald clay. SS, Borings.

pressure due to a column of 400 or 500 feet of water—which is equal to about 200lb. per square inch—would not only cause infiltration through fissures and cracks, but would in a short time enlarge them, abrade the very rock, and so day by day increase the flow into the driftways. As a general assertion, this evinces a confusion of the static with the dynamic laws of hydraulics.

If we stop the flow from a crack, and if the water cannot be diverted, the full hydrostatic pressure due to the whole column will be established at the very margin of the crack where it was artificially closed. But if we do not stop the flow from it and allow the discharge, the pressure at the margin within the tunnel will by no means be equal to the full hydrostatic column; for, in passing water along a fissure with a certain velocity, by far the largest part of that column will, under ordinary circumstances, be destroyed or consumed in overcoming the friction of the water over the large area of the fissure, and, as a rule, the effective pressure at the end of a fine crack within the tunnel would be only a small fraction of the whole column of water—probably not one per cent., so that no abrasion could take place, and the flow of the water, whatever it might be, would not increase day by day.

This being a very important question in reference to the proposed tunnel, let us take an example.—Assume a fissure 1 yard long and $\frac{1}{1000}$ part of an inch wide—about the thickness of tissue paper. Let this fissure continue in a vertical direction for a distance of 100 yards, to the bottom of the channel, and assume above that fissure 30 fathoms of water. What quantity of water will find its way through that fissure, and what will be the pressure at its margin within the Tunnel? We assume a clear opening throughout, and yet that fissure could only pass 4 gallons per hour into the tunnel, and the effective pressure at its margin would only be $\frac{1}{300}$ lb. per square inch. The effect of such a crack or opening would therefore be quite insignificant. Let all the circumstances remain the same, but assume the fissure 10 times as wide, viz., $\frac{1}{100}$ part of an inch in the clear: it would then pass into the tunnel 136 gallons per hour, with a marginal pressure of $\frac{1}{25}$ part of a pound per square inch; let it be $\frac{1}{10}$ inch wide in the clear, and it will pass 4,392 gallons per hour, with a marginal pressure of $\frac{2}{5}$ of a pound—and if we assume the fissure 1 inch wide in the clear, it will pass 139,905 gallons per hour, with a marginal pressure of $4\frac{1}{5}$ pounds per square inch.

It then becomes chiefly a question of the *nature* of the fissures with which we may have to deal, and while a fine crack one yard long would only admit an insignificant volume of water into the tunnel, a similar crack one inch wide would be a serious matter, very few of which would drown the drift. But even in the latter case no abrasion of the rock could take place, for a pressure of four pounds per square inch has no effect upon chalk.

But though the fissures within the driftways might be very fine, each passing or oozing out a comparatively small quantity of water, easily to be dealt with within a moderate length of the driftways, their number within a distance of twenty-two miles would be legion, and, we believe, would overpower all appliances. These fissures should not be permitted jointly to send water into the driftways; they should be closed as soon as practicable. How is that to be done? By keeping a water-tight main tunnel close upon the face of the driftway. As soon, however, as the cracks would be closed by the main water-tight tunnel, the full hydrostatic pressure of many hundred feet would be resting on it. The main tunnel would collapse unless it could bear a pressure of about fifteen tons per square foot on its superficial area. This circumstance determines the form and the material of the tunnel. It could not be an ordinary tunnel in any sense. Its form must be circular, and its principal material iron. No brickwork could stand that pressure at whatever thickness, within practicable limits, it might be assumed, because by increasing its thickness its superficial area would also increase. Nor could any brickwork be water-tight against such pressures, and, unless it be so, water will find its way into the tunnel very nearly as fast through the lining as without it.

We cannot, therefore, help differing from the resolution of the engineers that—

"In respect of the execution of the work itself, we consider it proper to drive preliminary driftways or headings under the channel, the ventilation of which would be accomplished by some of the usual modes adopted in the best coal-mines."

We consider this resolution fraught with danger. The driftways could never be accomplished without the aid of the main tunnel; nor would the proposed ventilation through the driftways be adequate. Why should the ventilation be similar to that adopted in our best coal-mines? Is the proposed tunnel to be driven through the coal measures? No, it is to be through the grey chalk, and a ventilation which may be adequate in coal measures would certainly fail in the chalk, from which a large amount of an irrespirable gas would exude. This is another reason why the main tunnel should be kept closely behind the face of the driftway, viz., to exclude the surface of the chalk. And why have two driftways to begin with? Moreover, there is no difficulty in sending into the tunnel through ordinary piping, to the face of the heading, ten times as much pure air by mechanical power as the best mode of ventilating coal-mines could possibly ensure.

The tunnel could only be worked by pneumatic pressure: this is obvious from recent investigations of eminent engineers; it could not be for a double line, because that system is not applicable to it; and the old atmospheric plan failed above ground.

We are of opinion that it is not an unreasonable proposition, to drive a tunnel under the Channel, but that in some measure it must be a venture. If we are to undertake such a venture to gain a magnificent prize, of immense value to the English and French nations, we must be prepared to meet all ordinary eventualities, and we must not fail in the attempt by want of foresight, energy, and by dint of proper means. It will cost a great deal, but not too much, with proper management and a little good fortune. The first step towards accomplishing the object would be to obtain a geological section across the Channel, on one, or perhaps on several lines; not a section constructed upon certain theories and assumptions, but one obtained from actual test of the materials which compose the bed of the Channel, following Mr. Hawkshaw's steps on shore also across the Channel, for which purpose the assistance of the Governments of England and France may be confidently expected.

DR. BALFOUR STEWART'S METEOROLOGICAL BLOCKADE

IMAGINE a line drawn round any district, and consider all the air that passes over that line outwards and inwards in any time. Let the whole quantity of vapour of water carried across the boundary line by this air be determined. If during any particular interval of time there is just as much vapour carried outwards as inwards, there must be in that interval either no rainfall on, and no evaporation from the district, or there must be just as much rainfall as evaporation. If more vapour is carried out than in, there must be more evaporation than rainfall. Or, if more vapour enters than leaves, the difference falls in excess of rain above evaporation.

Dr. Stewart proposes to establish a *cordon* of meteorological stations, and to arrange a reduction of observations taken at them, so as to keep, as far as possible, an exact account of the quantity of vapour entering and leaving the space over the surrounded district. This appears to me a most valuable proposal, which, if well carried out, must have a very important influence, tending to raise meteorology from its present empirical condition to the rank of a science. The object of the present notice is to suggest that the same system of account-keeping ought to be applied to electricity.

Whatever we may think as to the nature of electricity, it certainly has, in common with true matter, the property of being invariable in quantity. This property is conveniently enough expressed, as it were, mechanically, by the one-fluid hypothesis, which asserts that positive or negative electrification of any piece of matter consists in the presence of more or less than a certain quantum of the electric fluid; that quantum being the amount possessed when the matter in question exercises no attractive or repulsive force, varying with artificial variations of the electric condition of the testing body presented to it. On this hypothesis, "quantities of electricity," positive and negative, are excesses of the quantity of the hypothetical fluid above or below the "quantum" corresponding to zero of the electric tests.

The ordinary fair-weather condition in our latitudes presents us with negatively electrified air in the lowest stratum, extending at least as high as our ordinary houses above the surface of the earth; and positive electricity of greater amount, on the whole, in the higher regions. The atmospheric electrometer indicates in absolute electrostatic units the total quantity of electricity in the atmosphere, over a certain area of the place of observation; being the excess of the amount of positive above the amount of negative electricity in the whole column. This excess in fair weather is generally positive. The fact that it is not the electricity in the lower regions alone, but an effect depending on the whole electricity of the atmosphere from lowest to highest, that is the thing observed in the ordinary observation of atmospheric electricity, renders this subject more suitable even than moisture for the application of Dr. Stewart's blockade. Thus, the hygrometrical blockade is complete only if both moisture and the effective component of wind are known at all heights above the surface; the electrical blockade is complete when, besides the electrometer measurements at the observatory, the effective component of the wind at all heights is known. But among the many unknown quantities involved, the two departments of the blockade combined will give means for eliminating some and estimating others for which the hygrometrical blockade alone, or the electrical one alone, would be insufficient.

WILLIAM THOMSON

THE SCENERY OF ENGLAND AND WALES

The Scenery of England and Wales, its Character and Origin. By D. Mackintosh. (Longmans and Co.)

READERS of some of the geological journals are sufficiently acquainted with the name of Mr. Mackintosh. They know him as a writer who, for the last four or five years, with wonderful perseverance, has kept on enunciating certain views of denudation which he has adopted. His papers, however, do not suggest that their author possesses the large grasp of the subject, the range of acquirement in geological studies, and the gifts of style which must necessarily belong to the man who would successfully expound the history of the scenery of the country. The task is a difficult one—much more difficult than even geologists themselves usually believe—and the announcement that it had been undertaken by Mr. Mackintosh probably took a good many readers by surprise. They could not but award him the credit of great boldness, whether or not they found, on examination, that he deserved also the praise of success.

Mr. Mackintosh, as a writer on geological subjects, is under the influence of one dominant idea. He believes in the Sea, the whole Sea, and nothing but the Sea. It seems to haunt him like a nightmare. To his ear all sounds in Nature are drowned in the thunder of waves, the rush of ocean-currents, the beating of multitudinous billows, that batter and grind the solid substance of the land. A mist of ocean spray is ever in his eyes. He can but dimly see that any other powers are at work around him save the everlasting breakers. The fall of rain, the roar of rivers, the silent majesty of glaciers and snowfields, have little charm for him, and can never wean his affections from his first love. He can be brought to turn his thoughts neither to the right hand nor to the left, but keeps his eye stedfastly fixed on the one grand object of his faith and adoration. If, indeed, for a moment the contending claims of some other power in Nature obtrude too pertinaciously upon his notice, he clings to some bigger wave, or dashes into some stronger ocean-current until the temptation has passed away.

It is seldom that we meet with one governing idea so unflinchingly followed to the exclusion of anything and everything which might modify it; seldom that we encounter mental colour-blindness so thorough as to admit of the discrimination of apparently but one hue. Not merely does he everywhere and always reiterate that "the greater part of the land surface, at any given time, must present the form given to it by the sea," but he traces this marine sculpturing down to the minutest details of contour, even though rains and frosts and streams seem to rise up in protest to his face. The tendency unduly to exalt the power of the sea as a geological agent has always characterised the writings of English geologists, probably from the greater prominence which the sea acquires in the eyes of islanders. But the tendency never received such an extreme development as it has done in Mr.

Mackintosh's pages. He complacently remarks that hi views "more or less agree with opinions held by Sir R. I. Murchison, Sir Charles Lyell, Professor Phillips Mr. C. Darwin, and others. This *argumentum ad hominem*, we imagine, will hardly be relished by some at least of these gentlemen. Mr. Mackintosh should remember that if his views are sound, the citation of such names is not necessary, while, if they are erroneous, not all the big names in England can save them from the oblivion to which they are doomed.

The author of this volume has evidently never travelled. He tells us, too, that he purposely refrained from reading until his views were formed, "lest a bias should be given to his opinions." And his reading, since these unbiassed opinions were elaborated, appears to have consisted mainly of the recent journals and magazines in which he himself has been writing. And yet a man without travel, and without reading, sits down to write a book on the character and origin of the scenery of a country! He has taken his own little corner of the earth and framed his theory out of it, forgetful of the wide world outside, which must be studied as a whole, if one would well understand any part. While reading the book with laudable perseverance, we have had four lines of "Don Juan" constantly suggesting themselves, where the poet describes a certain easy-minded old gentleman as one who

"Saw with his own eyes the moon was round,
Was also certain that the earth was square,
Because he had journeyed fifty miles and found
No sign that it was circular anywhere."

We presume that Mr. Mackintosh's views would "more or less agree" with those of this philosopher as to the shape of the moon, and generally as to matters of fact regarding which there can be no dispute. Like the same worthy, too, he does not take things on trust. He uses his own eyes and draws his own inferences. He is certain of his convictions, because he has journeyed so many miles and found no sign that these convictions could be anything but true. Unfortunately, however, he has either made his journeys with a foregone conclusion in his mind, or they have been too limited to enable him fully to understand what the subject really is of which he proposes to treat; or, what is probably the truth, he lacks that grounding in exact knowledge of geological structure which is absolutely necessary to one who wishes to elucidate the history of a land surface.

So much for the general purpose of the volume. Its plan and execution are sadly unmethodical. It is divided into three books; but, in spite of the explanation of this arrangement given in the preface, it is not easy to trace any clear distinction in the subjects of the divisions. The reader is jerked from one topic to another, getting of some of them the merest glimpse, so that after a little he begins to experience something of the feeling of unrest which comes over him at another time when he tries to pick out the details of a landscape from the window of an express train. There is no index to the book, and unless a passage is specially noted down at the time of perusal its subsequent recovery is troublesome. Altogether the volume suggests to the reader the idea that he has here a multifarious collection of jottings and excerpts from note-books, strung together with not much reference to their connection. For example, the First Book, according to the table of contents, consists of "Introductory remarks on the causes of denudation and origin of natural scenery in various parts of the world." Under this comprehensive title come just twenty-one pages, in which a word or two are said about faults and fractures, the fact that rains, frosts, rivers, and glaciers are denuding agents is alluded to and not denied, while about fourteen pages, or two-thirds of Book I., are devoted to desultory remarks on sea-bottoms, Irish eskers, oceanic currents, waves in Norway, waves in Shetland and Caithness, waves on the coast of Ireland, sea escarpments in Ireland, remarks on Irish cliffs, sea-coast cwms in Ireland, beachless shores, denudation of Norway, denudation of South America and Australia. This introduction is really a very fitting one to the rest of the book. It shows how the hue of the author's spectacles not only colours all his own observations, but will not let him see the true tint of the observations of other people. For instance, he professes to condense from Forbes's work an "account of the most striking physical features of Norway, *excepting those resulting from glacial action.*" *Hamlet* with the Prince of Denmark omitted was nothing to this. If there is one country in the world more marvellously eloquent of glacial action than other countries it is Norway. That is the one grand physical feature of the peninsula; every fjord, every fjeld points to the grinding power of ice. Yet a writer on denudation, anxious as to the impartiality of his views, ventures to write about the sculpturing of the present physical features of Norway, and to pass the glaciers and snowfields by. Again, he cites Australia as a recently emerged area, where there cannot have been any "long-continued action of rains and streams." But he takes no note of the old river gravels, with cappings of basalt, hundreds of feet above the level of the present streams, which point to the passage of a vastly protracted period of subaërial erosion.

Perhaps no passage in the book shows better the author's obliquity of vision, and his consequent (though no doubt unintentional) unfairness, than one in this same introductory chapter, where, in lieu of giving the reader a general view of what denudation is, he states, on the authority of Mrs. Somerville, that a tidal current in the Shetlands runs at the rate of fifteen miles an hour, while "*the average velocity of the river Rhone is not a mile and a half an hour.*" No one unacquainted with the subject would be likely to escape the inference which the writer probably intended should be drawn, that even a rapid river like the Rhone has not more than a tenth of the erosive power of some marine currents. Now, though there can be no doubt that some of the most rapid currents known flow among the Orkney and Shetland Islands, yet we take leave to question whether any of them ever reach by any means so high a velocity as fifteen miles an hour. Yet even granting that they do, they are quite exceptional, and it was long ago shown by Dr. Fleming that their erosive power over a surface of rock is nearly, if not wholly, *nil*, for they cannot even rub off the crust of tender barnacles. But to set down the average velocity of the Rhone as "not a mile and a half an hour!" Shade of old Rhodanus! have mercy upon Mr. D. Mackintosh if that gentleman ever gets near enough the "rushing of the arrowy Rhone." A mile and a half an hour! why, that is a very feeble velocity for most of our comparatively sluggish British rivers. The Thames flows at the rate of two or three miles an hour, the Severn at three or four miles, and most of our upland streams run still faster. Surely there is just cause of complaint against a writer who, in support of a theory which he has adopted, cites facts which are wholly exceptional without saying that they are so, while at the same time he is led in his ardour unconsciously to misstate the facts which do not tell in his favour.

We have read this book with a feeling of regret that it should ever have been published. Its author is evidently a hard-working observer, and perhaps had he been less ambitious, and been content to wait some years longer until his experience had widened, and he had found time to mature and methodise his opinions, our verdict upon his labours might have been different. As it is, he has hastened before the world with a book of which, in a year or two hence, no one will see the crudity more keenly than he will do himself. A work which aims at giving a popular version of any branch of scientific inquiry should be eminently clear, accurate, and readable. Mr. Mackintosh's volume fulfils none of these conditions, and we only fear that its effect may be to discourage readers from seeking to learn more of what is in reality one of the most fascinating fields of geology.

OUR BOOK SHELF

Medical Chemistry.—*Manuel de Chimie Médicale et Pharmaceutique.* Par Alfred Riche. 8vo., pp. 771, figures 104. (Paris: Germer-Baillière, 1870. London: Williams and Norgate.)

We have here a comprehensive text-book of chemistry, in which the medical and pharmaceutical applications of the science are specially noticed. The author is one of the professors in the School of Pharmacy at Paris, and the "mineral chemistry" of the manual is essentially a reproduction of his course of lectures. The "organic chemistry" is based on the course of Professor Berthelot, and the toxicological portions of the work reflect the teaching of Professor Bouis. Though designed for the use of students of medicine and pharmacy, this manual is primarily a systematic exposition of the fundamental facts of chemistry, and its technical character is revealed only in incidental explanations. Thus, sulphuric acid is noticed with the oxygenated sulphur compounds, and its properties, preparation, commercial manufacture, purification, and chemical constitution, receive adequate treatment before its medical employment and its action as an irritant poison are considered. Again, in the section on the natural alkaloïds we get the chemical history of each of the more important opium bases before we obtain any information respecting the assay of opium, the action of the drug on the human system, or the symptoms of poisoning by opiates. The officinal processes for preparing the chemical substances used in medicine are plainly but briefly described, and practical directions are given for testing the purity and estimating the strength of commercial products. The author has devoted 150 pages to "biological chemistry," an important section of the science which receives scant notice in most manuals, and has minutely described methods of analysing milk, blood, urine, and calculi, which may be adopted by the physician to obtain trustworthy indications of the progress of disease or the effects of medicines. Professor Riche's manual has so many good qualities that we reluctantly call attention to a characteristic which detracts from its value as a treatise on general chemistry. While admitting that the modern or molecular notation is preferable to the notation based on the old equivalents, the author deliberately rejects the former "because it is not yet recognised in the official programmes." Consequently, the book is filled with symbolic formulæ which do not accord with accepted theories. In the introduction to the "organic chemistry," M. Riche attempts to adapt the exoteric notation of his school to modern ideas by doubling the symbols of oxygen, sulphur, and carbon; but English students will look with little favour on the hybrid formulæ thus produced. We trust that the author will burst his bonds of red tape before the second edition of his manual is issued. J. C. B.

Heads and Tales; or, Anecdotes and Stories of Quadrupeds and other Beasts, chiefly connected with Incidents in the Histories of more or less Distinguished Men. By Adam White, late Assistant in the Zoological Department, British Museum. (London: Nisbet and Co. 1870.)

The idea of bringing together the anecdotes of animals recorded in the biographies of great or well-known men is a good one; but the notion of interlarding these anecdotes with facetiæ selected chiefly from Mr. Mark Lemon's "Jest Book" can hardly be commended. Mr. White is sadly mistaken if he supposes that well-written stories of animal life require to be made palatable to school-boys by the addition of puns and shallow witticisms. Schoolboys may well be amused at the solemn way in which the author announces his discovery (in the pages of Macaulay) of the cause of the death of William III.; but they will think it beyond a jest when they themselves discover that six pages which should have been filled with anecdotes are occupied by Macaulay's account of the last days of King William. Mr. White does not exclude man from what he is pleased to term his anecdotical treatment of the great order Mammalia. Three stories of a ludicrous character, however, suffice to illustrate the human species. The schoolboy reader is duly warned against the theory of the genesis of man by natural causes in the following terms:—"Let us never for a moment rest in such fallacious theories, or accept the belief of Darwin and Huxley, with a few active, agitating disciples, that animals, and even plants, may pass into each other. Darwin and Huxley cannot change nature. They may change their minds and opinions, as their fathers did before them. It is, we expect, only the old heathen materialism cropping out." This extract is, perhaps, sufficient to show the author's mental calibre. It is not necessary to praise the illustrations of this book; it is quite sufficient to mention that they are from the drawings of J. Wolf.

Facts and Dates; or, The Leading Events in Sacred and Profane History, and the Principal Facts in the various Physical Sciences: the memory being aided throughout by a simple and natural method. By the Rev. Alex. Mackay, LL.D. (Blackwood and Sons.)

A so-called system of mnemonics may possibly be of use to young men cramming history and geography for competitive examinations; but we see no room for it in science-teaching. The scientific facts capable of being expressed by numbers, and which it is desirable to commit to memory, are really very few. Indeed, we believe they are so few in any given science, that it would take most people longer to master Dr. Mackay's system of artificial memory than to learn the numbers themselves. The author has spent a good deal of labour in so framing his mnemonic sentences as to contain ideas having some connection with the fact intended to be remembered. This is all very well; but the essential fault of his system, and of every such system, is, that it is not sufficient to remember the *idea* contained in the mnemonic sentence: every word of it must be accurately retained. We are sorry to see that Dr. Mackay is sadly afflicted with the Great Pyramid craze. The introduction of such a matter as the pretended scientific revelation into a book intended for school use is very much to be deprecated.

SENSATION AND PERCEPTION
II.

THE doctrine that there is a distinct organ for the realisation of Sensations only, apart from that for Perception, has been very generally taught, and has been insisted on by no one more strongly than by Dr. Carpenter in his otherwise most able and suggestive expositions of nervous physiology. He says:* "The general rule of action appears to be that the impressions made by external objects upon the afferent nerves, when transmitted to the spinal cord, ascend towards the cerebrum without exciting any reflex movements in their course. When such an *impression* arrives at the sensorium,† it excites the consciousness of the individual, and thus gives rise to a *sensation;* and the change thus induced being further propagated from the sensory ganglia to the cerebrum, gives occasion to the formation of an *idea.*" And that Dr. Carpenter here means by the word 'idea' what we have previously spoken of as that complex intellectualised sensation generally called a 'perception,' seems obvious from the following passage occurring on another page, where the same author says: "It is further important to keep in mind the distinction between the *sensations* themselves and the *ideas* which are the immediate results of those sensations when they are perceived by the mind. The ideas relate to the *cause* of the sensation or the object by which the impression is made" (p. 711). But since, in Dr. Carpenter's view, the sensory ganglia constitute the *sensorium*, in which impressions become conscious sensations; and because he naturally thinks it very improbable that there are two distinct organs of consciousness, he is compelled to adopt the hypothesis that the superficial grey matter of the cerebral hemispheres, in which intellectual operations are principally carried on, is not itself endowed with the function of consciousness. Thus he assumes—as the most probable inference to be drawn from various kinds of evidence—"that the sensory ganglia constitute the seat of consciousness not merely for impressions on the organs of sense, but also for changes in the cortical substance of the cerebrum; so that until the latter have reacted downwards upon the sensorium we have no consciousness either of the formation of ideas or of any intellectual processes of which these may be the subject."‡ And, although we are quite unable to agree with the conclusions themselves as to the absence of consciousness in connection with the activity of the cerebral hemispheres, and as to its presence as a functional attribute of the sensory ganglia alone, still it is sufficiently interesting, in a philosophical point of view, to find Dr. Carpenter declaring so confidently in favour of a distinct organ of consciousness, even altogether separate from those parts of the cerebral hemispheres in which what we have called § *potential knowledge* is produced—meaning by this term what is called knowledge, so far as it can exist *minus* the attribute of consciousness. The elaboration of this potential knowledge is, in fact, a process the possibility of which has been ably discussed by Dr. Carpenter in the section in which he speaks of "unconscious cerebration."

We must, however, briefly inquire into the reasons which have induced Dr. Carpenter to regard these so-called sensory ganglia as the seat of consciousness; though, before doing so, it will be well to draw the reader's attention to the following considerations. As it is quite true that different nerves, coming from the sense organs or surface of the body generally, do pass through the sensory ganglia on their way to the higher centres in the cerebral hemispheres, it is obvious that the impressions made upon any one of these lower centres must be *qualified* to a certain extent, inasmuch as they are the middle terms of a series, and therefore are related to their antecedents and to their consequents in the same way that these are related to one another—the antecedents being the external impressions, and the consequents the resulting perceptions. For, when an impression of a certain kind is made upon any given part of the surface of the body, this impression traverses definite nerve-fibres, in order to reach functionally related portions of the cerebral hemispheres, and so we may well suppose that the fibres, on their way, must necessarily pass through *definite parts* of the sensory ganglia, and produce, in certain of the ganglionic elements there situated, impressions of a *definite kind.*

Thus, therefore, although we may believe that no state of consciousness is aroused by this molecular action taking place in these lower sensory ganglia, the impressions made upon them may be, nevertheless, definite enough in kind and place to ensure a partial transference of such molecular movement along given and accustomed outgoing motor channels; such organic possibilities of motorial response having been slowly built up and elaborated, in past time, under the guidance of then co-existing and related conscious states. Thus, movements may at times be produced in every way similar, as regards mode of origin, to those automatic or reflex movements occurring through the intervention of the spinal cord alone; though they may be as much more complex, and apparently purposive, as these higher centres are more complex than the spinal centres. And it is, we think, because the movements are produced by reflections from the highest motor centres, *whose complexity renders the most purposive movements possible*, that such movements have been supposed to be invariably the sequences of conscious impressions or *sensations*, and have hence received the appellation of *sensori-motor.* This name, however, begs the question in dispute—as to whether impressions reaching thus far would be revealed in consciousness or not; and from what has been already said it will be seen that in the settlement of this question we must not rely too much upon the purposive nature of the movements as evidence that they are the results of conscious impressions. Reasonings of this kind led Pflüger to suppose that the spinal cord was also a seat of consciousness.

We quite agree with Dr. Carpenter* and others, however, in the opinion that the organic possibilities of executing all combined muscular movements of which the individual is capable, reside in the spinal cord and medulla, and also still higher in the motor centres in immediate connection with these so-called sensory ganglia—by virtue of definite nerve connections therein established. So that all the facts with which we are acquainted, as he says, "tend strongly in favour of the view that even voluntary movements are executed by the instrumentality of the automatic apparatus, and that they differ only from the automatic or instinctive in the nature of the stimulus by which they are excited." This doctrine may be aptly illustrated by reference to the act of coughing, since this is an instance in which a complicated set of movements usually produced automatically may nevertheless be incited by a voluntary determination. When so produced, the will is directed to the production of the result as a whole; no attempt being made to single out the different movements, and then to combine them; so that, as Dr. Carpenter also says, "the will thus seems obviously to take the place of the laryngeal or tracheal irritation as the *primum mobile* of the series, which, in its actual performance, is as automatic in the latter case as in the former." In each case, the same organised set of nerve connections in the higher motor centres (constituting the organic representatives of the combined muscular movements of the act of coughing) are called into activity; now by a volitional incitation descending from the cerebral hemispheres, and, at another time, as a result of an afferent stimulus reaching the

* Principles of Comparative Physiology, fifth edition, p. 707. 1854.

† Constituted by certain ganglionic structures at the base of the brain, in relation with the various sensory nerves, and usually spoken of as the *sensory ganglia.*

‡ Loc. cit., p. 546.

§ See paper on "Consciousness," in *Jour. of Ment. Science*, p. 512.

* Human Physiology, fifth edition, p. 516.

related sensory centres from some part of the respiratory passages themselves.

Bearing these facts in mind, and also the psychological view of the essential unity in the mode of evolution of all sensations or conscious states—whether simple or complex—we shall find that the performance of many acts of the so-called *sensori-motor* type do not necessarily lend such support to the supposition that the sensory ganglia are the seats of consciousness as they have been supposed to do. That the movements of an infant or of an idiot should appear to be automatic in nature, is only to be expected if we consider that they are responses to conscious impressions excited in quite undeveloped cerebral hemispheres, in which, as yet, the possibilities of intellectual and volitional action of the lowest type only are organised. Thus, the only action which at this time could possibly emanate from the operation of the intellectual centres would be such as Dr. Carpenter has supposed to depend upon the stimulus of mere sensations; and it does not at all follow, as he seems to suppose, that such movements are excited by sensations, realised as such in the sensory ganglia and thence reflected without the intervention of the cerebral hemispheres. Neither do we think his doctrine receives any stronger amount of support from the fact of our ability to perform certain *habitual* movements whilst the cerebrum is occupied with some engrossing train of thought.

It is, we think, an altogether improbable assumption to suppose that the so-called "secondary automatic" acts take place, as a general rule, altogether without the intervention of the cerebral hemispheres. Taking the instance cited by Dr. Carpenter, of the individual who, falling into a deep reverie whilst making his way through the streets, nevertheless walks with ease along accustomed routes, though his attention may be entirely absorbed by some particular train of thought, it is supposed that these movements are characteristic instances of *sensori-motor* acts, that they are brought about solely by reflections from some of the sensory ganglia, and without the intervention of the hemispheres. But it seems to us much more reasonable to suppose that the cerebral hemispheres have been concerned to some extent, even though the consciousness of the individual has been otherwise monopolised. In proportion to the frequency of the repetition of such movements—to the degree in which they have become habitual, so can we the more easily understand that the cerebral action involved may take place without arousing consciousness, and so quite independently of trains of thought which are monopolising the person's attention. A motor incitation now really volitional, may, though similar in all other respects, at another time be purely reflex and unconscious, even though passing over from regions of the cerebral hemispheres themselves;* the consciousness or the unconsciousness of the incitation depending upon the particular direction of the attention of the individual at the time being. This view seems rendered all the more probable if we consider what are the effects on man of even small injuries of parts of the cerebral hemispheres above the level of the sensory ganglia. If, in the instance above alluded to, the person maintains the erect position, and even walks perfectly well, through the intervention of nerve-centres no higher than the sensory ganglia, how is it that the same man would be completely paralysed on one side of his body for months or perhaps years by an effusion of blood into, or a softening of, a portion of brain tissue quite above these sensory ganglia—by a lesion, for instance, of a portion of the opposite hemisphere outside its *corpus striatum*? We may set such an individual upon his legs as often as we choose, but no amount of mere sensory impressions are capable of exciting the supposed *sensori-motor* movements; the paralysed limb is utterly powerless, and even the mere attitude of standing, when the individual is unsupported, is found to be impossible.

* See article on "Physiology of Thinking," *Fortnightly Review*, Jan. 1869.

The experimental evidence which has been appealed to is also capable of receiving different interpretations; and, indeed, physiologists themselves have already expressed directly contrary opinions upon this subject. The evidence is, in fact, of such an uncertain nature as to be quite incapable of leading to a very definite conclusion, unless we have formed some decided opinion as to the real nature of a sensation, and as to how this differs from what is called a perception. Flourens denies, for instance, that birds or mammals whose cerebral hemispheres have been removed are any longer capable of appreciating sensory impressions; whilst Magendie, Longet, Vulpian, and many others maintain that such animals are capable of feeling simple sensations, and that they are therefore, to a certain extent, in possession of consciousness. But it may be fairly maintained that the way in which such animals respond to external influences acting upon them are explicable without postulating the existence of consciousness, if we bear in mind that they do still retain their sensory ganglia and all the related motor centres in organic connection with these; and if we bear in mind also what has been already said as to the degree in which impressions, reaching only so far as these sensory ganglia, and not revealing themselves in consciousness at all, are, nevertheless, *qualified*, and therefore capable of exciting those purposive movements which exist potentially in the related motor centres in the form of definite nerve connections. The molecular mobility of these centres has only to be disturbed in order to bring about, with machine-like precision, the natural movements themselves. Longet and Vulpian look upon the *pons Varolii* as the seat of *general sensibility*,* and there certainly seems much more evidence in favour of this view than in support of the doctrine of Dr. Carpenter that such is the function of the optic thalami. Evidence of different kinds seems quite opposed to the latter view; but much *may* be said—even though, as we think, to little purpose—in favour of the opinion of Longet and Vulpian. The *corpora quadrigemina* are similarly supposed to be the seats of perception for optical impressions. And one of the strongest facts that has been recorded in favour of the supposed *sensori-motor* nature of certain movements was observed in a pigeon, which lived eighteen days after its cerebral hemispheres alone had been removed by Longet. When this animal was taken into a dark room, every time a light was brought near its eyes the irides contracted, and often even winking occurred; "mais chose remarquable," Longet says,† "aussitôt que j'imprimais un mouvement circulaire à la bougie enflammée, et à une distance assez grande pour qu'il n'y eût point sensation de chaleur, le pigeon exécutait un mouvement analogue à sa tête." Nevertheless, it is said that this same animal sometimes seemed to avoid obstacles, and sometimes knocked himself against them. So that when we consider how closely the movements of the eyes are bound up with visual impressions generally, this following of the strong light, which seems so much to suggest consciousness, may be capable of explanation without having recourse to such a supposition. Dr. Carpenter has called attention to the fact that when the eyelids are closed, if we attempt to move the eye-balls in any given direction, we can only do this with considerable difficulty, and with an extreme sense of effort—"This sense being the result of the state of tension in which the muscles are placed by the effort to move the eyes without the guiding visual sensation." He then adds:—"Now, on the other hand, the will may determine to fix the eyes upon an object; and yet this

* These conclusions were arrived at from an observation of birds and mammals whose cerebral hemispheres, corpora striata, thalami, corpora quadrigemina, and cerebellum had been all removed, leaving within the cranial cavity only the *pons*, or *tuber annulare*, and the medulla. (Longet, "Traité de Physiologie," 3rd ed. t. iii. p. 156.)

† Loc. cit. p. 428.

very fixation may be only attainable by a muscular movement, which movement is directly excited by the visual sense without any exertion of voluntary power over the muscles. Such is the case when we look steadily at an object whilst we move the head from side to side; for the eyeballs will then be moved in a contrary direction by a kind of instinctive effort of the external and internal recti, which tends to keep the retina in their first position, and to prevent the motion of the images over them." These are said to belong to the category of voluntary movements, and yet we are not ourselves conscious that they are taking place; we know of it only, as Dr. Carpenter says—or rather learn to infer the existence of such movements in ourselves—by observing what takes place in other persons. We must make due allowances, therefore, for facts like these, when attempting to interpret what takes place in animals from whom a part of the brain has been removed; and we must also bear in mind that the endowments of the lower nerve-centres are different amongst different classes of animals, before we come hastily to the conclusion that movements of the kind mentioned in the pigeon were indicative of consciousness on its part; and still more before we conclude from such phenomena that the sensory ganglia in man are also seats of consciousness. As regards motor power, the differences are most notable amongst different groups of animals. Thus, after complete removal of the cerebral hemispheres, fish, reptiles, birds, and the lower mammalia experience extremely little diminution in their powers of movement. Carp and frogs continue to swim as well as before; a pigeon when abandoned in the air flies to the ground, settling lightly on its feet; whilst a rabbit runs away when irritated, performing these movements with no appreciable difficulty, and with only a slight evidence of weakness. The weakness becomes much more notable when the operation is performed upon a dog, though it is less marked in proportion as the animal is a young one. An adult dog deprived of his cerebral hemispheres is, however, no longer capable of maintaining the erect position, though it can still move its legs freely whilst lying down.

The effect in man, of even limited injuries to one or other hemisphere, in producing paralysis of the opposite side of the body, has been already referred to. Such variations must be taken into account in our interpretations of Longet's experiments with the pigeon. But even Longet himself, though he makes the *pons* the centre for general sensibility and the *corpora quadrigemina* the centre for visual sensations, seems, after all, to entertain considerable doubts or to whether he is warranted in making use of the word "sensation." Thus he says: "Certes en prenant le mot *sensation* dans son acceptation rigoureusement métaphysique, et ne l'appliquant qu'à tous les cas d'exercice de la sensibilité avec *conscience*, on devra admettre que la protubérance, siége de la sensibilité générale, et les lobes cérébraux, siége de l'intelligence, doivent nécessairement mettré, pour ainsi dire en commun leur activité, et concourir au même acte." But then he adds, "Mais à la rigueur, ne pourrait-on pas permettre aux physiologistes de distinguer la *perception* simple (en quelque sorte *brute*) des impressions, de l'attention qui leur est accordée, de l'aptitude à former des idées en rapport avec elles?" To this question we would reply that the power of simple perception with which Longet wishes to endow these lower centres is probably not attended by Consciousness, as he himself seems to intimate, and therefore such a word is altogether unsuitable to express that *unconscious discrimination* of impressions, which may be followed by apparently purposive movements, resulting from the excitation of these lower centres. How this unconscious discrimination may occur, and how it may result in definite movements, have been shown.

Thus, we think the experimental evidence leads us to the conclusion that *unconscious* or *organic discrimination* takes place in the sensory ganglia, just as it takes place in the spinal cord; only that the discrimination in the former is of a higher type, and results in the more purposive movements, because it takes place in nerve-centres of higher rank. For the production of a distinct state of feeling or sensation, however, even of the simplest kind, conscious intellect is needed, and this cannot be brought into operation without the conjoint activity of the cerebral hemispheres.

We do not consider that such a conclusion is in the least shaken by the evidence furnished by comparative anatomy, notwithstanding what Dr. Carpenter* says to the contrary. He writes as follows:—"Thus we are led by the very cogent evidence which comparative anatomy supplies, to regard this series of ganglionic centres as constituting the real *sensorium*, each ganglion having the power of rendering the mind conscious of the impressions derived from the organ with which it is connected. If this position be denied, we must either refuse the attribute of consciousness to such animals as possess no other encephalic centres than these, or we must believe that the *addition* of the cerebral hemispheres in the vertebrated series alters the endowment of the sensory ganglia,—an idea which is contrary to all analogy." We feel most surprised that Dr. Carpenter should have expressed this latter view; in the first place, because it is quite adverse to the general doctrines of Von Baer, or, in other words, to the doctrines of Evolution which he has done his best to elucidate; and, secondly, because such a notion is opposed to the information afforded by actual experiment as to the alteration in the endowment of the motor centres (to which we have already referred) in ascending the vertebrate scale. As specialisation of structure occurs, so must we get specialisation of function; and we are glad to find that an idea, long familiar to ourselves, has also occurred to Mr. Herbert Spencer, and has been thus clearly expressed by him†:—"It does not follow, as it at first sight seems to do, that feelings are never located in the inferior nervous centres. On the contrary, it may well be that in lower types [of animals] the homologues of these inferior centres are the seats of consciousness. The true implication is, that in any case the seat of consciousness is that nervous centre to which mediately or immediately the most heterogeneous impressions are brought; and it is not improbable that in the course of nervous evolution, centres that were once the highest are supplemented by others in which co-ordination is carried a stage further, and which, therefore, become the places of feeling, while the centres before predominant become automatic."

The conclusions at which we have arrived have an important psychological bearing. Thus, Herbart in Germany, followed by Sir William Hamilton in our own country, made Cognition or discrimination the fundamental fact of Mind, rather than Sensation or mere feeling (which is regarded as its basis by many others), and it must be confessed that physiological evidence accords with the former rather than with the latter view. In the first place, because no consciousness in the form of sensation can take place without the aid of intellectual activity under the form of cognition or discrimination; whilst, on the other hand, cognition or intellectual action may take place under the form of a mere *organic* or *unconscious discrimination*, without the intervention of consciousness. Thus, in the individual, consciousness or feeling comes to be superadded as an additional accompaniment to certain mere organic discriminations; so that consciousness, without which sensation cannot exist, is secondary, whilst cognition, in the form of unconscious discrimination, is primary. Out of this primary undifferentiated organic discrimination, such as alone pertains to the lowest forms of animal life, there has been gradually evolved that which we know as feeling and consciousness.

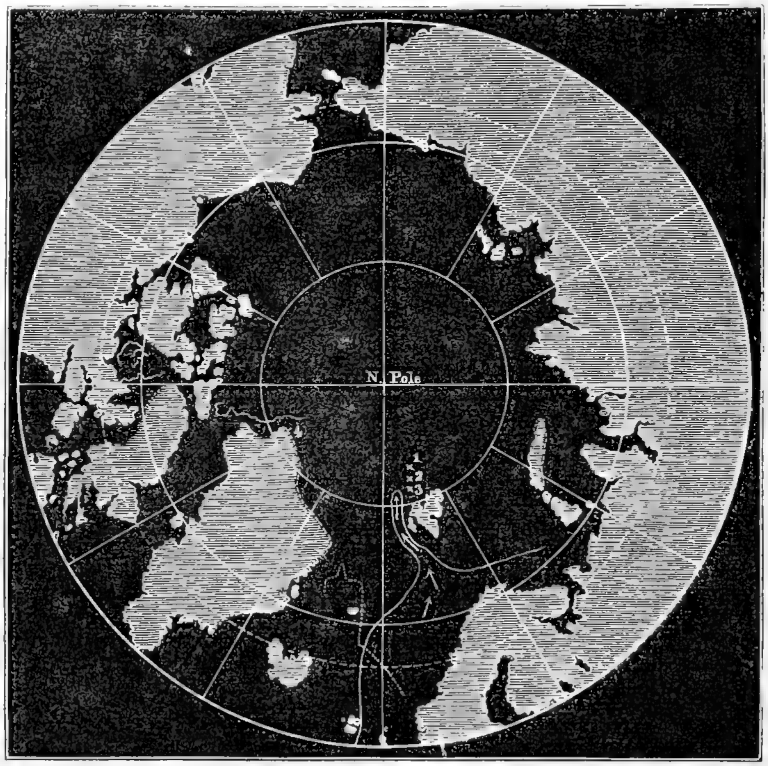
H. CHARLTON BASTIAN

* Op. cit., p. 503. † Principles of Psychology, Oct. 1868, No. 2, p. 105.

THE GERMAN AND SWEDISH EXPEDITIONS TO THE ARCTIC REGIONS

ENGLAND seems ready to resign the position she once held as chief of all the competitors in Arctic exploration. Our flag has been carried within $7\frac{1}{2}$ degrees of the North Pole; our seamen have forced from the ice-bound straits which lie to the north of America the secret of the North-Western Passage; and from the days of Scoresby until those of Franklin we have been foremost in scientific researches within the dreary Arctic wastes. But now the answer to all who would emulate the deeds of a Parry or a Ross, a Beecher or a Franklin, is the stereotyped *cui bono.* A business account of the probable gains of an Arctic journey must be rendered before England will send men or ships to the Polar seas.

In the meantime, Swedish and German explorers are pushing their way boldly into the regions where England won her Arctic laurels—perhaps we ought rather to say, ice-wreaths. Already the most northerly spot reached by our seamen has been all but attained, and there is yet room for supposing that this very year the second German expedition may push its way to the Pole itself. Scientific results of extreme value have also been attained. The course of the Gulf Stream (if Mr. Findlay will permit the name) has been tracked into very high latitudes, its depth has been gauged, and the nature of the currents which run beside it, or beneath it, has been carefully inquired into. The various forms of life which people those Arctic seas have been examined with loving care (extending even to a judicious use of powder and shot, or nets and fish-hooks, as the case might be) by the naturalists who have accompanied the expedition. And lastly, a very important addition, about which I hope to make some remarks on a future occasion, has been made to our knowledge of the variations of the magnetic needle in Arctic regions.



MAP OF THE NORTH POLAR REGIONS

The primary object of all three expeditions has been to attain, if possible, the North Pole of the earth. Dr. Petermann, who had the principal part in planning the German expeditions, has a theory about Greenland, which was associated, perhaps not very fortunately, with the other objects of the German voyagers. But undoubtedly the attainment of the highest possible northerly latitude was their principal aim.

A glance at the accompanying map will show the nature of the Arctic regions, so far as they have yet been explored. The circle 10 degrees from the North Pole has hitherto been crossed in only two neighbourhoods. The figure shows (1) where Parry made his most northerly point in 1827. The Swedish and German expeditions of last year pushed their way towards the same region, and the crosses numbered (2) and (3) indicate the spots they respectively reached. In 1854 Dr. Kane crossed the circle of 10 degrees near (4), having pushed his way along the inlet above the north-western point of Greenland. And in 1865 Dr. Hayes reached the same point, after traversing a large part of Greenland in sledges drawn by Esquimaux dogs.

Notwithstanding the hopes which M. Lambert has formed of attaining the North Pole by passing through the Straits between Asia and North America (shown near the top of the map), there seems every reason for believing that if the North Pole is ever reached by man it must be either along the course pursued by Kane and Hayes, or by the path which Parry followed. In fact, it is reasonable to confine our attention wholly to the latter course, since Dr. Hayes' journey sufficed to show that without the means of crossing the sea, further passage northwards from (4) is impossible, and it is inconceivable that any suitable sea-boat could be carried to (4) either by Kane's or Hayes' route.

The Swedish expedition to (2) is perhaps the most hopeful sea-journey that has yet been made towards the North Pole. They had been engaged until late in the Arctic season in scientific researches on the coast of Norway; yet they succeeded in pushing their way within a few miles of the most northerly point yet reached, and were even then only impeded by the dangers due to the approach of winter. There seems every reason to believe, that had they started a few months earlier they might have pushed their way much further north.

The German expeditions, undertaken in the two years, seem to have followed a course less likely to be successful. Dr. Petermann holds that Greenland extends much further towards the north-west than its shores have yet been traced—nay, even past the Pole, perhaps, to the neighbourhood of Behring's Straits, between Asia and America. Both expeditions sought to reach the north-eastern shores of Greenland with the object of ascertaining whether this theory, or General Sabine's view that Greenland has some such figure as is indicated by the dotted line in the map, is the more correct.

Twice in 1868 Captain Köldewey was forced to abandon this attempt, and each time after his defeat he made for the shores of Spitzbergen. Thus, on July 18, he had already crossed the 80th parallel, and was close to the station marked (3); but thence he again made, by a long *détour*, for the shores of Greenland. It was after his second repulse that he reached his most northerly point (3), close to the most northerly limit of the Swedish expedition.

This year, Captain Köldewey, now in a steamship, has pursued the same tactics, except that he has been less ready to accept defeat, and has persistently sought to penetrate the ice-laden seas which surround the Greenland coast. The dotted line shows the general course of the second expedition; and it will be seen that when last heard of they were close by Greenland, and far south of the 75th parallel. Captain Gray, who brought the latest intelligence of their doings in this neighbourhood, states that on August 1, although the sea was still much encumbered with ice, it was becoming rapidly clearer, so that the *Germania* was likely to have little difficulty in reaching the Greenland coast. I confess, however, that I do not share the hopes which have been expressed of the successful progress of the expedition this year. The result of the expeditions of 1868 seems to point very clearly to another course than that which the *Germania* is now seeking to pursue: and there is nothing in the whole history of Arctic expedition to encourage a hope that a way can be found so far to the west (at least in latitudes below 80°), to the neighbourhood of the North Pole.

The figure indicates the course of the mean summer and autumn isotherm of 3° Reaumer (about 39° Fahr.), in the North Atlantic. Along the course marked by arrows a branch of the Gulf Stream has been traced (in summer) as far north as latitude 81½°; the main stream making its way towards Novaia Zemlia.* Does not Nature herself seem to point out this track past Spitzbergen as the proper course for North Polar explorers? Here, in the first place, the mildest temperature is found; and in Arctic voyaging this is a matter of no small importance. Here also is an assisting current—*valeat quantum valere debet.* But the chief circumstance to be noticed is, that the course followed by the Gulf Stream shows that there is open water—ice-encumbered, no doubt, but still not ice-bound—in this direction. It is well worthy of notice, too, how deep the sea is along this part of the Atlantic. Herr von Freeden remarks, that the whole of the Bernese Oberland might be hidden, "its presence unbetrayed even by an eddy," under the ocean to the north-west of Spitzbergen. Long ago, indeed, Scoresby found no bottom with a two-mile line. Here, then, if anywhere, a ship might expect to find her way, though experience has shown again and again that that way is full of dangers.

Either along this course or along the track suggested by Herr von Freeden, the Pole, I doubt not, will yet be reached. It will be remembered that Sir Edward Parry, setting forth from Spitzbergen on his famous "boat and sledge" expedition, was foiled by an unforeseen difficulty. The whole mass of ice over which he had tracked his way for more than a hundred miles began to drift southward, so that, as fast as Parry and his party travelled northwards, they were set back by the relentless sea and wind. Now, Parry's defeat shows at once the hopefulness of the course suggested above, and of Von Freeden's proposition that an expedition like Parry's should be commenced earlier in the season, when the ice is as yet unbroken. The very fact that Parry's great ice-ship floated freely shows how wide and deep the seas must be even far to the north of the spot he reached. For not only could he see no sign of water in front—and the Arctic voyager can recognise a "water-sky" at a great distance—*but the point where he turned must have been a few days before some hundred miles at least further north*, for he and his party had been floated back more than a hundred miles. There must then have been, that year at least, a course round the floating ice-fields which would have carried a daring seaman to an open sea between the North Pole and station 1, and far to the north of the latter point. On the other hand, the ease with which Parry's party pursued their way northwards shows, as Herr von Freeden justly remarks, that it would be no very difficult matter to attain the Pole itself over the ice, if the journey were made in early summer.

RICHARD A. PROCTOR

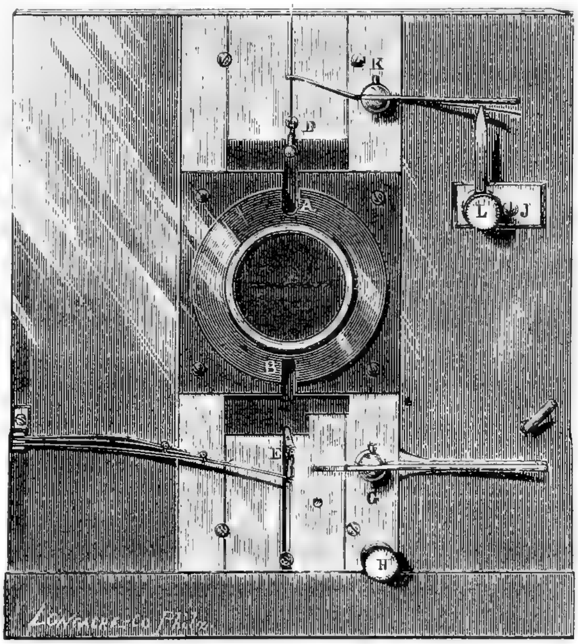
* Petermann's Geog. Mittheilungen, Part VI. The paper on "the scientific results of the first German North-polar Expedition," by Herr W. von Freeden, in this number of the Mittheilungen, will well repay careful study. In Part IX. the progress and results of this year's expedition, so far as they are yet known, are detailed in a series of letters from the people on board the *Germania*.

IMPROVED ECLIPSE CAMERA

IT is to be hoped that shortly, in view of the approaching total eclipse in December next—to observe which we trust a Government expedition will be organised—English astronomers will be making arrangements for obtaining as valuable a series of photographs as the one which rewarded the efforts of the American astronomers last year.

We therefore append a description of the important modifications successfully introduced by Professor Morton, of Philadelphia.

A B represents the face plate of the camera, to which the eye-piece tube was attached, its other end being screwed to the telescope. The diaphragm plate, D E, moved across the axis of the instrument, being drawn downwards by the combined spring, C F. The strength



of this spring could be reduced by raising the outer end of one or both the upper strips so as to disengage the forks at their end from the lower spring, and then turning them forward in a direction normal to the front of the box, out of the way.

The spring was attached to the diaphragm plate by a swivel hook.

A number of diaphragm plates were provided, with slits respectively of $\frac{1}{40}$, $\frac{1}{30}$, $\frac{1}{20}$ and $\frac{1}{10}$ of an inch in width. These plates could be readily interchanged, and, in combination with the springs, gave a very wide and yet delicate series of fixed adjustments for the times of exposure.

To make the exposure, the plate was drawn up until the projecting pin, D, could be caught on the lever, K, which would then retain it. On depressing the outer end of this lever, however, with the finger, the hold on the pin was disengaged, and the plate flashed across the axis of the tube, allowing light to traverse the narrow slit as it flew past. The plate was then arrested on the end of the second lever, G. When an exposure of some seconds was required, as during the totality, a plate having a round orifice exposing the entire field of the eye-piece was substituted for the one with the narrow slit, and was so arranged that, when caught by the upper lever, it covered the lens, but when fallen to the second lever, exposed it entirely; when, however, this lever was in turn touched, the plate descended again far enough once more to close the lens. By touching these two levers in succession, it was then possible to make a "time exposure" with great nicety and accuracy, as proved by actual experience during the eclipse.

To secure a chronographic record of each exposure, a binding screw was provided to make one connection with the general mass of the face-plate including lever K, and another at L, to carry on the circuit when the downward motion of the lever brought the spring at its side in contact with the point projecting from L. In raising the lever for a new exposure, the spring at its side was pressed back so as to pass the point without contact.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Kant's View of Space

THE following paragraphs, I believe, faithfully render sundry passages of Kant's writings:—

"Objects are given to us by means of sense (Sinnlichkeit), which is the sole source of intuitions (Anschauungen); but they are thought by the understanding, from which arise conceptions (Begriffe)." ("Kritik," p. 55. Hartenstein's Edition.)

"The understanding is the faculty of thought. Thought is knowledge by means of conception." (*Ibid.* p. 93.)

"The original consciousness of space is an intuition *à priori*, and not a conception (Begriff)." (*Ibid.* p. 60.)

"Space is nothing else than the form of all the phenomena of the external senses; that is, it is the subjective condition of sense, under which alone external intuition is possible for us." (*Ibid.* p. 61.)

"Our nature is such, that intuition can never be otherwise than sensual (Sinnlich); that is, it only contains the modes in which we are affected by objects. On the other hand, the power of thinking the object of sensual intuition, is the understanding. Neither of these faculties is superior to the other. Without sense, no object would be given us, and without understanding none would be thought. Thoughts without contents are empty, intuitions without conceptions (Begriffe) are blind." (*Ibid.* p. 82.)

"Time and space are 'mere forms of sense'" (Formen unserer Sinnlichkeit, "Prolegomena," p. 33) and "mere forms of intuition." ("Kritik," p. 76.)

With these passages before one, there can be no doubt that that thorough and acute student of Kant, Dr. Ingleby, was perfectly right when he said that Kant would have repudiated the affirmation that "space is a form of thought." For in these sentences, and in many others which might be cited, Kant expressly lays down the doctrine that thought is the work of the understanding, intuition of the sense; and that space, like time, is an intuition. The only "forms of thought" in Kant's sense, are the categories.

T. H. HUXLEY

January 14

I DO not believe Professor Sylvester has been betrayed, as Mr. G. H. Lewes asserts, into any misconception of this matter by me.

When Kant, at the outset, says, "Alles Denken aber muss sich, es sei geradezu oder im Umschweife, vermittelst gewisser Merkmale, zuletzt auf Anschauungen...beziehen," it would take the veriest dunderhead not to see that all forms of intuition must be, indirectly at least, forms of thought. I never dreamed of disputing so obvious a position. But I object to the phrase "forms of thought," as designating Space and Time, on the ground of precision. They are *peculiarly* forms of general Sense, and not forms of Thought *as Thought*. Kant, I believe, eschewed the phrase in that sense, and, for all I see, might for the same reason have disclaimed it.

Ilford, Jan. 14

C. M. INGLEBY

IT is not *my* habit "when objections are made to what I have written, silently to correct my error or silently disregard the criticism." If the objections are well founded, I think it due to the cause of truth to make a frank confession of error, and in the opposite case to reply to the objections.

With reference, then, to Mr. Lewes's strictures in NATURE's last number, I beg to say that Dr. Ingleby has "betrayed" me into no error. If I have fallen into error, it is with my eyes open, and after satisfying myself by study of Kant, that to speak of Space and Time, whether as forms of understanding, or as forms of thought, is an unauthorised and misleading mode of expression. Space and Time are forms of sensitivity or intuition. The categories of Kant (so essentially in this point differing from those of Aristotle) do not contain Space and Time among them, and are properly called forms of understanding or thought.

To the existence of thought the operation of the understanding is a necessary preliminary.

Sensibility and intuition are antecedent to any such operation.

Can Mr. Lewes point to any passage in Kant where Space and Time are designated *forms of thought?* I shall indeed be surprised if he can do so—as much surprised as if Mr. Todhunter or Mr. Routh, in their Mechanical Treatises, were to treat *energy* and *force* as convertible terms. To such a misuse of the word energy it would be little to the point to urge that *force without energy is a mere potential tendency*. It is just as little to the point in the matter at issue, for Mr. Lewes to inform the readers of NATURE that *intuition without thought is mere sensuous impression*.

Dr. Ingleby has rendered, in my opinion, a very great service to the English reading public, by drawing attention to so serious and prevalent an error as that of confounding the categories (the proper forms of thought *as thought*) with Space and Time, the forms of intuition, the Sentinels, so to say, who keep watch and ward outside the gates of the Understanding.

Athenæum Club, Jan. 15

J. J. SYLVESTER

Correlation of Colour and Music

SOME twenty-six or twenty-seven years ago, in a lecture on Light at the London Institution, I suggested an analogy between the octaves of Sound and Light; not then knowing the view of Sir J. Herschel to which Dr. Pereira subsequently called my attention.

I endeavoured to support the hypothesis of three primary colours by supposing the intermediate colours to arise from the blending of the primary. Thus orange would result from the blending of red and yellow, green from yellow and blue, and violet from the secondary red impinging on the blue or indigo. This seemed to me a less arbitrary explanation than that of Sir D. Brewster of a superposition (in degrees of intensity chosen to suit the hypothesis) of all the primary colours throughout the whole spectrum. Spectrum analysis has now much changed our views on this subject.

The interesting article in your number for January 13, by Mr. Barrett, has recalled my attention to the matter, and induces me to ask whether he, or any of your contributors, can explain a phenomenon which I have very often observed, as have doubtless others, but which I have never seen noticed in any work on Light.

It is this. When a very brilliant solar-rainbow is seen, there is plainly visible within, and forming a continuous spectrum with the main rainbow, a repetition, but in much narrower bands, of the rainbow: the same seven colours in the same order; and within this again, I have, on certain occasions, detected a third. Are these repetitions of the spectrum as suggested by Sir J. Herschel? If so, we should have two, three, and more reds, and so of the other colours, in which light, producing the impression of the same colour on the retina, would have different wave-lengths, say, in the ratios of one, two, four, &c.; or is the phenomenon due to some other cause?

W. R. GROVE

January 15

I VENTURE to call attention to a curious point in connection with the very interesting note by Mr. W. F. Barrett on the "Correlation of Colour and Music," which appeared in yesterday's NATURE (January 13). The researches of Helmholtz and others have (as is well known) overthrown, to a certain extent, the old idea of the three primary colours—red, blue, and yellow—and have shown that if any *three* are to be selected, red, blue, and green have greater claims than the former. Now, in Mr. Barrett's diagram these correspond to the following notes:—

Red.	Yellow.	Green.	Blue-Indigo.
C.	E.	F.	G.
Tonic.	Third.	Sub-dominant.	Dominant.

The old triad, red, yellow, blue, correspond to the common chord; but the new triad, red, green, and blue, to the *tonic, subdominant* (or fourth) and *dominant* (or fifth); or, in other words, to the three notes which constitute in music the *fundamental base* of the scale.

F. DE CHAUMONT, M.D.

Army Medical School, Netley, Jan. 14

Government Aid to Science

I CANNOT but feel flattered that my letter on this subject should have been thought so dangerous as to require a leading article in the same number by way of immediate antidote, but I must beg you to allow me to correct one or two errors into which you have fallen as to the views I really hold, and which it seems I failed clearly to express. You say, you "understand Mr. Wallace to mean that the main result of cultivating science is merely the gratification of those directly engaged in the pursuit, and that they who do not take this personal interest in it derive little or no benefit from it."

The first half of this passage does express, though imperfectly, what I believe to be the truth; the latter half expresses the exact opposite of what I have ever thought or intended to write on the subject. The main result of the cultivation of science I hold to be, undoubtedly, the elevation of those who cultivate it to a higher mental and moral standpoint; while the secondary, but not less certain result, is the acquisition of countless physical, social, and intellectual benefits for the whole human race. But if these are the *secondary* and not the *primary* results of cultivating science, it seems to me to be radically unsound in principle, and sure to fail in practice, if by means of any system of State support we seek to find a short cut to these secondary results.

The only logical foundation for advocating the furtherance of scientific discovery by the expenditure of public money, would be the belief that science can be most successfully pursued by those whose chief object is to make practical and valuable discoveries; whereas the whole history of the progress of science seems to me to show that the exact opposite is the case, and that it is only those who in a noble spirit of self-sacrifice give up their time, their means, even their lives, in the eager and loving search after the hidden secrets of Nature, who are rewarded by those great discoveries from which spring a rich harvest of useful applications.

One more point: I do not admit that it is just to tax the community for all the Government institutions you name, but in the short space at my command I could not go into details. I have stated how I think some of these institutions require modification to make them accord with the fundamental principle of just government; and if that principle is a sound one, it is easy to see in what way the others should be dealt with. As an example I may indicate, that a detailed survey, like that of the large-scale Ordnance-maps, being primarily a boon to the landowners of the country, should not be *wholly* paid for by the public.

ALFRED R. WALLACE

Food of Oceanic Animals

I FIND on my return home that Dr. Wallich is vexed at my not having given him the credit of having already answered the question which I ventured to put in the ninth number of NATURE, and that he apparently accuses me of inconsistency as regards my estimate of his observations on deep-sea life. I hasten to assure him that my opinion in that respect has never changed; nor do the extracts which he has given from my reports warrant such an inference.

I certainly overlooked some of his remarks in the "North Atlantic Sea-bed" bearing on my question, in which he says (page 131), it may be asked "under what other conditions than exceptional ones can marine animal life be maintained without the previous manifestation of vegetable life, as must be the case if it exists at extreme depths?" And he answers this inquiry by submitting that "in the majority of the marine Protozoa—as for instance in the Foraminifera, Polycystina, Acanthometræ, Thalassicollidæ, and Spongidæ—the proof of these organisms being endowed with a power to convert inorganic elements for their own nutrition, rests on the indisputable power which they possess of separating carbonate of lime or silica from waters holding these substances in solution." But this does not appear to be a satisfactory answer to the inquiry; because a limpet separates carbonate of lime from sea-water in order to construct its shell, yet it cannot be assumed that this animal (which is well known to be a vegetable-eater) has also the power of converting other inorganic substances for its own nutrition. Among the Protozoa, many, probably all, of the Rhizopods are animal-eaters. With regard to sponges, Dr. Bowerbank says (Mon. I., p. 122) that in the greater number their nutriment "is probably molecules of both animal and vegetable bodies, either living or derived from decomposition," and that "the fæcal matters exhibit all the characteristics of having undergone a complete digestion."

J. GWYN JEFFREYS

P.S.—In the 10th number of NATURE, Dr. Martin Duncan, under the head of "Deep-Sea Corals," opposes a statement in what he calls a postscript to my report on the "Deep-Sea Dredging Expedition in H.M.S. *Porcupine*." This statement was not part of my report, nor had I anything to do with it.

J. G. J.

MY attention has been directed to a paragraph in one of the late numbers of NATURE referring to Professor Dickie's interesting remarks on the bathymetrical distribution of Algæ, and raising the question of the mode of nutrition of the great sheet of animal life, which is now shown to extend over the bottom of the sea at all depths.

This curious problem was of course one of the first which engaged our interest when working up the results of the dredging cruise of the *Lightning*. In April last, I proposed a solution in one of the "Afternoon Scientific Lectures" in connection with the Royal Dublin Society, which was afterwards reprinted in full in the "Annals and Magazine of Natural History." I see from notices in several newspapers that this question has excited considerable interest; I may, perhaps, therefore be allowed to quote the passage in the lecture specially bearing upon it:—

"The question of the mode of nutrition of animals at these great depths is a very singular one. The practical distinction between plants and animals is, that plants prepare the food of animals by decomposing certain inorganic substances which animals cannot use as food, and recombining their elements into organic compounds upon which animals can feed. This process is, however, constantly effected under the influence of light. There is little or no light in the depths, and naturally there are no plants: but the bottom of the sea is a mass of animal life. On what do these animals feed? The answer seems to be sufficiently simple: nearly all the animals—practically *all* the animals, for the small number of higher forms feed upon these—belong to one sub-kingdom, the Protozoa, whose distinctive character is that they have no special organs of nutrition, but that they absorb nourishment through the whole surface of their jelly-like bodies. Most of these animals secrete exquisitely-formed skeletons, sometimes of lime, sometimes of silica. There is no doubt that they extract both of these substances from the sea-water, although silica often exists there in quantities so small as to elude detection by chemical tests. All sea-water contains a certain proportion of organic matter in solution. Its sources are obvious. All rivers contain a large quantity: every shore is surrounded by a fringe which averages about a mile in width of olive and red sea-weeds: in the middle of the Atlantic there is a marine meadow, the Sargasso Sea, extending over three millions of square miles: the sea is full of animals which are constantly dying and decaying; and the water of the Gulf Stream, especially, courses round coasts where the supply of organic matter is enormous. It is, therefore, quite intelligible that a world of animals should live in these dark abysses, but it is a necessary condition that they should chiefly belong to a class capable of being supported by absorption, through the surface, of matter in solution; developing but little heat, and incurring a very small amount of waste by any manifestation of vital activity. According to this view, it seems highly probable that at all periods of the earth's history, some form of the Protozoa, rhizopods, sponges, or both, predominated greatly over all other forms of animal life in the depths of the warmer regions of the sea; whether spreading, compact, and reef-like, as the Laurentian and Palæozoic eozoön;

or in the form of myriads of separate organisms, as the globigerinæ and ventriculites of the chalk. The rhizopods, like the corals of a shallower zone, form huge accumulations of carbonate of lime, and it is probably to their agency that we must refer most of those great bands of limestone which have resisted time and change, and which come in here and there with their rich imbedded lettering, to mark, like milestones, the progress of the passing ages."

The following passage, referring to another aspect of the question, was published in the 114th Number of the "Proceedings of the Royal Society":—

"The vitreous sponges along with the living Rhizopods and other Protozoa which enter largely into the composition of the upper layer of the chalk-mud, appear to be nourished by the absorption through the external surface of their bodies of the assimilable organic matter which exists in appreciable quantity in all sea-water, and which is derived from the life and death of marine animals and plants, and, in large quantity, from the water of tropical rivers. One principal function of this vast sheet of the lowest type of animal life, which probably extends over the whole of the warmer regions of the sea, may possibly be to diminish the loss of organic matter by gradual decomposition, and to aid in maintaining in the ocean the 'balance of organic nature.'"

I cannot at present enter into detail, as the whole subject of the conditions of life at great depths will be fully discussed in the second part of the preliminary report to the Royal Society on the *Porcupine* Expedition. I may mention, however, that the much more extended researches of the past summer have increased our confidence in the general accuracy of our former conclusions; while careful analyses by the physicists who accompanied the expedition have proved the existence in the water at all depths of a very appreciable and tolerably constant proportion of organic matter in a condition suitable for assimilation by animal organisms. WYVILLE THOMSON

January 7

MY friend Mr. J. Gwyn Jeffreys informs me that he is not answerable for the postscript to his letter, a sentence in which I noticed in a letter published by you in the last number of NATURE. Will you kindly insert this statement.

Lee, January 10 P. MARTIN DUNCAN

[The postscript was editorial, and so appears on the face of it.]

NOTES

IT was announced by Mr. Lockyer at the meeting of the Royal Astronomical Society, on Friday last, that the great refractor of 25 inches aperture, constructed by the Messrs. Cooke, of York, is so near completion that it will be erected in the observatory prepared for it at Gateshead early next month. The completion of this magnificent instrument, with which Mr. Newall has endowed science, marks an epoch in astronomy. Mr. Newall has in fact done what the French Government has already done, and what our Government ought to have done; he has furnished observers with an instrument capable of grappling with the physical problems which have now to be solved—one on a level with our present requirements; and we doubt not that when it is once at work, the wish of its owner, that science may be advanced by it, will be amply fulfilled.

WE are informed that the Senate of London University have proposed to establish a Faculty of Science.

THE last number of the journal of the German Chemical Society contains a biographical sketch of the late Professor Graham, in which his scientific merits are more fully analysed than in the interesting sketch lately published by Professor Williamson in the columns of NATURE. Professor Hofmann, the author of the German biographical notice, has added a photograph of the late Master of the Mint, and an autographic copy of a letter of particular interest to the society. It runs as follows:

"4, Gordon Square, London, Dec. 28, 1868. My dear Hofmann,—I am much gratified by the receipt of your kind letter, and have since received the official intimation of my election as an honorary member of the Berlin Chemical Society over which you preside, which I esteem a high compliment and great honour. I have written a line to Messieurs the secretaries in acknowledgment, which I beg you to forward to them. There is a communication of mine before the Royal Society at present, which I believe will amuse you, or at least the hardiesse of the thing will surprise. What do you think of Hydrogenium, a white magnetic metal of the specific gravity 2?—I remain, dear Hofmann, sincerely yours, THOS. GRAHAM."—On Saturday, January 8, this society gave a dinner to Professor Hofmann, on his retiring from the presidency. The presence of a great number of the celebrities of the town added to the significance of this meeting. Professor Magnus (who acted as chairman on the occasion), Dove, Virchow, Rose, Dubois-Raymond, Kronecker, Curtius, and others, as also some of the Ministers of State, the American Ambassador (Mr. Bancroft), &c., honoured the meeting with their presence, and partly with their speeches. A great number of the foreign members sent messages from England and France, or from distant parts of Germany. The following telegram was received from M. Dumas, at Paris:—"Félicitations et vœux! Longue prospérité à la société! Longue vie à Hofmann! Votre fête est la fête de famille des chimistes du monde entier, qui tous l'admirent et l'aiment." A photolithograph representing Dr. Hofmann, the discoverer of compound Ammonium, as Jupiter Ammon, surrounded by a halo of Aniline colours, was distributed and explained by the artist, and a hymn to Aniline, composed for the occasion, gave a humorous tone to the latter part of the festival.

ALL readers of the "Origin of Species" are aware that the theory now universally (and rightly) known as "Darwinian," was independently conceived and thought out by a naturalist who knew nothing of Darwin's views of the operation of natural selection, and who was at that time thousands of miles away from England. The English public are therefore not likely to forget that to Mr. Alfred Wallace, as well as to Mr. Darwin, belongs the distinction of having discovered "a new idea, a new genus of thought." In Germany, where Darwinism has excited such profound interest, the claims of Mr. Wallace have been somewhat overlooked by the distinguished men who have expounded the theory of natural selection. This has now been rectified by the publication of a pamphlet entitled "Charles Darwin und Alfred Russell Wallace," in which Dr. A. B. Meyer reprints the papers by which the theory was first made known; narrates the circumstances of their publication; and gives slight sketches of the lives of their authors. Dr. Meyer adds to these biographical sketches, lists of the writings of their subjects. Such lists are sometimes not brought down to so late a date as they should be; but in the case of Mr. Wallace, so far is this from being the case, that we see noted as published in the pages of NATURE an article on Geologic Time, which we regret to say we have not yet been able to lay before our readers, owing to the extraordinary pressure upon our columns.

PROFESSOR MAYER was elected, at the meeting of the French Academy on January 10, a correspondent of the section of Physics in place of the late Prof. Matteucci. Of 47 votes, Prof. Mayer received 40; of the remainder, 5 were given to Prof. Kirchhoff, and 1 each to M. Ångström and Sir W. Thomson. We are indebted to the *Revue des Cours Scientifiques* for the following information with regard to vacancies in the lists of corresponding members of the various sections of the Paris Academy of Sciences. The Astronomical section has four corresponding members to replace, namely, Enke, Admiral Smyth, Petit, and Valz; but as the most recent vacancy occurred so long ago as 1867, it is probable that the section considers that the number of places for corresponding members exceeds that of the foreign and provincial astronomers worthy of the honour. In the Physical section, into which, as our readers are aware, Prof. Helmholtz of

Heidelberg and Dr. Mayer of Heilbronn, have recently been elected, there is still a vacancy caused by the death of Principal Forbes, which took place in December 1868. In the section for Geography and Navigation no successor has yet been appointed to M. A. d'Abbadie, elected *membre titulaire* in April 1867. In the Chemical section there are two vacancies, that of Bérard of Montpellier, who died in June last, and that of Prof. Graham, the Master of the Mint, who died in September. There are likewise two vacancies in the Mineralogical section, which includes the Geologists and Palæontologists. They were occasioned by the promotion of Sir Roderick Murchison to the rank of Foreign Associate, and the death of M. Fournet of Lyons. M. Harrman has been nominated by this section for the first place; Dr. W. H. Miller of Cambridge will probably obtain the second. Mr. Dana is, however, also spoken of; likewise two French geologists, M. Lory of Grenoble and M. Leymerie of Toulouse. The Zoological and Anatomical section has three *fauteuils* to dispose of, those of Quoy of Brest, Carus of Dresden, and Purkinje of Prague. One of them will in all probability be assigned to Prof. Huxley. Lastly, there are two vacancies in the Medical section, those of Panizza of Pavia and Sir W. Lawrence. Prof. Lebert of Breslau will almost certainly be nominated by the section for one of the vacancies.

THE Chancellor of the North-German Confederation has presented to the Federal Council the report of the Scientific Commission on the best means of observing the transit of Venus in 1874. The detailed report proposes to send two expeditions to different points of the northern, and two others to different localities in the southern hemisphere.

THE third volume of Dr. Percy's admirable "Metallurgy" will shortly be issued. There will still be another volume to complete the work.

THE Royal Irish Academy at their last meeting approved of some alterations in the bye-laws proposed by the Council. By these alterations the Council for the future will be divided into two Committees: one of Science, consisting of eleven members, and one of Polite Literature and Antiquities, consisting of ten members. The Committee of Publication to consist of four members from each of the Committees of Council. This change will very much simplify the management of the Academy. The first election under the new bye-laws will take place on the 16th March next, and we trust that at least one biologist may be elected into the Committee of Science. For many years past neither a zoologist nor a botanist has been elected into the Council.

L'Institut has announced that from the beginning of the new year it will open its columns to the discussion of scientific subjects of interest to the public at large. We hold that it is an important part of the work of a weekly scientific journal to afford opportunity for instructing others than scientific workers, and also to afford opportunity for a more careful and thorough sifting of most scientific questions than is possible at the meetings of learned societies or in the pages of periodicals published monthly or quarterly. It is satisfactory to us to find that our views on this head are endorsed by so long established and ably conducted a journal as *L'Institut*. As the space which we can devote to letters is necessarily limited, we take this opportunity of begging that our correspondents will make their communications as short as is consistent with clearness.

IN a paper published in a recent number of the *Journal of the Society of Arts*, Mr. Alexander Wallace expresses his conviction that the cultivation of the silkworm may now be successfully and profitably carried out in England, as the causes which led to the failure of the attempts made by the British, Irish, and Colonial Silk Company some forty years ago have been greatly modified. He advocates the adoption of the oak-feeding silkworm of Japan, Bombex Yama-mai, and thinks that the experience of a few more seasons will show the limits of temperature and locality wherein it may be acclimatised.

HAVING adverted in our number of last week to the view recently maintained by Prof. Huxley that the difference between Celt and Saxon is merely one of language, we think it right to call attention to the rejoinder of a "Devonshire Man," printed in the *Pall Mall Gazette* of Tuesday last. The writer energetically opposes Prof. Huxley's attempt to prove identity of race between the natives of Tipperary and the men of Devonshire. He shows further, that Cæsar was fully alive to the essential difference of character between the Celts and the Teutons, and that he defined those characters in language which for accuracy and precision could not be exceeded in our day. The "Devonshire Man" did not, however, adduce any evidence depending on physical characters in support of his view of the question; probably leaving this powerful weapon to some one who has made a special study of European ethnography.

MR. W. CHANDLER ROBERTS has been appointed Chemist to the Mint. The selection of this gentleman to fill this important office is a good one: many points arise during the working of the precious metals that require careful investigation, and Mr. Roberts will doubtless also continue the valuable researches interrupted by the death of Professor Graham.

WE have received specimens of a new process of photo-mechanical printing, patented by Messrs. Edwards and Kidd, of 22, Henrietta Street, Covent Garden. It seems admirably adapted for the reproduction of the works of the great masters of etching and engraving. We are unable as yet to speak of the process as applied to photographs of landscapes.

THE Royal Danish Society of Sciences has offered the following prizes for scientific memoirs, which may be written in Latin, French, English, German, Swedish, or Danish, and must be sent to the secretary of the Society, Professor J. S. Steenstrup, before the end of the month of October next. A gold medal for a memoir establishing a mathematical theory of some branch of assurance hitherto destitute of any such foundation; a gold medal for an experimental and theoretical essay on the law of Cauchy relating to the dispersion of coloured rays, with especial reference to the number of constants necessary to be introduced into the formula; and the Classen prize of 300 rixd. (about 34*l.*), for an investigation of the movement of the air in a system of ventilation. Full details of the questions, in French, will be found in the "Oversigt" of the Society for 1869, No. 1.

MR. JAMRACH, of St. George's Street East, in a letter addressed to *Land and Water*, gives the following extraordinary list of animals now on sale at his establishment:—"1 pair of South African lions, 1 brown hyena, 1 striped hyena, 8 Tasmanian devils, 1 large rare dasyurus, 8 dasyurus maugeii, 6 ichneumons, 4 banded ichneumons, 1 musk cat, 1 African skunk, 1 pair American black bears, 1 pair zebras, 1 pair imported yaks, 6 llamas, 2 Iceland ponies, a new deer, a Brocket deer, a springboc, a harnessed antelope, 2 female and 1 male Wapiti deer, a female nylghaie, a pair fat-tailed sheep, 10 kangaroos, 1 broad-nosed wombat, 1 pair mouflon, a Formosa pig, 8 large crested porcupines, 4 Java porcupines, 1 Java hare, 4 vulpine phalangers, 2 black phalangers, 1 pacca, 4 baboons, 1 pair large drills, 1 mandrill, 2 Mona monkeys, 1 ringtail monkey, 3 green monkeys, 1 blue fox, 1 pair flying opossums, 1 pair emus, a maraboo, a pair Mexican cranes, a pair Demoiselle cranes, 5 spur-wing geese, 16 pair Carolina ducks, 1 pair Australian wild ducks, 2 pair white peafowl, 1 pair lineated pheasants, sand grouse, Mogadore partridges, a New Zealand rail, large European vulture, 1 black hawk, 1 condor, a female Bateleur eagle, a secretary, 2 caracaras, 1 Australian thick-knee, 1 snapping turtle, 20 grey parrots, 12 green parrots, 20 king lories, 1 China lori, 4 Pennant's parakeets, 3 Roselle's parakeets, 12 large cockatoos, 16 rose cockatels, 5 Leadbeater's cockatoos, 3 Nasicu cockatoos, 1 China cockatoo, 10 pair cockatilles, 4 large white-crested cockatoos, 1 male bloodwing, 1 mealy rosella, 6 ringnecked parakeets, 2 Alexandrine parakeets, 1 dwarf parrot, 2 rare Amazones, 7 pair Carolina parrots, piping crow, 1 mynah, 60 pair African love-birds, 80 nonpareils, 1 hang nest, 1 Indian crow pheasant, 55 pairs St. Helena wax-bills, 60 Virginian nightingales, 20 grey cardinals, 16 popebirds, 20 pair Java sparrows, Wydah birds (yellow-backed, red-shouldered, Cape of Good Hope), Madagascar grosbeaks, zebra waxbills, chesnut finches, Napoleon bishops, common bishops, harlequin doves, zebra doves, Australian doves, necklace doves, 3 blue Australian porphyrios."

We notice that an individual was examined on Tuesday at Worship Street on the charge of sweating sovereigns. The details of the case, which are of considerable importance to the public, will be watched with interest. It appears that the coins are dissolved by acid, aided by a battery, and that the loss in some cases equals about two shillings in the sovereign.

In the track of vessels from Australia to China lies an island called Pleasant Island. Previous to 1865, the natives had a bad reputation. A Captain Brown reported favourably of them in that year, and mentioned that he was told that an Englishman was residing there. In August 1868, Captain Hall, of the barque *Glenisle*, was boarded by the island canoes, and two whaleboats, with two Englishmen, one of whom had been twenty-eight years on the island, and had a son eighteen years of age. They told him they tried to visit all ships passing within easy distance, and seemed anxious for it to be known that they could supply ships with pigs and cocoa-nut oil. By his advice they purposed to cultivate potatoes, and gave him *an advertisement* to put in the colonial papers. Unfortunately, this document has baffled all attempts to decipher it, from the faulty writing. The island was stated by them to be nine miles across, and twenty two miles in circumference.

ANTHROPOLOGY AND ETHNOLOGY

[We have been favoured by the Count Marshal of Austria with the following abstracts of the more important papers read at the Innspruck Congress.]

Prof. Semper on the Natives of the Pellew Islands

These natives have come to a comparatively rather high degree of civilisation, and have been wronged by being ranked among the primitive savages. Prof. Semper, who has lived several months among them, proves his assertion by a detailed exposition of their political, social, and religious institutions. The residence of the pontiff-king and the house where the chieftains of tribes hold their meetings, are decorated with painted basso-relievos. The traces of a commixture of the natives with the Malayan race are insignificant; they seem, however, to have mixed notably with the Papuans.

Prof. Strobel on the Paraderos of Patagonia

These "Paraderos" (from the Spanish verb *parar*, to stay) are accumulations of remnants of repasts, fragments of pottery, unpolished stone-knives, arrow-heads, &c., superficially covered with blown sand. In one of these accumulations a human skeleton, and several skulls of brachy-hypocephalous type, were found. The pottery had evidently been shaped by hand, and burnt hard by an open fire—not in furnaces. The distinction between a Palæolithic and a Neolithic period cannot be maintained with respect to the southern-most portion of South America; no polished stone-implements having hitherto been found south of St. Luis in the centre of the Pampas, although grinding-stones and polishable minerals are not wanting there. The polished stone-implements found at St. Luis may have been imported from Peru. The objects found in the Paraderos must be anterior to the European invasion; neither the Patagonians nor the Indians of the Pampas using at present any stone-weapons, but being armed with lassoes, bolas, and lances. Arrows and bows having gone out of use since the introduction of horses by the Europeans. The Indians of Chaco and the inhabitants of Terra del Fuego, who have refused to use horses, still use arrows as a weapon. Horsemanship seems not to have had any diminishing action on the size of the Patagonians, still conspicuous for tallness; the inhabitants of Terra del Fuego, though no horsemen, being rather of small size. Prof. C. Vogt said that the collections made in South America by Mr. Claray have safely arrived in Europe, and that among them is a human lower jaw of uncommon size. Prof. Seligmann observed that the skeleton of a giant, in the museum of Innsbruck, offers likewise an uncommonly developed lower jaw, a peculiarity mentioned by Prof. Langer as generally connected with gigantic size. Prof. Virchow remarked that the outline of the jaw in question is rather curved than angular.

Prof. Virchow on Comparative Measurements of Crania

It is uncertain whether the great number of crania found in Denmark in sepultures of the Stone Period, belonged to the persons of rank, or to those immolated to honour them—as Mr. Worsaae concludes from the circumstances under which they have been found. At all events, they must have belonged to inhabitants of the Danish isles, or of their immediate neighbourhood. Ninety-six crania have been extracted from one single sepulture near Borreby. Those from the first part of the Bronze Period, when the dead were buried unburnt, are not abundant. Eschricht and Nilsson agree in ascribing the crania of the Stone Period to Laplanders or Esquimaux. The crania of the Greenlanders are conspicuously Dolichocephalous, not to say Scaphocephalous. The insertions of the temporal muscles are unusually distinct, the temporal ridges reaching beyond the *tubera parietalia*; the root of the nose is very narrow and the eyes very near to each other; the facial portion is more developed than in any other race. The few Dolichocephalous crania found in the sepultures are far from offering any analogy to those of Greenlanders. The Laplanders are known to be a Brachycephalous race, whose outward form is evidently the result of their mode of living. The temporal diameter of the crania of this people is ordinarily very considerable, the root of the nose is very broad, and the middle of the lower jaw conspicuously compressed. The crania from the sepultures do not bear more than a distant resemblance to the type just described. The crania of the Finnic race—abstraction made of individual variations—are relatively Brachy-hypocephalous. The Danish crania here in question may be possibly of Finnic origin, the more, as history proves this race to have spread formerly far more southward in Scandinavia than at present. Two forms may be distinguished among these crania, not so discrepant, however, as to indicate the co-existence of two distinct nations, although a commixture between two nations may have taken place. The Slavonians are nearly generally admitted to be Brachycephalous, and the Germans to be Dolichocephalous; the Poles and the Wends, however, make an exception to this rule, being anything but Brachycephalous. Crania from peat-bogs of North Germany exhibited to the Anthropological Congress, held at Paris in 1867, are decidedly Dolichocephalous, not Prognathous, without a decidedly ferocious expression, &c. Those extracted from the Danish peat-bogs exactly resemble them, and have, moreover, the greatest analogy with the crania of the Basques, a nation which (as may be historically ascertained) had spread in ancient times over Southern France and North Italy under the denomination of "Iberians." It results from all this, with some degree of probability, that the nation to which the skulls in the peat-bogs are to be referred was rather of Meridional than of Septentrional origin. Chronological dates, relating to the crania here in question, are still insufficient. At present, no trace of man's existence during the reindeer-period has been ascertained in North Germany. Remains of reindeer have been found in Mecklenburg and lately (probably) in the Uckermark, but not associated with any products of human industry. The co-existence of the Dolichocephali, whose remains have been found in peat-bogs, with the reindeer, is therefore not yet proved, although in some degree probable.

Prof. Seligmann on Exostoses in the Meatus auditorius of Peruvian Crania

SOME years ago Prof. Seligmann found on Peruvian crania of the Titicaca form (cylindrical, elongated by bandages) considerable exostoses on the external meatus auditorius, a very rare morbid affection. No traces of such exostoses were found on the other variety of Peruvian crania so nearly related to the North American form, and, like these, flattened by pressure between boards. The crania first referred to are most similar to the so-called *Avarian* skulls, to be met with from Austria as far as into France; but exostoses have never been found on any of these last. The cause of these exostoses was at last found out in the narrative of the conquest of Peru by coeval Spanish authors, all describing the solemn inauguration of the descendants of the Incas, who had come to the age of sixteen years. They were then compelled to undergo most exciting exertions of body and mind, and the hardest privations; the ceremony of piercing the ears being the term of these severe trials. The lobes of both ears were widened by introduction of metallic cylinders, so that a gold or silver disc of the diameter of an orange could find room in each of them. The Spaniards designated the wearers of this distinction as "Orejones" (Great-ears). A Spanish author says, it would scarcely be credible that the lobes of the ear could bear such a weighty ornament if they were not sustained by a loop of a finger's size. The excitement attending the trials, the comparatively late epoch of the operation, together with its rapid and violent mode of performance, may possibly have provoked a pathological process affecting the cartilaginous, and, subsequently, the osseous portion of the ears. Many tribes lengthen the lobes of their ears by introducing pieces of wood, &c., and a South American tribe is named "Orejones" on account of this custom; in these cases, however, the lengthened portion is relaxed. If the above supposition is exact, it leads to the following result: all the Peruvian crania of the Titicaca form, offering the above-described exostoses, are those of male individuals of high caste, having passed their sixteenth year; and the appellation "Inca crania," hitherto applied to flattened Peruvian skulls, is inexact. Deafness was not the necessary consequence of these exostoses, the narrowest aperture of the meatus auditorius being sufficient for the perception of sounds.

Dr. Glatter on the Influence of Race-differences on the Vital Processes

THIS influence is evident in the descendants of an Italian colony, living at Lemberg, who are in the habit of entrusting themselves for treatment to native Italian physicians, who, according to their custom, treat their patients with frequent bleedings, to the amount of 8 to 10 ounces, without any damage to their health. Poles, submitted to the same treatment, often suffer very bad consequences from it. The natives of Alpine regions established at Vienna are endowed with a high degree of vitality, and generally of longevity. The Servians are very prolific in their native country; north of Mohacs, however, the number of births among them is diminishing, so that the population of Servian places approaches extinction. Births are numerous and easy, and deaths comparatively few among Jews in every country, thus proving their strong accommodative power, and consequently their aptitude for commercial business. At Pesth, Jewish merchants reach a higher average age than Christian ones; the reverse is the case there among workmen, as tailors, &c. Suicide is rare, mental alienation frequent among Jews. Among Magyars, the number of births is moderate, the mortality rather great, and as a necessary consequence, the Slavonian population is more and more encroaching on them. Notwithstanding the very notable introduction of Turkish blood during the long occupation in the sixteenth and seventeenth century, the Finnic race and characters have suffered but little alteration, as proved by the striking similitude between Magyar and Finnic crania. The Hungarian Slovacks possess a high degree of vitality, and, notwithstanding certain noxious customs (hot wine given to women immediately after parturition, and brandy given to sucking babes), the mortality among them is anything but considerable. The Wends, living in groups in the Comitate of Wieselburg, are tall, with small heads, and, notwithstanding their irregular and excessive mode of living, generally attain to a good old age. The Germans in the Comitate of Pesth are all very prolific, but their number increases but moderately, as the rate of mortality is rather considerable. The Roumanians are reported to be generally of small size, with rather light brain, and to be subject to tuberculosis and to caries of the teeth. The Poles are more affected by epidemics than the Ruthenians; deaths among them are more numerous than births, while the Ruthenian population is constantly increasing in numbers. Prof. Sigmund has observed in the case of Italians and Spaniards, that wounds are more inclined to gangrene than in individuals of other races.

Prof. C. Vogt on a Microcephalous Subject

THE data concerning this subject have been communicated by M. de Vilanova, Professor of Geology at Madrid. His name is Vincenzo Ortis, of Codina, born at Castillon del Duca (province of Valencia), in 1813. The dimensions of his head are: facial angle, 59°; circumference of the cranium, 0·46 metres; upper arch, 0·19 m.; longitudinal diameter, 0·14 m.; transverse diameter, 12 m. His total length does not exceed 1 metre. The sternal limbs are very long, with a rudimentary sixth finger on each hand; the abdominal members are short, with a sixth toe on each foot; his whole body is covered with long hairs. His character is rather meek and timid; when irritated he tears his clothes without doing harm to others. He is unable to speak, but makes very expressive faces. His mode of progression is by leaps. The comparatively advanced age of fifty-six years, and the existence of six fingers and toes, make Ortis an exception among Microcephalous subjects.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 13.—The following papers were read:—"On the Mineral Constituents of Meteorites," by Nevil Story-Maskelyne, M.A., Professor of Mineralogy in the University of Oxford, and Keeper of the Mineral Department, British Museum. Communicated by Prof. H. J. Stephen Smith, F.R.S. [We are compelled to postpone an abstract of this paper.]

"On Fluoride of Silver." Part I. By George Gore, F.R.S. This communication treats of the formation, preparation, analysis, composition, common physical properties, and chemical behaviour of fluoride of silver. The salt was prepared by treating pure silver carbonate with an excess of pure aqueous hydrofluoric acid in a platinum dish, and evaporating to dryness, with certain precautions. The salt thus obtained invariably contains a small amount of free metallic silver, and generally also traces of water and of hydrofluoric acid, unless special precautions mentioned are observed. It was analysed by various methods: the best method of determining the amount of fluorine in it consisted in evaporating to dryness a mixture of a known weight of the salt dissolved in water, with a slight excess of pure and perfectly caustic lime in a platinum bottle, and gently igniting the residue at an incipient red heat until it ceased to lose weight. By taking proper care, the results obtained are accurate. The reaction in this method of analysis takes place according to the following equation: $2AgF + CaO = CaF_2 + 2Ag + O$. Sixteen parts of oxygen expelled equal thirty-eight parts of fluorine present. One of the methods employed for determining the amount of silver consisted in passing dry ammonia over the salt in a platinum boat and tube at a low red heat. The results obtained in the various analyses establish the fact that pure fluoride of silver consists of nineteen parts of fluorine and 108 of silver. Argentic fluoride is usually in the form of yellowish brown earthy fragments; but when rendered perfectly anhydrous by fusion, it is a black horny mass, with a superficial satin lustre, due to particles of free silver. It is extremely deliquescent and soluble in water; one part of the salt dissolves in ·55 part by weight of water at 15°·5 C.; it evolves heat in dissolving, and forms a strongly alkaline solution. It is nearly insoluble in absolute alcohol. The specific gravity of the earthy-brown salt is 5·852 at 15° 5 C.; the specific gravity of its aqueous solution, at 15°·5 C., saturated at that temperature, is 2·61. By chilling the saturated solution, it exhibited the phenomenon of supersaturation and suddenly solidified, with evolution of heat, on immersing a platinum plate in it. The solution is capable of being crystallised, and yields crystals of a hydrated salt; the act of crystallisation is attended by the singular phenomenon of the remainder of the salt separating in the anhydrous and apparently non-crystalline state, the hydrated salt taking to itself the whole of the water. The fused salt, after slow and undisturbed cooling, exhibits crystalline markings upon its surface. The dry salt is not decomposed by sunlight; it melts below a visible red heat, and forms a highly lustrous, mobile, and jet-black liquid. It is not decomposed by a red heat alone; but in the state of semi-fusion or of complete fusion it is rapidly decomposed by the moisture of the air with separation of metallic silver; dry air does not decompose it. In the fused state it slightly corrodes vessels of platinum, and much more freely those of silver. The salt in a state of fusion with platinum electrodes conducts electricity very freely, apparently with the facility of a metal, and without visible evolution of gas or corrosion of the anode; a silver anode was rapidly dissolved by it, and one of lignum-vitæ charcoal was gradually corroded. A saturated aqueous solution of the salt conducted freely with electrolysis, crystals of silver being deposited upon the cathode, and a black crust of peroxide of silver upon the anode; no gas was evolved; with *dilute* solutions gas was evolved from the anode. By electrolysis of anhydrous hydrofluoric acid with silver electrodes, the anode was rapidly corroded. The electrical order of substances in the fused salt was as follows, the first-named being the most positive: silver, platinum, charcoal of lignum-vitæ, palladium, gold. In a dilute aqueous solution of the salt, the order found was: aluminium, magnesium, silicon, iridium, rhodium, and carbon of lignum-vitæ, platinum, silver, palladium, tellurium, gold. The chemical behaviour of the salt was also investigated. In many cases considerable destruction of the platinum vessels occurred, either in the experiments themselves, or in the processes of cleaning the vessels from the products of the reactions. Hydrogen does not decompose the dry salt, even with the aid of sun-light, nor does a stream of that gas decompose an aqueous solution of the salt, but the dry salt is rapidly and perfectly decomposed by that gas at an incipient red heat, its metal being liberated. Nitrogen has no chemical effect upon the salt, even at a red heat, nor upon its aqueous solution. Dry ammonia gas is copiously absorbed by the dry salt. In one experiment the salt absorbed about 844 times its volume of the gas. The salt in a fused state is rapidly and perfectly decomposed by dry ammonia gas, and its silver set free. A saturated solution of the salt is also instantly and violently decomposed by strong aqueous ammonia. Oxygen has no effect either upon the dry salt at 15° C., or at a red heat, nor upon its aqueous solution. Steam perfectly and rapidly decomposes the salt at an incipient red heat, setting free all its silver. No chemical change took place on passing either of the oxides of nitrogen over the salt in a state of fusion. By passing anhydrous hydrofluoric acid vapour over perfectly anhydrous and previously fused fluoride of silver, at about 60° Fahr., distinct evidence of the existence of an acid salt was obtained. This acid salt is decomposed by a slight elevation of temperature. Numerous experiments were made to ascertain the behaviour of argentic fluoride in a state of fusion with chlorine, and great difficulties were encountered in consequence of the extremely corrosive action of the substances when brought together in a heated state. Vessels of glass, platinum, gold, charcoal, gas carbon, and purified graphite were employed. By heating the salt in chlorine, contained in closed vessels, formed partly of glass and partly of platinum, more or less corrosion of the glass took place; the chlorine united with the platinum and fluoride of silver to form a double salt, and a vacuum was produced. By similarly heating it in vessels composed wholly of platinum, the same disappearance of chlorine, the same double salt, and a similar vacuum resulted. Also, by heating it in vessels composed partly of gold, an analogous double salt, the same absorption of chlorine and production of rarefaction was produced. And by employing vessels partly composed of purified graphite, a new compound of fluorine and carbon was obtained.

"Approximate determinations of the Heating Powers of Arcturus and α Lyræ." By E. J. Stone.—About twelve months ago the author began to make observations upon the heating-power of the stars. At the February meeting of the Royal Astronomical Society he first became aware of what Mr. Huggins had done upon this question: his arrangements, however, did not appear to the author to meet the difficulties. After some trials, he arranged his apparatus in the following novel manner:—He uses *two pairs* of plates of compounds of antimony and bismuth. The areas are about $(0\cdot075)^2$ inches, and their distance is about 0·25 inch. The poles are joined over in opposite directions to the terminals of the pile and galvanometer. The whole pile is screwed into a tube of one of the negative eyepieces of the great equatorial. This completely shuts the pile up in the telescope-tube. A thick flannel bag is then wrapt over the eyepiece and terminals. The bag is prevented from actually touching the case of the pile, and is useful in preventing the irregular action of draughts upon the case of the pile and terminals. The wires are led from the terminals of the pile to the observatory library. The two faces of the pile are so nearly alike, that the currents which are generated by any equal heating of them are exceedingly feeble. The telescope is first directed so that the star falls between the two faces, and allowed to remain thus until the needle is nearly steady at the zero. The star is then placed alternately upon the two faces, and the corresponding readings of the galvonometer taken as soon as the needle appears to have taken up its position, which usually takes place in about ten minutes. The author next referred to the way in which he refers his results to those produced by independent sources of heat at known distances. The mean result of the observations on two nights is 0°·0198 F., as a measure of the heating effect of Arcturus in raising the temperature of the plate of antimony and bismuth when the heat is condensed by the object-glass of 12·75 inches. The direct effect without object-glass would be 0°·000000685 F. The author had not yet determined the coefficient of absorption for the object-glass, but if it be provisionally taken at $\frac{2}{3}$, the direct heating effect of Arcturus = 0°·00000127 F. The result may be otherwise stated as follows:—That the heat received from Arcturus is sensibly the same as that from the face of a Leslie cube containing boiling water at 383 yards. In the case of α Lyræ the heating power is = 0°·0088 F. This result is so much smaller than those obtained from Arcturus, although the observations of Arcturus were made under more unfavourable circumstances, that the author cannot but regard it as a fact that the star Arcturus does give us more heat than α Lyræ—a result probably due to the same cause which gives rise to the difference in colour between these stars, viz., the greater absorption of the red end of the spectrum in the case of α Lyræ than in the case of Arcturus. He mentioned that on June 25, 1869, he made a comparison between Arcturus and α Lyræ. The result gave for the heat received from Arcturus: to that from α Lyræ : : 3 : 2; but on account of the observations of α Lyræ having been interrupted by cloud, they were not, however, sufficiently numerous to eliminate mere errors of reading. From these observations the author concludes that Arcturus gives to us considerably more heat than α Lyræ; that the amount of heat received is diminished very rapidly as the amount of moisture in the air increases; that nearly the whole heat is intercepted by the slightest cloud; that as first approximations, the heat from Arcturus, at an altitude of 25°, at Greenwich, is about equal to that from the cube containing boiling water at a distance of 383 yards. The heat from α Lyræ at an altitude of 60° is about equal to that from the cube at a distance of 860 yards. The form given to the pile appears likely to be useful in many inquiries respecting differences of heating power.

Ethnological Society, January 11.—Dr. Richard King in the chair. Col. Lane Fox read a note on the use of the mere or pattoo-pattoo of New Zealand, in which he showed that this weapon is used as a thrusting-instrument, and should not, therefore, be referred to the type of the club. He regards it as having had its origin from the stone celt, since a series of transitional forms may be traced connecting the two implements. The author's opinion on the use of the mere was supported by a letter from the Rev. J. W. Stack, of Kaiopoi, communicated to Dr. Hooker, C.B., in which the writer explained that the mere was always used for thrusting and not for striking.—A communication was read from Dr. Haast, F.R.S., on some stone implements discovered in Bruce Bay, New Zealand. A polished stone chisel and a sharpening-stone were found by a party of miners in an auriferous "lead." Advancing inland from the present shore of the bay, several distinct belts of land may be observed, each characterised by peculiar vegetation; and it was in the fourth belt, at a distance of 525 feet from the present high-water mark that these implements were found. They are now deposited in the Canterbury Museum, N.Z. Although these polished implements are much more highly finished than are the roughly-chipped implements hitherto found in or near moa-ovens, the author does not venture to express an opinion on the relative antiquity of the two types: indeed, he considers it probable that they may have been used simultaneously by two races co-existing in the islands—the more highly-civilised using polished tools and dwelling near the coast, while the inhabitants of the interior retained the use of roughly-chipped implements, and followed the dinornis as it retreated inland. Mr. Bonwick referred to the great antiquity of these gold-bearing terrace-deposits.—At the same meeting Dr. Gustav Oppert read a paper on the Kitai or Kari-kitai. These are a small race of about 50,000 persons, dwelling near the Caspian Sea in the Russian province of Derbend, and in the Siberian district of Guldja. They are the descendants of a race which once ruled over China and Central Asia. One of their great princes, Yelintashe, was identified by the author with the celebrated Prester John or Presbyter Johannes. Dr. Oppert referred to the use of the names of metals by the Tatars as proper names and titles of dynasties—such as the Iron dynasty, Golden dynasty, &c. According to their own historical records, the Tatars had come from a district abounding in gold and iron. Dr. Hyde Clarke contrasted the valuable philological arguments brought forward in the present paper with the frivolous mode in which comparative philology is often employed. He alluded to the ethnological cause of the decline of the great empire of the Kitai, and referred it to the inability of any small dominant race to hold in subjection a large population composed of mixed races.

Royal Microscopical Society, January 12.—The Rev. J. B. Reade, F.R.S., president, in the chair. Mr. J. Browning read a paper on a new mode of measuring spectra bands. Mr. Browning described an adaptation, by himself, of the micrometer screw to the microscope, which afforded an easy and accurate method of measuring the bands of the absorption spectrum, and the invention was accepted as a valuable improvement on the method hitherto employed for the purpose.—Mr. W. S. Kent, F.Z.S., of the British Museum, read a paper on "the *Calcareous spiculæ* of the *Gorgonaceæ*, their modification of form, and the importance of their characters as a basis for genuine and specific diagnosis." This paper was illustrated by an elaborate series of drawings of the animals and the spicula of the various species.—In consequence of the time occupied by the reading of the previous papers, a contribution from Mr. A. Sanders, M.R.C.S., "On an undescribed stage of development of *Tetrarhynchus corallatus*" was taken as read.

DUBLIN

Royal Irish Academy, January 10.—Sir Robert Kane in the chair. The Rev. Dr. Dickson read an account of some portions of the "Ars moriendi," preserved in the manuscript room of the College Library, and compared it with the photographs of the perfect copy of this work in the collection of Herr Weigel, of Leipsig. It is an excellent specimen of block-printing. The fragments in the library appear to have been portions of an early printed volume, as well as of one printed with great care, and belonged to the edition in small folio of twenty-four leaves printed on the one side.—Dr. John Barker read a paper on the "illumination of microscopic objects." One of the most important improvements of late years in object-glasses of high powers has been the immersion of objectives of a particular construction into a film of water placed on the glass covering the object, whereby it is found that the definition, light, magnifying power, and working distance are each much increased. The object of the paper was to show how the present principle could be applied with great advantage to the general illumination of objects. The results of some experiments were then detailed. Wenham's paraboloid was altered as follows: the tip was ground flat, and a film of water was introduced between it and the under surface of the glass slide containing the object, free action of the stage movements being thus allowed, and no light was lost. This form of illumination is suitable to all kinds of axial illumination, though it is but right to add that it has only practically been tried in a form corresponding to Wenham's paraboloid. Details of the construction of the paraboloid, its size, and curvature were given; and the paper concluded by the author claiming for this mode of illumination the following advantages:—1. Objects are seen by light reflected from their surfaces, and, if transparent, from their interiors. 2. No disturbing light impinges on the retina. 3. All shadows are avoided. 4. The oblique rays of light are economised. 5. The light is purely achromatic. 6. The interior of partially transparent objects can be lit up. 7. Definition is improved. 8. It is easy of application; and, lastly, it is not expensive.—Dr. Stokes presented, on behalf of W. T. De Visme Kane, Esq., a large stone celt found in Ireland. A copy of the second volume of the "Brehon Laws," just published, was laid on the table. The following were elected members:—W. Archer, Professor R. Ball, R. Day, Sir T. Esmonde, Bart., T. A. Jones, Rev. J. P. Mahaffy, and J. P. O'Reilly.

PARIS

Academy of Sciences, January 10.—M. Delaunay communicated a memoir on the physical constitution of the moon, and Father Secchi one on the constitution of the solar corona, and some peculiarities presented by rarefied gases when rendered incandescent by electric currents: we shall return to these papers.—M. Becquerel presented the second part of his eighth memoir on electro-capillary phenomena, in which he treats of the muscular, nervous, and other currents.—M. E. Becquerel communicated a note on the determination of weak electromotor forces, in which he described a method of determining the amount of force developed in organic bodies and their parts.—M. Piarron di Mondesir communicated the second part of his paper on a new method for the solution of problems in mechanics, and M. Verdeil a note indicating two experiments to be made, by means of the pendulum, to determine the variation of the resistance of the air with the velocity.—A discussion on the proposed demonstration of Euclid's postulate of parallel lines, by M. Bertrand, was raised by the opening of a sealed packet deposited by M. Lionnet on the 27th December last. M. Boillot maintained that it is impossible to get rid of the idea of infinity when we attempt to demonstrate Euclid's postulate; and M. J. Hoüel, the impossibility of demonstrating the principle of the theory of parallels by means of a plane figure. M. Fuix called the attention of the meeting to a demonstration of the postulate, independent of the idea of infinity given by him in a published work.—In a memoir on nitrous acid by M. E. Frémy, the author stated that pure nitrous acid dissolves without decomposition in a great excess of cold water, but that it is split into nitric acid and deutoxide of nitrogen by the addition of pulverulent bodies. He also referred to the reducing properties of nitrous acid, and to its behaviour and modification by substitution under the influence of hydrogenated bodies.—MM. Odet and Vignon presented a paper on the action of dry chlorine upon dry nitrate of silver, in which they described an experiment confirming their previous supposition that in the preparation of anhydrous nitric acid by this means, the reaction combines two phases, namely: 1. Production of chloride of azotyle with evolution of oxygen; and 2. Reaction of the chloride of azotyle upon the excess of nitrate of silver.—A memoir was also presented by M. A. Boillot, on the synthesis of hydrosulphuric acid by exposing flowers of sulphur to the action of the electric spark in contact with hydrogen; and one by M. T. Schlœsing, containing analyses of the mineral contents of the waters of arable lands.—M. Feil addressed a reply to a previous note by M. Gaugain on the manufacture of artificial gems; and MM. A. Riche and P. Champion a memoir on the manufacture of tom-toms and cymbals.—Of biological papers only few were communicated, the chief one being a continuation of M. Lacaze-Duthier's researches upon the morphology of the Mollusca, in which the author treats of the *Lamellibranchiate Acephala*, or ordinary bivalved molluscs.—M. Colin discussed the question whether there is any relation between the intelligence of animals and the development of the nervous centres, and showed by numerous tables that there is no exact relation between the size of the encephalon and the observed intelligence.—M. Bergeon noticed the purpose of the lachrymal glands, which he considered to be chiefly the moistening of the air passages, and of the air passing through these to the lungs, so that they are really connected with the function of respiration.—M. Drouyn de Lhuys communicated an extract from a letter noticing the attacks of an *Acarus* upon the grape-vines at the Cape of Good Hope. The parasite is said to live upon the roots, and between the bark and wood of the plants.

VIENNA

Imperial Academy of Sciences, December 9, 1869.—Dr. L. J. Fitzinger communicated the first part of a critical revision of the Rhinolophous family of Bats. It treated of the genera *Cœlops*, *Phyllorhina* and *Asellia*.—Director Tschermak presented a memoir on the form and composition of the Felspars.—Dr. J. Peyritsch communicated a memoir on abnormities of structure in the Umbelliferæ, containing the description of a series of malformations of the flowers in *Carum Carui*, *Daucus Carota*, *Torilis anthriscus*, and *Peucedanum Chabræi*.—In connection with these the author discussed the axial or carpellar nature of the fruit of the Umbelliferæ, and remarked that such cases show that the distinction between leaf and axis is not well founded in nature.—M. Schrauf noticed the occurrence of Brookite in iron-glance from Piz Cawradi, to the south of Chiamut in the Tavetsch valley of Graubündten.—The table of observations at the Central Meteorological Observatory, for the month of November, was communicated.

December 16, 1869—Professor Reuss communicated a memoir by Dr. Manzoni "On the Italian Fossil Bryozoa," in continuation of previous papers by the same author. The present paper related exclusively to the genus *Lepralia*, of which the author described and figured 21 species, 15 of them as new forms. Of the species described, 12 are from the middle miocene of Turin, 4 from the middle pliocene of Castelarquato, and the remaining 5 from the upper pliocene of the neighbourhood of Reggio in Calabria.—Professor A. Winckler presented a memoir on some formulæ and methods relating to the theory of definite integrals.—Dr. Tiele, of Bonn, and Dr. T. Oppolzer communicated statements of the elements of Comet III., 1869, and the latter a memoir on the determination of the path of a comet.—Professor E. Hering presented a first memoir on the influence of respiration on the circulation of the blood, in which he maintained that the system of the vasomotor nerves experiences a periodic innervation by the respiratory nervous centre, which causes periodic contractions of the muscular coat of the vessels. These he regarded as respiratory movements of the vascular system.—Dr. F. Steindachner communicated the second portion of his memoir on the Fishes of the Senegal, in which he described the species (28 in number) belonging to the families Gobiidæ, Mugilidæ, Gerridæ, Chromidæ, Anabatidæ, Pleuronectidæ, and a part of the Siluridæ. Four of these were described as new, namely: *Eleotris senegalensis*, *daganensis*, and *Lebretonis*, and *Mugil Dumerili*. The first two belong to Bleeker's sub-genus *Culius*, the previously known representatives of which occur in the Indian Ocean and Polynesia. The author regarded *Chromis mossambicus* (Peters) as specifically distinct from *C. niloticus*, *Hemichromis bimaculatus* and *auritus* (Gill), and *H. guttatus* (Günther) as varieties of one species, *Chrysichthys acutirostris* (Günther) as identical with *C. nigrodigitatus* (Lac.), and *Gerres octactis* (Bleeker) with *G. melanopterus* of the same author.

BERLIN

German Chemical Society, January 10. — The following papers were read:—Wichelhaus, "On a base isomeric with cyanide of ammonium." By the action of the tribasic formic ether $CH(OC_2H_5)_3$ on acetamide $NH_2C_2H_3O$, a base of the following composition, $CH.NC_2H_3O.NHC_2H_3O$, was obtained. This substance is converted by water into the acetate of the new base $CH.NH.NH_2$. The latter is a volatile liquid, yielding crystallised salts.—Philipp, "On perchloride of iodine;" Hansen, "On the ethylides of thallium;" P. W. Hofmann, "On the manufacture of sulphuric acid." The author, who is at the head of the manufactory of Dienze in France, accounts for the loss of oxides of nitrogen in the manufacture of sulphuric acid, by proving that these oxides are partly reduced to nitrogen, when the sulphuric acid in the lead-chambers sinks below a certain strength. The loss can therefore be avoided by carefully regulating the steam admitted into the chambers.—Schoras, (1) "On the influence of sunlight on the reduction of metallic chlorides through oxalic and tartaric acids;" (2) "On the colorisation of dry platinocyanides through traces of moisture."—Friedel and Ladenburg, "On silicopropioxic acid;" Tieman, "On derivatives of guanidine;" Junning, "Mechanical explanations of chemical reactions;" Schuchard, "On the preparation of zirconium."

BONN

Lower Rhenish Society for Natural and Medical Science—*Chemical Section*, November 13. — Professor Binz exhibited a new body, "Dihydroxylchinin," obtained by G. Kerner from quinine by treating the latter with potassic permanganate. It gives all the reactions of the alkaloid, but differs from it amongst other things in the want of basic properties and the absence of influence on the organ of taste. It likewise differs from it essentially in its physiological properties, being entirely indifferent even in large doses. Dr. Zinke gave an account of new synthesis of aromatic acids. He has obtained phenyl-acetic acid from Monochloroacetic acid, and brombenzol by treatment with finely-divided silver. Professor Kekulé communicated the results of some experiments of Dr. Thorpe, showing that bromine free from iodine enters the ethyl-group of ethylbenzole even at a low temperature, and that from the bromide thus formed various derivatives can be obtained, some of which have already been proved by Berthelot. Dr. Budde gave a preliminary report on his researches on the electric conductivity of hydrogen, oxygen, and nitrogen, at various pressures. His results agree most nearly with those of Faraday, and show a greater decrease of resistance than of pressure.

November 27.—Dr. Muck communicated his recent researches on the formation of manganic sulphide from various manganese salts and various soluble sulphides.—Professor Rhitthausen likewise made some communications on the occurrence (not hitherto observed) of amygdaline in vetch seeds.

DIARY

THURSDAY, JANUARY 20.

ROYAL INSTITUTION, at 3.—On the Chemistry of Vegetable Products: Prof. Odling.

ROYAL SOCIETY, at 8.30.—On the Mechanical Performance of Logical Inference: W. Stanley Jevons.—Preliminary Paper on certain Drifting Motions of the Stars: R. A. Proctor.—On Jacobi's Theorem respecting the relative Equilibrium of a Revolving Ellipsoid of Fluid, and on Ivory's Discussion of the Theorem: J. Todhunter, F.R.S.

LINNEAN SOCIETY, at 8.—On the Flora of Iceland: Prof. Babington.—On New British Spiders: Rev. O. P. Cambridge.

ZOOLOGICAL SOCIETY, 8.30.—Descriptions of a new genus and of eighteen new species of Land and Marine Shells: Henry Adams.—On the genus Pelargopsis of the family Alcedinidæ: R. B. Sharpe.—Description of a new Fish from the vicinity of Aden: Lieut.-Colonel R. L. Playfair.

CHEMICAL SOCIETY, at 8. ANTIQUARIES, at 8·30.

NUMISMATIC SOCIETY, at 7.

FRIDAY, JANUARY 21.

ROYAL INSTITUTION, at 3.—On Haze and Dust: Professor Tyndall.

PHILOLOGICAL SOCIETY, at 8.15.

SATURDAY, JANUARY 22.

ROYAL INSTITUTION, at 3.—On Meteorology: Mr. Scott.

ROYAL BOTANIC SOCIETY, at 3.45.

MONDAY, JANUARY 24.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.

ENTOMOLOGICAL SOCIETY, at 7.—Anniversary Meeting.

LONDON INSTITUTION, at 4. MEDICAL SOCIETY, at 8.

TUESDAY, JANUARY 25.

ROYAL INSTITUTION, at 8.—On the Architecture of the Human Body: Prof Humphrey.

ETHNOLOGICAL SOCIETY, at 8.—On the Origin of the Tasmanians, geologically considered: J. Bonwick.—On a Frontier-line of Ethnology and Geology: H. H. Howorth.—The Nicobar Islanders: G. M. Atkinson.

INSTITUTION OF CIVIL ENGINEERS, at 8.

ROYAL MEDICAL AND CHIRURGICAL SOCIETY, at 8.30.

WEDNESDAY, JANUARY 26.

SOCIETY OF ARTS, at 8.—On the Modes of Reading in Use by the Blind, and the Means for arriving at Uniformity: Thomas Armitage, M.D.

GEOLOGICAL SOCIETY, at 8.—On the Crag of Norfolk and associated Beds: Joseph Prestwich, F.R.S., F.G.S.—On the Fossil Corals of the South Australian Tertiary Deposits: Dr. P. Martin Duncan, F.R.S., Sec. G.S.—Note on a very large undescribed Wealdean Vertebra: J. W. Hulke, F.R.S., F.G.S.

ARCHÆOLOGICAL ASSOCIATION, at 8.

BOOKS RECEIVED

ENGLISH.—The Year-book of Photography for 1870: G. W. Simpson (Piper and Carter).—The Bible in India: Louis Jacolliot (J. C. Hotten).—The Body and its Health: E. D. Mapother, M.D. (Simpkin, Marshall and Co).—Natural Phenomena and Chronology of the Seasons, Part I.: E. J. Lowe, F.R.S. (Bell and Daldy).—Journal of the Statistical Society.—The Geology, Botany, and Zoology of the Neighbourhood of Alnwick: G. Tate (H. Hunter).

FOREIGN.—Note sur les Surcharges à considerer dans les Calculs des Tabliers Metalliques: M. L. Leygue.—Chênes de l'Amerique Tropicale.—Compendium der Physiologie des Menschen: Julius Budge.—Untersuchungen aus dem Physiologischen Laboratorium in Würzburg: R. Gescheidlen.—Die Praktische Markscheidekunst: E. Borchers.—Industries anciennes et moderne de l'Empire Chinois: Paul Champion.—Annales des Sciences Géologiques: Hébert et Alph. Milne-Edwards.—Cours Elémentaire de Mecanique Theorique et Appliquée: Ch. Delauny.—Cours Elémentaire d'Astronomie: Ch. Delaunay.—Recherches sur l'Ancienneté de l'Homme dans les Grottes et Monuments Megalithiques du Vivarais: J. Ollier de Marichad—Berliner Astronomisches Jahrbuch für 1872: W. Förster.—Handbuch der Chemischen Technologie: P. A. Bolley.—Ueber die Altesten Formen des Organischen Lebens: Ferd. Roemer.—Ueber den Parasitismus in der Organischen Natur: Maximilian Pertz (through Williams and Norgate).

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ERRATA.—Page 238, second column, line 34 of footnote: for "habitude" read "hebetude."—Page 289, second column, line 37: for "rectorial" read "vectorial."

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

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Of Nature trusts the Mind that builds for aye."—WORDSWORTH.

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And, SECONDLY, to aid Scientific men themselves, by giving early information of all advances made in any branch of Natural knowledge throughout the world, and by affording them an opportunity of discussing the various Scientific questions which arise from time to time.

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In addition to the above, there are columns devoted to Correspondence.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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THURSDAY, JANUARY 27, 1870

DUST AND DISEASE

PROFESSOR TYNDALL'S lecture last Friday night at the Royal Institution, which we give *in extenso* in another column, has excited unusual interest, not only on account of the Professor's beautiful demonstration of the presence of organic dust in our London atmosphere, but from the manner in which he has sought to connect this presence with certain theories of disease held by part of his audience.

The revelations made by an ordinary sunbeam passing through a hole in the shutter are familiar enough; and the changes produced on the beam by a candle flame or a red-hot poker (an experiment used long ago by Dr. Wollaston for another purpose) will show in a rough manner the nature of the investigations.

Their practical result may be thus stated: London air contains a large amount of organic particles powerfully reflecting a light thrown upon them; and these particles cease to reflect light when the air containing them is submitted to the action of a high temperature, or when it is passed through a strainer or filter. Some of the appearances produced by certain modifications of the experiments are striking. Such, for example, as the disappearance of reflected light when air of a temperature below the incandescent point is made to rise through the beam showing the dust; or when certain gases are used instead of warmed air. In these cases the reflection of light from the dust particles disappears, and blackness takes its place. We are not, however, convinced that the Professor's explanation of this striking phenomenon is quite tenable. It presupposes a rapidity in the gas and air currents greater than can be followed by the more sluggish dust particles; so that these are left behind, or thrown to one side, and the rarefied air or gas deprived of dust particles enters the beam, and becomes invisible from absence of reflecting particles.

One would suppose that, sooner or later, the particles must follow the air in which they float, unless the heated air or gas become so much lighter than the particles that the latter will tend to fall downwards. This point, however, is one which admits of further demonstration.

The microscope, on its side, has not been behindhand in the same field, and has told us something more about this organic air dust. It is found to vary in character according to the objects from which it proceeds, and according to the degree of ventilation in an apartment. A microscopist, with his air analyser, would very likely have told Professor Tyndall's audience how they were breathing fragments of each other's clothes, and the scurf skin of each other's hands and faces, besides other matters brought into the Institution by the listeners, or wafted in through the windows; and if a whiff of sewer air had entered the room, living *vibriones* would probably have been among the subjects of the microscopist's demonstration. Chemistry also has been at work in the same direction, and by means at her disposal she has been able to estimate approximately the amount of organic matter in air; and this application of chemical methods is now in common use for determining the state of ventilation in inhabited buildings, as well as the comparative purity of the air in town and country. We are glad that Prof. Tyndall has enlisted optical analysis in the same useful field of inquiry. His lecture, from the perfection of his experiments, was well adapted to impress the advantages of pure air on the minds of his audience and the public at large.

We cannot help feeling, however, that it would have been well if the able lecturer had confined his statement strictly to the scientific aspects of his subject. The germ theory of disease has nothing in common with it, and yet it was referred to as if to show that the fact of organic dust existing in the air rendered the existence of "disease germs," as they are called, more probable than they were before. In scientific subjects we cannot accept mere theories for facts. Let the advocates of disease germs first prove their existence, and then possibly optical and microscopic analysis will throw light on their mode of conveyance.

In imperfect science, as in other imperfect things, the first false step may lead anywhere, as the following extract from Dr. Bryden's singularly interesting report on Indian cholera, one of the supposed germ diseases, will show:—

"The facts of the first European invasion showed that aërial transmission did not account for all the phenomena observed, such as the transmission of cholera by fomites, and the occasional infection of attendants on the sick. Hence there was initiated (*a*) the doctrine that cholera might be propagated by human intercommunication, and, as the latest phase of this doctrine, we find the confident assertion promulgated as a truth, that cholera is always and not occasionally so propagated. To prop up this assertion it was necessary to make a second assumption or theory. And hence arose the doctrine (*b*) that cholera is multiplied in the human economy. But this also must have stood alone and unsupported, unless it could be shown how and where the multiplication took place. And this led on to the starting of the third theory (*c*), which asserts that cholera is multiplied in, and is spread around by, the intestinal evacuations of those already suffering from the disease. But even this, although urged in the most forcible manner, did not meet all difficulties; and there arose the demand that it should be supplemented by a fourth theory. In relation to this demand, the latest theory (*d*) alleges that the evacuations of an individual in whom cholera has not become apparent, and never will appear, may be the means of spreading cholera around."

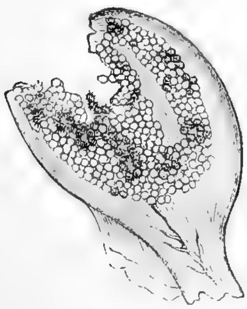
By endeavouring without observation to attain to knowledge which can only be arrived at by observation, theory has, in this instance, walked round in a circle and left science outside. In great questions affecting the health and life of nations, theories are quite out of place. They do no good, cost money, and bar scientific progress.

Practically, so far as health is concerned, Professor Tyndall has given us a scientific account, not only of certain optical properties of impure air, but likewise of the benefit of several popular practices, such, for example, as lighting fires during epidemics to purify the air, the use of gauze curtains in malarious districts as a protection against fever, covering the mouth with a cloth during sleep in fever countries, and the like. He has further given us an additional means of estimating the purity or impurity of the air we breathe. He has shown that heat purifies, more or less, impure air; and that impure air can be deprived of its suspended impurity by filtering it, as is the case with water. On the real proximate aërial cause of disease, if such there be, no new light has been yet thrown either by the optician, the microscopist, or the chemist.

VEGETABLE MONSTROSITIES

Vegetable Teratology: An Account of the Principal Deviations from the usual Construction of Plants. By Maxwell T. Masters, M.D., F.L.S. With numerous illustrations by E. M. Williams. (Published for the Ray Society. 1869.)

IN the volume before us we have the most complete account that has yet been given to the public of the various aberrant forms which are from time to time presented by the different organs of which plants are composed. Such investigations are no mere idle amusement for the leisure hours of naturalists, but have an important scientific bearing. Since botanists have attempted to arrange the vegetable kingdom in a classification possessing a higher claim to the title of "natural" than that proposed by Linnæus, it has been acknowledged that the true, though hidden, relationships of a genus may often be indicated by an abnormal or monstrous variety. A new interest has been given to these inquiries by the theory, now so generally adopted by naturalists, that affinity in structure is but an indication of consanguinity in descent; these exceptional forms or "sports" being regarded as frequently reversions to an ancestral type of structure. Apart, however, from such modifications as are of importance in systematic botany, there are others which are noteworthy as throwing light on controverted points in morphology, and on the relation to one another of the different organs. Among these are the exact morphological character of the carpel, viewed in the light of a metamorphosed leaf; and of the so-called "inferior" ovary, whether its covering is to be considered as a united calyx-tube, or as a modified continuation of the axis. The occasional substitution of one organ for another is carried to a far greater extent in the vegetable than ever appears, even occasionally, in the animal kingdom. As Dr. Masters remarks, the animal physiologist would regard as an incredible monstrosity the replacement of sperm-cells by germ-cells, or the converse; although these are comparable to abnormal growths, of which several are recorded, where ovules are borne by stamens, or pollen is produced inside ovules. The two wood-cuts which we give illustrate these remarkable transformations.



Pollen within Ovule of Passiflora

Ovule-bearing Anther of Cucurbita

De Candolle was the first systematic botanist to draw attention to the importance of Vegetable Teratology: he was followed by Moquin-Tandon, Morren, and others; and the great work of Moquin-Tandon has been followed by Dr. Masters in the main in classifying the phenomena under discussion. This classification of an enormous number of isolated facts presents considerable difficulties. It might at first sight appear as if the most natural arrangement would be to arrange under one head all the known modes of malformation or aberration of each organ: but this plan would involve much repetition, from the frequency with which it happens that similar organs are abnormally affected in the same manner; as when the parts of the calyx and corolla are both unduly increased in number. The plan adopted by Dr. Masters, though very artificial, possesses the advantage of clearness and of easy reference. He divides the phenomena of Teratology into four sections: 1, Deviations from ordinary Arrangement; 2, Deviations from ordinary Form; 3, Deviations from ordinary Number; 4, Deviations from ordinary Size and Consistence; each with several subdivisions. Until we know more of the cause of these variations from ordinary structure, a more scientific classification would appear to be hopeless.

The work is essentially one of reference, a collection of facts rather than a statement of theories. An enormous number of instances, illustrative of every conceivable variation from normal structure, has been collected with unwearied assiduity from English and foreign records, and with that personal knowledge of the subject which few possess to so great a degree as the author. Where Dr. Masters so far strays from his subject as to enter into morphological questions, as when he discusses the irregular monandrous flower of Orchids, we are tempted to wish that he had permitted himself more digressions of the kind.

The text is illustrated by a large number of woodcuts, original and copied, which add greatly to the clearness of the descriptions; and not the least valuable portion of the work is the long list of references at the end of each section to papers and monographs bearing upon it, forming a complete bibliography of the subject. In the lists of plants which are mentioned as peculiarly subject to each description of malformation, we could wish that more care had been taken not to designate the same plant by more than one scientific name, a practice confusing to the student. We also regret that in some instances recognised botanical terminology has been departed from; as in the distinction drawn by Lindley and Oliver between "regularity" and "symmetry." These, however, are but minor defects in a work which we can cordially recommend to all students of botany, who are interested in the real structure of the various organs of plants.

A. W. BENNETT

ATTFIELD'S CHEMISTRY

Chemistry: General, Medical, and Pharmaceutical, including the Chemistry of the British Pharmacopœia. By John Attfield, Ph.D., F.C.S. 1 vol. pp. 624. (London: Van Voorst.)

THIS book is mainly intended to supply the want of a manual more expressly suited to the requirements of students of medicine and of pharmacy. A work of this nature necessarily differs in many particulars from the ordinary run of chemical manuals, and it would be unjust, therefore, to judge of it altogether by the standards generally employed in determining the degree of excellence of such books. It is obviously impossible for the medical student to make himself acquainted with the multitude of organic compounds known, the greater portion of which are simply interesting to the scientific chemist on account of the theoretical opinions based on them; and hence it would manifestly be absurd to censure the author of this book for the fact that much of what constitutes modern organic chemistry is either but cursorily treated, or altogether omitted. Nor, on the other hand, should he be blamed for giving what might otherwise appear undue prominence to the descriptions of substances which are simply interesting from the fact of their application as remedial agents, but of which the chemical constitution is either entirely unknown or but imperfectly understood. In all that concerns the most immediate objects which the author had in view in its compilation, his book is a faithful record of the present state of the science. Thus, on page 353 we notice a very complete description of the method of preparing the newly-discovered alkaloid apomorphia, the remarkable physiological effects of which have lately attracted so much attention. The plan of the work is entirely novel. The author commences with some very pertinent advice to candidates as to the best method of studying the book in order to fit themselves for examination by the various boards. After the usual introduction, the student passes on to the practical study of the general properties of the non-metallic elements, and when he has familiarised himself with the various manipulative processes, and acquired a certain amount of chemical knowledge, he proceeds to the study of the general principles of chemical philosophy. The properties of the various metallic elements, their official preparations, and the tests employed in their detection, next engage his attention; after which he is put through a systematic course of qualitative analysis. The student next occupies himself with the study of the compounds of vegetable and animal origin, with the reactions of the alkaloids and of some other organic principles, and of the various substances which the author distinguishes as Galenical, and which can only fairly be regarded from a pharmaceutist's point of view, many of them being "not yet brought within the grasp of the chemist." The principles of toxicology, and the various methods employed in the examination of morbid urine and calculi, are then explained, and the different classes of official, Galenical, and chemical preparations enumerated. A course of quantitative analysis, sufficiently comprehensive for the student's requirements, and consisting of both gravimetric and volumetric processes, next follows. Several of the gravimetric methods are, however, in our opinion not the best at the disposal of the analyst. Thus, for the estimation of nitric acid Frankland and Armstrong's method of determining the amount of that acid in potable waters, is the only one recommended. This method, although doubtless excellently adapted to the purpose for which it was devised, is not, however, generally applicable. We would recommend the method of Vernon Harcourt to Dr. Attfield's attention. With some slight modifications, this method is pronounced by Professor Bunsen, of Heidelberg, in whose laboratory it is constantly used, to be by far the best of the many processes hitherto proposed for the estimation of nitric acid; and in the laboratory to which the writer is attached it is frequently employed with the most satisfactory results. The account given of the processes for the ultimate analysis of organic substances also appears to be somewhat defective, and the statement that the best combustion-furnace is that known as Hofmann's is open to dispute. The furnaces of Eslenmeyer and of Donny as modified by Glaser are certainly to be preferred; indeed, we understand that the Berlin professor has already renounced the use of the furnace which bears his name. Dr. Attfield is surely in error, also, in recommending (page 460) that the boiling point of a liquid should be determined by inserting the bulb of the thermometer in the heated liquid. Kopp pointed out long ago the errors incidental to this method of procedure. These, however, are defects of but minor importance, and may easily be remedied in future editions. We have derived much satisfaction from the perusal of Dr. Attfield's book: it is eminently practical in its character, and is written with a just appreciation of the small amount of time for the study of chemistry at the disposal of the student in medicine and pharmacy.

T. E. T.

OUR BOOK SHELF

Japanese Shells.—*Japanische Meeres-conchylien.* By Dr. C. E. Lischke. (Cassell: 1869.) Quarto, with 14 coloured plates.

JAPAN is not less remarkable for the works of its people than for its natural productions. Its sea-shells are of a mixed character, arctic and tropical. Some species range to the Mediterranean; for *Verticordia granulata* of Seguenza, from the Sicilian tertiaries, which I have now discovered living in the Gulf of Egina at a depth of 130 fathoms, was lately dredged by Mr. A. Adams in the seas of Japan, and is described by him as *V. multicostata.* Another species of *Verticordia*—or perhaps more correctly *Hippagus*—the *H. acuticostatus* of Philippi, a Calabrian and Sicilian fossil (which occurs also in our Coralline Crag, under Sowerby's name of *V. cardiiformis*), is the *V. Deshayesiana* of Fischer, and *V. Japonica* of A. Adams, from China and Japan. The only other known living species of *Hippagus* (*Trigonulina ornata*, D'Orbigny = *H. novemcostatus*, Adams and Reeve) is common to the West Indies and China. Unfortunately we know far too little of the former and present course of those great currents which traverse the ocean in every direction, to be able to explain satisfactorily the geographical distribution of the marine fauna. Nevertheless, although physical data are wanting, zoological facts are accumulating; and Dr. Lischke, as well as Mr. Arthur Adams, have rendered great assistance by their investigation of the Japanese mollusca. The present is not a complete treatise on the subject; but it shows great care and critical acumen, and it is beautifully illustrated. The author is Oberburgomeister of the large manufacturing town of Elberfeld, and finds time not only for his onerous public duties, but also for good scientific work; so that in other countries besides our own, writers on natural history are not confined to the class of paid professors.

J. GWYN JEFFREYS

Chemistry for Schools.—*An Introduction to the Practical Study of Chemistry.* By C. Haughton Gill, Assistant Examiner in Chemistry at the University of London. (London: Walton.) 8vo. pp. xv. and 315. 1869.

DURING the last few years the subject of science teaching in schools has occupied so much attention that a special class of manuals has been originated for the schoolmaster's use. Those which treat of Chemistry have been in some cases experiments, seldom remarkable for true appreciation of their professed purpose, or, perhaps, merely the pecuniary speculation of an ignorant writer. Under such circumstances, it is gratifying to meet with a book of this kind, which really is what it was intended to be—"a sufficient manual of chemistry for schools and junior students, and an aid to teachers wishing to introduce the science into the ordinary course of school study."

Mr. Gill's experience as teacher of chemistry and experimental physics at University College School appears to have been embodied in his book, if we may judge from its decided and perspicuous tone, and an evident intention that the pupil should strive, not only to *know*, but to *reason*. It is, indeed, precisely at this point that the power and merits both of teacher and writer become most apparent; and we have no hesitation in saying that it is in this sphere that the efficacious distinction between one manual and another lies.

After "Directions to the Reader" (as to the most advantageous mode of using the book), a list is given of the chapters into which the subject is divided. An exhaustive series of questions follows each chapter. A great deal of space has been gained by printing many of the necessary comments and descriptions in a smaller type than the more important text; and the illustrations, though generally of diminutive size, are no doubt large enough, and certainly distinct enough, for most readers. It need hardly be said that the province of *Chemistry for Schools* is comprised within the limits of the "metalloids" and their immediate allies. The nomenclature employed is throughout what has been termed "Berzelian," but is, in fact, derived from the hereditary Latin forms, which have been common for centuries to the whole of natural science, and are still the only ones which can be legitimately adapted to the requirements of our own language. The writer terminates with some useful appendices, not the least valuable of them being a list of necessary apparatus and chemicals, with approximate cost.

Mr. Gill has fairly earned the thanks of scientific chemists; nor will the schools be slow to appreciate a manual which has been thus well devised and executed by an author who has himself been a successful school teacher.

The Blow-Fly.—*A Monograph on the Anatomy and Physiology of the Blow-Fly.* By Benjamin Thompson Lowne. (Van Voorst.)

In this little volume, just issued by Van Voorst, Mr. Lowne has treated the subject of his monograph very exhaustively. The text is judiciously divided into two parts, the first comprising a neat popular sketch of the organisation of this familiar and pertinacious little companion of domestic life; and the second containing the more technical and elaborate account of the author's own dissections and investigations, which are illustrated by ten very beautiful plates, engraved by his own hand from his own microscopical demonstrations.

The book is eminently satisfactory, as being a clear and complete statement of what is known of fly-organisation. But it has also, in some degree, the stamp of original research upon it, and represents a remarkable amount of labour and industry. The nature of the all-embracing integuments, and the way in which they are modelled to form the external organs and implements of the creature's active life, are in the first instance dwelt upon. The theme then passes on to the examination of the digestive and assimilative apparatus, the arrangements for circulation and respiration, the nerve structure, and the organs of special sense. It would be possible to pause upon matters of particular moment and interest in each one of these departments of the treatise. But it must, for this occasion, suffice to draw attention to the explanation of the way in which the so-called false tracheæ of the trunk are modelled into an exquisite strainer, to enable the fly to draw off the finer and more nutritious parts of the half rotten pulpy matters that are used as food, and to the manner in which the terminal lip of this sucking trunk is furnished with supplementary rasping teeth and salivary pores, to allow such matters as loaf sugar to be broken down and dissolved into a juice also available for suction. The description of the manner in which the poisers, properly the abortion of the second pair of wings, are turned to account as ears which receive the vibrations of sound upon terminal knobs, instead of within trumpet cavities, is also most worthy of notice. But before all must stand Mr. Lowne's demonstration of the fly brain. He shows that the fly has a sense-centre, or cephalic ganglia, some thirty times larger than that of the most portly beetle, which sufficiently accounts for the energy and vivacity of the insect's life; and that it has also, in common with the bee and the ant, a small rudimentary convoluted brain, attached by a little footstalk to the larger and simpler nerve-mass of the head. Mr. Lowne holds that the fly clearly exhibits some trace of mental faculty, such as memory, in virtue of this shadowing forth of true cerebral organisation.

Terrestrial Physics.—*Ueber die Lehre von den Meeresströmungen.* By Dr. Adolf Mühry. (Göttingen, 1869. London: Williams and Norgate.)

This is a very successful attempt to introduce something like order into the complicated phenomena of oceanic currents. The author sketches first the two well-known main systems, viz. (1) the great west-current which forms a belt of nearly 50° of latitude on both sides of the equator, and to which the earth's rotation, combined with the inertia of the ocean, is assigned as cause; (2) the great thermal circulation from the poles towards the equator, with its compensating current in the opposite direction; both are, according to the author, produced by the difference in density of cold and warm water, and he refutes, with great knowledge and sagacity, the opinions of previous writers, of Maury among others, who seek the cause in differences in the amount of evaporation and rain, the prevailing winds, and the amount of saline matter in the sea.

Then follows an *exposé* of comparatively local systems. Here the author supplants the incompleteness of known facts by his own speculations, which are neither always clear nor above the suspicion that doubtful points have been decided by the author, with a view of confirming his own hypotheses. Thus a very elaborate chapter on the currents in the North Polar Basin rests entirely on his assumption that sea-water behaves like pure water as regards the temperature at which it has the greatest density. He describes some very crude experiments made by him, which prove the fact in his opinion, but are contradicted by the well-known experiments of such a distinguished physicist as Despretz, who found different points of maximum density for different saline solutions.

B. L.

Protozoe Helvetica.—*Mittheilungen aus dem Berner Museum der Naturgeschichte über merkwürdige Thier-und Pflanzenreste der schweizerischen Vorwelt.* Edited by W. A. Ooster and C. von Fischer-Ooster. Part I. Basle and Geneva, 1869. 4to. pp. 14, map and two double plates. (London: Williams and Norgate.)

This is the first fasciculus of a series intended to illustrate the palæontology of Switzerland. The work is intended chiefly as a means of making known by descriptions and drawings a number of interesting fossils from the animal and vegetable kingdom, in part at least new to science. Most of these have been derived from the Swiss Alps, and are now preserved in the Bern Museum of Natural History. It is also intended to serve as the organ for shorter palæontological communications from the whole extent of Swiss territory, the several authors being answerable for their own views. The first part contains a short paper, just completed, "On the Red Limestone of Wimmis and its Fauna;" the next will contain plates and descriptions of various remarkable fossils from the Swiss Alps. Three, or at most four such parts will form a volume, when a title-page and index will be issued.

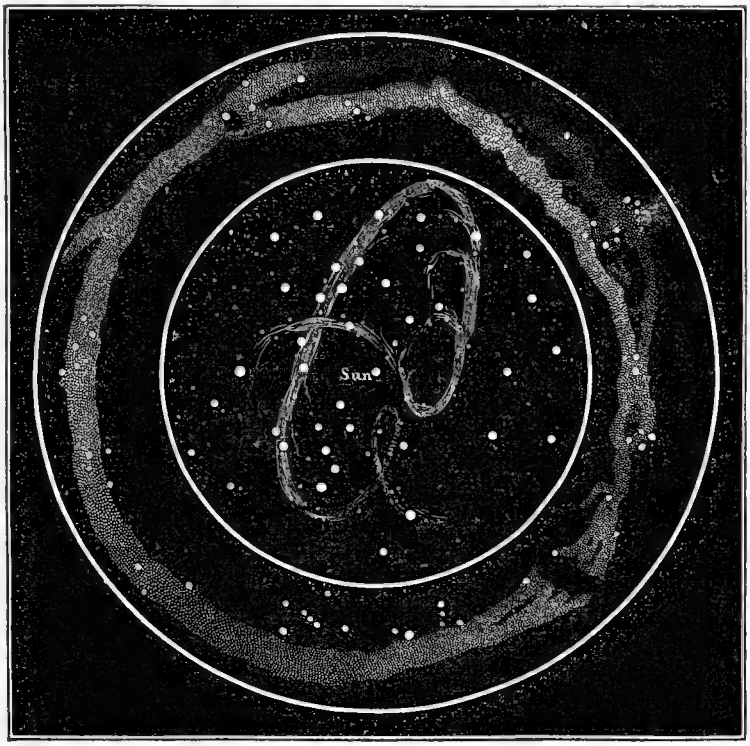
We need only add that the plates before us contain figures of fish-teeth (*Oxyrrhina*, sp.), mollusca (*Inoceramus Brunneri*, and an undetermined species), and echinodermata (*Collyrites Friburgensis* and *C. capistrata*), that the drawings are of large size, and, except for occasional flatness in the shading, well-executed.

H. B. B.

ARE ANY OF THE NEBULÆ STAR-SYSTEMS?

THIS may seem a bold question, for it is commonly believed that Sir William and Sir John Herschel—the Ajax and the Achilles of the astronomical host—have long since proved that many of the nebulæ are star-systems. If we inquire, however, into what the Herschels have done and said, we shall find that not only have they not proved this point, but that the younger Herschel, at any rate, has expressed an opinion rather unfavourable than otherwise to the theory that the nebulæ are galaxies in any sense resembling our own sidereal system.

Sir William Herschel, by his noble plan of star-gauging, proved that the stars aggregate along a certain zone, which in one direction is double. He argued, therefore, that presuming a general equality to exist among the stars and among the distances separating them from each other, the figure of the sidereal system resembles that of a cloven disc. And as the only system from which he could form a probable judgment—I mean the planetary system—presented to him a number of bodies, widely separated from each other and each a globe of considerable importance, he reasoned from analogy that similar relations exist in the sidereal spaces. This being so, his cloven disc theory of the sidereal system seemed satisfactorily established.



Then, of course, those nebulæ which exhibit a multitude of minute points of light very close together, and those other nebulæ which, while not thus resolvable into minute points, yet in other respects resemble those which are, came naturally to be looked upon as distinct from the sidereal system. The analogy of this system, in fact, pointed to them as external star-systems, resembling it in all important respects.

Then there were certain other objects, which seemed to present no analogy either to the sidereal system or to separate stars. These objects Sir Wm. Herschel considered to belong to our sidereal system; for he could not put them outside its range without looking on them as objects *sui generis*, which would have been to abandon the argument from analogy. In order to explain their appearance, he suggested that they might be gaseous bodies, by whose condensation stars would one day be formed.

The value of Sir Wm. Herschel's work is not in the least affected even if science have to reject every one of these opinions. He himself held them with a light hand; he had once held other opinions; and he was gradually modifying these. Had he seen one sound reason for rejecting any or all of them he would have done so instantly. For it belonged to the strength of his character that he was never fettered by his own opinions, as weak men commonly are.

Sir John Herschel did for the southern heavens what his father had done for the northern. He completely surveyed and gauged them. It is commonly believed that the results of his labours fully confirmed the opinions which his father had looked upon as probable.

Let us see if this is so.

Sir W. Herschel thought the Milky Way indicated that the sidereal system has the figure of a cloven disc; Sir John Herschel judges rather that the sidereal system has the figure of a flattened ring. Sir Wm. Herschel thought the stellar nebulæ are probably external galaxies; Sir John gives reasons for believing that they lie within our system, and Whewell considered that these reasons amount to absolute proof.

It has been further believed and stated that the researches of the elder Struve go far to confirm the opinions put forward by Sir W. Herschel as probable.

Let us inquire how far this is true.

Struve found that the numbers of stars of given magnitudes exhibit nearly the same proportion in different directions. Thus supposing that in a given direction there are three times as many stars of a certain magnitude as there are of the next highest magnitude, then in other directions, also, the same relation is observed. This is a very striking law; but to make it serve as a proof of the opinion which Sir William Herschel had put forward as probable, it would be necessary that another law should be exhibited. For clearly, if that opinion were just, it would be easy to calculate what the relation should be between stars of different magnitudes. Had Struve been able to show that the numbers actually seen corresponded to the relations thus calculated, he would have gone far to render that view certain which Herschel always spoke of as merely an assumption.

But Struve found no such law of stellar distribution. On the contrary, he found a law so different, that in order to force the facts into agreement with Sir William Herschel's views about the sidereal system, he had to invent his famous theory of the extinction of light in traversing space. Now, according to this theory, we cannot see to the limits of our sidereal system, even though we could increase the powers of our telescopes a million-fold; so that if the theory is true, the question which heads this paper is at once disposed of. Obviously, we cannot see galaxies beyond the sidereal system if we cannot see to the limits of that system. And I may note in passing that (independently of Struve's theory) the most powerful telescopes cannot render visible the most distant stars of our sidereal scheme; so that if the nebulæ are really external galaxies, the stars we see in them must be enormously greater than those in our galaxies, supposing Herschel was right in thinking these tolerably uniform in magnitude.

Before proceeding to exhibit the evidence which has led me to the conviction that the nebulæ belong to our sidereal system, I may mention some reasons for believing that if Sir William Herschel's labours in the sidereal heavens were to be begun now, not only would he not have been led to adopt as probable the view on which he formed his opinions, but he would have rejected it as opposed to known analogies.

He had argued that because the planetary system exhibits a definite number of bodies separated by wide distances, therefore analogy should lead us to regard the sidereal system as similarly constituted, though on a much larger scale. This was perfectly just. Despite the various differences which no one recognised more clearly than he did, this view was the only one he could safely adopt for his guidance, ninety years ago.

But would not he have been the first to reject that view if he had known what we now know of the solar system? If he had known that besides the primary planets, there are hundreds of minute bodies forming a zone between the orbits of Mars and Jupiter; that the rings of Saturn are formed of a multitude of minute satellites; that innumerable meteor-systems circle in orbits of every conceivable degree of eccentricity; that near the sun these systems grow denser and denser; that the comets of the solar system must be counted by millions on millions; that, in fine, every conceivable form of matter, every conceivable degree of aggregation, and every conceivable variety of size, exists within the limits of the solar system,—would he, then, have been led by analogy to recognise in the sidereal system only discrete stars and masses forming into stars?

From a careful study of all that Sir William Herschel has written, I feel certain, that in the case I have imagined, he would have been prepared, even before commencing his labours, to expect precisely that variety of matter, size, and aggregation, which modern observations, rightly understood, prove actually to exist within the range of the sidereal system.

The Herschels, father and son, discovered about 4,500 nebulæ. Other observers have brought up the number to about 5,400. When these are divided into classes, it appears that some 4,500 must be looked on as irresolvable into discrete points of light. But of these the greater proportion so far resemble resolvable nebulæ as to lead to the belief that increase of optical power alone is wanting to resolve them.

Taking these irresolvable nebulæ, however, as we find them, and marking down their places over the celestial sphere, we recognise certain peculiarities in their arrangement. In the northern heavens they gather into a clustering group as far as possible from the Milky Way. In the southern heavens they form into streams, which run out from a region nearly opposite the northern cluster of nebulæ; but the *extremities* of the streams are the region where nebulæ are most closely crowded. The Milky Way is almost clear of nebulæ.

This withdrawal of the nebulæ from the Milky Way has been accepted by many as clearly indicating that there is *no* association between them and the sidereal system. The opinion of the Herschels, if they had been led to pronounce definitively on this point, would have been different, however; for the younger Herschel quotes (as agreeing with it) a remark of his father's to the effect that the peculiar position of the northern nebular group is not accidental. If not accidental, it can only be due to some association between the nebular group and the galaxy. Every other conceivable explanation will be found to make the relation merely apparent—that is, accidental, which neither of the Herschels admit.

But yet stronger evidence of association exists; evidence which I do not hesitate to speak of as incontrovertible. Space will only permit me to treat it very briefly.

There is a certain well-marked stream of nebulæ in the southern heavens leading to a well-marked cluster of nebulæ. There is an equally well-marked stream of stars leading to an equally well-marked cluster of stars. The nebular stream agrees in position with the star-stream, and the probability is small that this coincidence is accidental. The nebular cluster agrees in position with the star-cluster, and the probability is still smaller that this second coincidence is accidental. Such are the separate chances. It will be seen at once, therefore, how small the chance is that both coincidences are accidental.

The cluster here referred to is the greater of the celebrated Magellanic Clouds. When it is added that the evidence is repeated point for point in the case of the lesser Magellanic Cloud, the indications of association appear overwhelmingly convincing. If the nebulæ really are associated in this manner with fixed stars, the question which heads this paper is disposed of at once.

But there is yet further evidence.

The nebulæ pass by insensible gradations from clusters less and less easily resolvable, to nebulæ properly so called, but still resolvable, and so to irresolvable nebulæ. Now clusters are found not only to aggregate in a general manner near the Milky Way, but in some cases (on which Sir John Herschel has dwelt with particular force) to exhibit the clearest possible signs of belonging to that zone. If they then belong to the Milky Way, can any good reason be given for believing that the various other classes of nebulæ are not associated with the sidereal scheme? Where should the line be drawn?

Again, some of the nebulæ are gaseous, and all the gaseous nebulæ exhibit the same spectrum. Now, two classes of gaseous nebulæ, the planetary and the irregular nebulæ, exhibit a marked preference for the Milky Way, and therefore we must admit the probability that they, at any rate, belong to the sidereal scheme. But then a large proportion of the irresolvable nebulæ are also gaseous, and as they are formed of the same gases, we see good reason for believing that they also must belong to our galaxy. This, however, brings in all the nebulæ, since the recent detection by Lieut. Herschel of the same bright lines in or rather *on* the continuous spectrum of a star-cluster, shows the great probability which exists that with more powerful spectroscopes all the nebulæ may be found to exhibit these bright lines, that is, to contain these particular gases. I pass over the facts, that many nebulæ are found to be closely associated with stars, and that if any doubt could remain as to the association being real and not apparent, it would be removed by a picture of the nebula M 17, as seen in Mr. Lassell's great reflector at Malta. The reader will be more interested by the following quotation, which I extract (by permission) from a letter of Sir John Herschel's:—

"A remark which the structure of Magellanic Clouds has often suggested to me has been strongly recalled by what you say of the inclusion of every variety of nebulous or clustering forms within the galaxy, viz., that if such be the case—*i.e.* if these forms belong to, and form part and parcel of the Galactic system—then that system includes *within itself miniatures of itself* on an almost infinitely reduced scale; and what evidence, then, have we that there exists a universe beyond—unless a sort of argument from analogy, that the Galaxy with all its contents may be but one of these miniatures of a more vast universe, and that there may, in that universe of other systems on a scale as vast as our galaxy, be the analogues of those other nebulous and clustering forms which are not miniatures of our galaxy?"

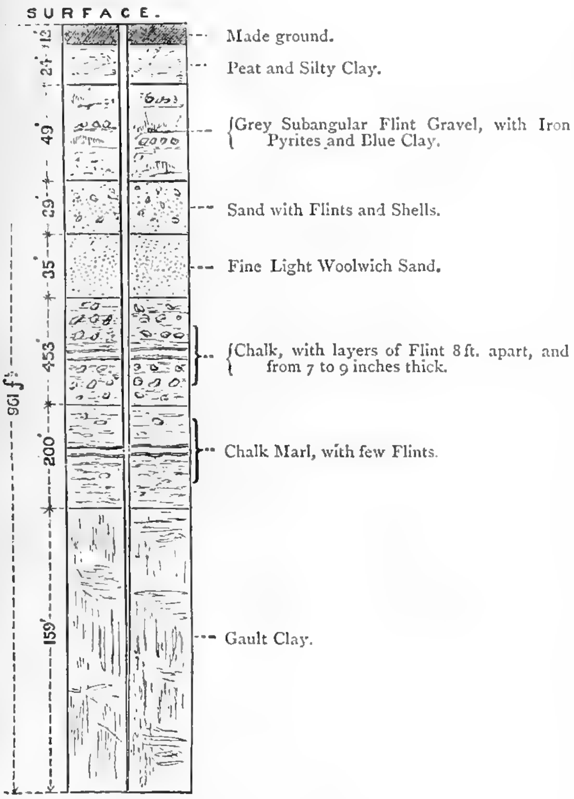
It will be seen that, while Sir John Herschel is quite ready (should the evidence require it) to adopt altogether new views about the nebulæ, he is *not* ready to forego the grandeur of those noble views of the universe which he and his father have established, thereby earning the well-deserved gratitude of every lover of astronomy.

And then with regard to the *actual* form of our galaxy or Milky Way, the figure introduced shows that its apparent one as projected on the heavens may really be due to an arrangement differing both from the cloven disc or flattened ring, a point to which I shall return in a subsequent article.

RICHARD A. PROCTOR

THE CROSSNESS WELL-BORING

THIS boring, which was commenced by the Metropolitan Board of Works for the purpose of supplying the engines and dwelling-houses at Crossness with pure water, has, as may be seen from the accompanying diagram, reached a depth of 961 feet without piercing the Lower Greensand, where it was expected a good supply would be found.

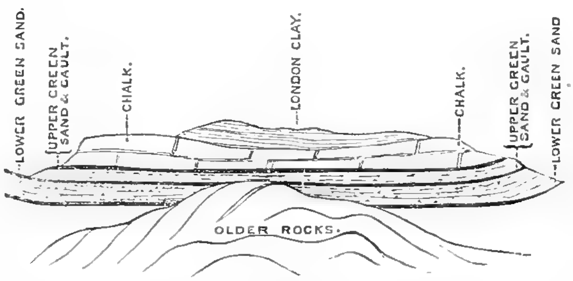


Section of Crossness Well-boring.

In consequence of the great difficulties attending the extraction of broken rods, &c., from the boring at that great depth, together with the uncertainty of the Lower Greensand being present, the boring has been discontinued. This is much to be regretted, as, if persevered with for a further depth of 40 or 50 feet, it would undoubtedly pass through the gault, which seldom exceeds 200 feet in thickness, 147 feet of which are now entered, and would thus add to the knowledge we at present possess of the substratum of London.

The chalk and gault clay at their outcrop to the north and south of London are underlaid by the Lower Greensand, which is from 150 to 400 feet thick; this, if continuous, as are the chalk and gault, would give a water-bearing strata of great capacity.

But it has been proved that its continuity is broken; as at Harwich, where after boring 1,000 feet through chalk, some carboniferous slates were found, and at Kentish Town, where beneath chalk and gault were found red sandstone and clay, though whether they belong to the Old or New Red Sandstone group, could not be ascertained. Mr. W. Whitaker very reasonably supposes that there is an underground ridge of older rocks crossing the London basin, which was an island when the Greensand was deposited, as the accompanying sketch shows, thus accounting for its absence in the places above mentioned.



Section across London Basin, showing Probable Position of Ridge of Old Rocks.

If the Crossness boring were continued, and the Greensand were not found, the direction in which this ridge runs would be ascertained, and thus would be prevented much fruitless outlay to those contemplating well-boring; in addition to which, some important facts connected with the London water supply would be made known; further, it might decide the question as to the existence of the coal measures beneath London, at a practicable depth, which, it will be admitted, is a question of universal interest. Under these circumstances, surely Government aid ought to be invoked, as the Board of Works are unwilling to proceed with the boring on their own responsibility.

UTILISATION OF SEWAGE

THE British Association Committee on the Treatment and Utilisation of Sewage has requested us to state that a number of towns and private individuals have already sent in or promised subscriptions for defraying the expenses of the contemplated investigation referred to in the circular published in NATURE of the 2nd of December, and that a Special Meeting of the Committee will be held on the 15th of February next to decide what further steps are to be taken in furtherance of the object in view.

The Committee therefore requests that town and district authorities who have not yet replied to the circular will at their earliest convenience communicate with the Committee, and state what sum will be subscribed; or, if it be decided not to subscribe, what is the reason for declining.

Should the total amount subscribed be insufficient for adequately continuing the inquiry, it is the intention of the Committee to return the subscriptions received.

The following Towns and Districts have subscribed, or signified their disposition to do so:—Stoke-upon-Trent, Exeter, Plymouth, Devonport, Paisley, Coventry, Oxford, Maidstone, Torquay, Wakefield, Dewsbury, Hereford, West Hartlepool, Kendal, Weymouth, Enfield, Penzance, Balsall Heath, Bromley, Bridport, Malvern, Abingdon, Atherton, Toxteth Park, and Walton-on-the-Hill.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Kant's View of Space

ALTHOUGH I do not feel myself called upon to modify in the least what was said in my former letter on this subject, the three letters which appear to-day in answer to it are too important to be left unnoticed.

The case is briefly this: In the "History of Philosophy" I had to expound Kant's doctrine, and to criticise it, not only in itself, but in reference to the great question of the origin of knowledge. In the pages of exposition I *uniformly* speak of Space and Time as forms of Intuition; no language can be plainer. I also mark the distinction between Sensibility and Understanding, as that of Intuition and Thought. After enumerating the Categories, I add, "In those Categories Kant finds the pure forms of the Understanding. They render Thought possible."

But when, ceasing to expound the system, I had to criticise it, and especially to consider it in reference to the great question; there was no longer any need to adhere to a mode of expression which would have been obscure and misleading. I therefore *uniformly* class Space and Time *among the forms of Thought*, connecting them with the doctrine of Necessary Truths and Fundamental Ideas, which, according to the *à priori* school, are furnished ready-made—brought by the Mind as its native dowry, not evolved in it through Experience.

Now the question is, Have I put language into Kant's mouth which he would disclaim, or is such language misleading? That Kant would have said the language was not what he had employed, I freely admit; but that he would have disclaimed it as misrepresenting his meaning, I deny. I was not bound to follow his language when the task of exposition was at an end; but only bound not to translate his opinions into language which would distort them.

In classing Space and Time *among* the Forms of Thought I classed them *beside* the Categories of the Understanding and the Ideas of Reason, *i.e.*, the purely intellectual conditions existing *à priori* in the Mind. The Mind is said by Kant to be endowed with three faculties—Sensibility, Understanding, and Reason. The activity of the Mind is threefold—Intuitive Thought, Conceptive or Discursive Thought, and Regulative Thought. There could not be an equivoque in my using the word Thought in its ordinary philosophical acceptation as expressive of all mental activity whatever, exclusive of mere sensation; although Kant assigns a more restricted meaning in his technical use of the word, *i.e.*, what we call Logic. And that Kant *meant* nothing opposed to the ordinary interpretation is obvious. It is obvious because, as I said in my former letter, Intuition without Thought is mere sensuous impression. Mr. Sylvester demurs to this, so I will show it in a single citation:—"In the transcendental Æsthetic," says Kant, "we will first isolate Sensibility by separating from it all that the Understanding through its concepts thinks therewith, so that nothing but empirical Intuition remains. Secondly, we will lop off from this empirical Intuition everything relating to Sensation (*Empfindung*); so that thereby nothing will remain but pure Intuition and the mere form of phenomena, which is the one thing that Sensibility can furnish *à priori*. By this investigation it will appear that there are two pure forms of sensuous Intuition which are *à priori* principles of Cognition." ("Kritik," § 1. ed. Hartenstein, p. 61).

Mr. Sylvester correctly says, that Intuition and Thought are not convertible terms. But he is incorrect in assuming that they differ as potential and actual; they differ as species and genus; therefore whatever is a form of Intuition, though not a form of Logic, must be a form of Thought; unless intuitive Thought be denied altogether. How little Kant denied it is evident in every section of his work. In asserting that Space and Time as Intuitions belong to the subjective constitution of the Mind—*subjectiven Beschaffenheit unseres Gemüths* (p. 62)—he expresses this; but it is unequivocally expressed in the following definition:—"A perception, when it refers solely to the subject, as a modification of its states, is *sensation*, an objective perception is *cognition: this is either Intuition or Concept*, 'intuitus vel conceptus.'" ("Kritik," p. 294.) Is not thought implied in cognition? Again:—"The proposition 'I think' is an undetermined empirical Intuition, *i.e.*, Perception; consequently, it proves that Sensation, which belongs to Sensibility, must lie at the basis of this proposition......I do not mean thereby that the 'I' in the 'I think' is an empirical representation (*Vorstellung*), on the contrary, it is *purely intellectual because it belongs to thought in general*. But without some empirical representation which would give Thought its material there could be no such act of Thought as the 'I think'" (p. 324, *note*).

"Man is always thinking," says Hegel, "even when he has nothing but intuitions; *denkend ist der Mensch immer auch wenn er nur anschaut*." (Encyclop. § 24.)

If, because Kant has a restricted use of the term Thought, all who venture on the more ordinary use are said to misrepresent his philosophical meaning, I must call upon those who criticise this laxity to refrain henceforth from speaking of Reason as Thought, since Kant no less excluded Reason from the province of the Understanding. If "the only forms of thought, in Kant's sense, are the Categories," this sweeps away Reason on the one side, as it sweeps away Sensibility on the other; and Ideas are not more correctly named Thoughts than Intuitions are. Kant, it is true, speaks of the concepts of Reason, and defines an Idea to be a "Vernunft begriff" (page 294); but Kant, equally and in a hundred places, speaks of the "concept of Space" (Begriff des Raumes). The truth is, as already intimated, that in spite of his technical restriction of Thought to the formation of concepts, he recognised intuitive and regulative Thought no less than discursive Thought; nor would his system have had any coherence without such a recognition. Why does he call his work the "Critik of Pure Reason," unless he intended to display the common intellectual ground of Sensibility, Understanding, and Reason? and does not the word Thought, in ordinary philosophical language mean this activity of the Intellect? When, by Sir W. Hamilton, Dr. Whewell, Mr. Spencer, and myself, the phrase Forms of Thought is used, does not every reader understand it as meaning Forms of intellectual activity?

In conclusion, I affirm that in the ordinary acceptation of the term Thought—the activity of the Mind—Space and Time as forms of Intuition are forms of Thought, conditions of mental action; and to suppose that because Kant's language is different, his meaning is misrepresented by classing forms of Intuition among the forms of Thought is to misunderstand Kant's doctrine and its purpose. GEORGE HENRY LEWES

January 22.

DR. INGLEBY, I should think, is quite entitled to say not only that Kant might, but that he would, have disclaimed the phrase Form of Thought as applied to Space or Time taken simply. The remark of Mr. Lewes, that "intuition without thought is mere sensuous impression,"—or, as it might have been put, that phenomena of sense (constituted such in the forms of Space and Time) must further be thought under Categories of Understanding, before they can be said to be known or to become intellectual experience—cannot be a sufficient reason for making a Form of Thought proper out of a Form of Intuition.

There is, nevertheless (and Mr. Lewes does not fail to suggest it), a sense in which, when taken along with the Categories of the Understanding, and with or without the Ideas of the Reason, the Forms of Intuition may be spoken of as Forms of Thought: Thought being understood, with the same extension that Kant himself gives to Reason in the title (not the body) of his work, as equivalent to faculty of Knowledge in general. It is in this sense that Kant calls all the forms alike, *à priori* principles of Knowledge; and the ambiguity of the word Thought is so well recognised, that the English writers, arraigned by Prof. Sylvester, take no great liberty, when for their purpose, which commonly is the discussion of the general question as to the origin of Knowledge, they talk generally of Kant's "Forms of Thought." If, indeed, any of them ever speaks of Space as a "form of the Understanding," which was part of the original charge, the case is very different; Kant being so careful with his *Verstand*. But Mr. Lewes at least would never be caught speaking thus, even though his main reason for merging Intuition in Thought might seem to justify this also. G. CROOM ROBERTSON

University College, January 22.

YOU will perhaps permit me to make a remark on a controversy at present going on in your columns. There has seldom, I believe, been a grosser or more misleading perversion of the Critical Philosophy than ascribing to Kant the view that Space and Time are in any meaning of the terms "forms of thought." One of his chief grounds of complaint against Leibnitz is, that the latter "intellectualised these forms of the sensibility" (Meiklejohn's Translation of the "Critick," p. 198): and lest the import of this assertion should be mistaken, he explicitly tells us that "Space and Time are not merely forms of sensuous intuition, but intuitions themselves" (Meiklejohn's Trans., p. 98): that is, *sensuous* intuitions, as he has been just before asserting that all human intuitions must be. It is precisely on this distinction of pure sensibility and pure thought that Kant founds the possibility of Mathematics—a science which could never be derived from a mere analysis of the concepts employed, but only from the construction of them in intuition. He ridicules, for example, the idea of attempting to deduce the proposition, "Two right lines cannot enclose a space," from the mere concepts or notions of a straight line and the number two. "All your endeavours," says he, "are in vain, and you find yourself compelled to have recourse to intuition, as in fact Geometry always does." (Meiklejohn, p. 39: see also his long contrast of Mathematical and dogmatical methods in the beginning of the "Methodology.") And not only is Kant's Mathematical theory founded on this distinction but his Physical theory also, since it is only by means of pure intuition that he connects pure thought with sensations (see the "Schematism" and still more the "General Remark on the System of Principles," Meiklejohn, pp. 174-7); and when he fails to make out this connection he regards the Ideas of Pure Reason as possessed of no objective validity (Transcendental Dialectic). In the first edition of the "Critick" he went still further, and in his remarks on the Second Paralogism of Rational Psychology he speaks of "that something which lies at the basis of external phenomena, which so *affects* our *sense* as to give it the representations of *space*, matter, *form*, &c." And while he abbreviated his discussion in the second edition he tells us in his preface that he found nothing to alter in the views put forward in the previous one.

I might quote whole pages of the "Critick" in proof of these views, but I ought rather to apologise for writing so much after the letters which you have already published. I believe the mistakes as to Kant's doctrine of Space and Time, his refutation of Idealism, and his discussion of the Antinomies of the Pure Reason, are almost without a parallel in the History of Philosophy.

Trinity College, Jan. 22 W. H. STANLEY MONCK

State Aid to Science

I OBSERVE that both in your leading article and in the correspondence upon Mr. Wallace's letter, the soundness of his theory of taxation seems to be conceded, though you quarrel with his inference that Science ought not to receive Government aid. But will his theory hold water for a moment? The theory as I understand it is this: "No money raised by general taxation ought to be applied for any purpose which does not directly benefit everybody." In other words, "It is not fair to take A's money and use it for the benefit of B." Why not, if at the same time you take a proportionate amount of B's money and use it for the benefit of A? Suppose you tax people who don't want gratuitous education for themselves, and spend the money on primary schools. This is expenditure for the direct benefit of one class only; and indirect benefits, according to Mr. Wallace, are not to be taken into account. This, according to the theory, would be an unfair application of public money. But if at the same time you apply a proportionate amount of public money for the benefit of all those who reap no direct good from gratuitous schools, you exactly redress the injustice; and, so far as it goes, expenditure on Science is an expenditure of this character.

If Mr. Wallace's theory were sound, there is no conceivable application of public money which it would not condemn. There is no public expenditure which directly benefits all. Take the payment of dividends on Consols, which eats up a third of our revenue. How does an agricultural labourer benefit by this? Not directly, certainly, and I am not sure that he does even indirectly. The only indirect good is, that it maintains public credit, and enables the Government to borrow again and to go to war on the strength of it. What good does that do to the labourer? Perhaps it may be said it is the fulfilment of a moral obligation. But whose moral obligation? Not Hodge the ploughman's. Even the least exceptionable of all outlay, that on police, is of very doubtful benefit to those who have nothing to lose. And the theory, if sound, must go a step further than Mr. Wallace carries it. If all public expenditure ought to benefit all, it ought by the same reasoning to benefit each in exact proportion to his contribution, and no system of taxation and expenditure even pretends to approach this condition.

Obviously Mr. Wallace could not have meant what he said. He must have meant this: "Public expenditure as a whole ought to benefit taxpayers in proportion to what they pay." Put in this way it is a fair doctrine, to which our actual adjustment of taxation and expenditure ought to approximate as nearly as may be. But this is quite consistent with special expenditure for the benefit of special classes, provided it is fairly balanced by other special expenditure for all other classes. If, on the whole, men of science are getting more than their share of the good things going, by all means stop the supply; if they are getting less than their share, give them something more. This is surely fair, and it is an intelligible working principle. Mr. Wallace's principle has only this to recommend it, that it would be impossible to find any object which would justify the levying of a single sixpence from your humble servant or any other TAXPAYER

P.S.—I hope that in discussing Mr. Wallace's argument on his own grounds, I shall not be supposed to agree with him that the direct and immediate benefit is the only thing to be looked to. If a man or a class gets a benefit, it does not lose its value by coming indirectly. And, as a matter of fact, expenditure on Science does, as you and others have sufficiently pointed out, confer indirect benefits on the non-scientific classes, incomparably beyond any little direct advantage to the scientific students whose work is promoted by it.

Use of the word "Correlation"

I OBSERVE in your last number you adopt the phrase of Mr. Barrett, "Correlation of colour and music." Will you and Mr. Barrett pardon a criticism on the application of the word "correlation?"

I believe I was the first who ever used the word at all as an English word, though the words "correlate," "correlative," &c., are to be found in Johnson. At all events, I stretched the meaning, and apologised for so doing in my essay on the "Correlation of Physical Forces." Wherever the word "correlative" was used to express a mutual and inseparable relation of two ideas, such as parent and offspring, height and depth, &c., I ventured, for want of a better term, to apply it, and the new substantive "correlation" to reciprocal relations of phenomena, such as heat and electricity, electricity and magnetism, &c.—not then (1842) supposed, except by me, to be relations of necessity, and not even now supposed to be inseparable in idea.

The application of the word has latterly been much extended, and we hear of correlation of growth, correlation of diseases, correlation of sciences, &c. I rather regret this; there is nothing of greater importance, especially for works on physical science, than accuracy, as far as may be, in the use of words: perfect accuracy is impossible.

Mr. Barrett has, I think, extended the import of the word beyond reasonable limits. There is no correlation between colour and music, further than there is a correlation between anything and everything. The word "analogy," used also by Mr. Barrett, is, in my humble judgment, far more accurate as applied to the classes of phenomena he treats of. I hope he will excuse a "parent" when complaining of ill-treatment to his "offspring," although the offspring may have had a little congenital deformity.

January 22 W. R. GROVE

Rainbow Colours

I AM reminded by Mr. Grove's statement at p. 314 (that he has seen three repetitions of the spectrum within the primary) of a splendid rainbow, which I saw at the Falls of the Handeck, near Meyringen, last summer.

The sun was very bright, about midday, and looking down at the Fall there appeared the most beautiful rainbow I ever saw. The colours were intense, probably from the spray being in fine drops; and I observed between the primary and secondary, *i.e.* between the two violets, a band of *a fine rich brown colour*.

I have often observed when rainbows are bright, that there is a dark band of a neutral tint between the two. This effect was shown very beautifully in a drawing by Mr. Alfred W. Hunt, exhibited at the Water Colour Society two or three years ago. He appears to have seen the same effect, but I had never seen the rich brown colour before. It was no effect of background, for when I varied my position the brown moved with the bows.

I have also often seen four or five, what may be called tertiary bows, inside the primary. They are grouped together as it were, and form a band of alternate red and green, becoming fainter as they recede from the primary. They appear to be a repetition of the primary in which the red and green are the most prominent colours.

Gateshead, January 23 R. S. NEWALL

Cuckows' Eggs

WILL you kindly allow me space to thank Prof. Newton for the trouble he has taken in replying to my inquiries, although I must confess I am still unconvinced?

My omission of the name of the eminent oölogist in my last letter was entirely accidental, for I had no purpose in concealing it, but rather the reverse. My quotation was from a letter of Mr. Hewitson's, in the *Field* of March 17, 1868.

Mr. Newton mentions the eggs of the Black Cap Warbler and the Tree Pipit, as some indication of the existence of a condition which I doubted in my sixth question. I have not found the eggs of the Black Cap vary more than this, that in some the ground colour was of a warmer tone than in others. The eggs of the Tree Pipit, I freely admit, do vary greatly, but their variations are all confined to different shades of nearly the *same colour*—viz., purple; ranging from purplish red on the one side, to bluish purple on the other, but these variations have, nevertheless, so much similitude that there is no difficulty in at once recognising them.

Mr. Newton says: "If the eggs in question were not cuckows', what birds laid them?" My reply is, simply, that they were laid by the birds in whose nests they were found. It seems to me far more likely that an egg laid by a certain bird should vary slightly from the rest of her eggs in the same nest, than that another species should lay eggs varying to the extent mentioned by Dr. Baldamus—viz., from vinous red to greenish blue, olive green, plain brown, &c., or even pure white, or light blue green, mentioned by Degland and Gerbe, as quoted by Mr. Newton.

Mr. Newton will excuse me for saying that I did not refer to the German authors mentioned by him in the footnote to his letter, excepting where quoted by Dr. Baldamus, for unfortunately I do not possess a knowledge of the German language, and am therefore unacquainted with their writings.

The doubts I have expressed, and still feel, have nothing personal in them, but only apply to the theory and the evidence on which it is supported. It does seem to me singular that these extreme variations of colour in the eggs of the cuckoo should only have been remarked in Germany. They do not appear to have been observed in Britain. Mr. Newton does not say he has found them himself, and admits that the evidence on which these German eggs are pronounced cuckoos' might have been more satisfactory. Mr. Hewitson says "few eggs differ less," and Mr. Dawson Rowley has remarked, in a letter to the *Field*, "I believe few men have taken with their own hands so many eggs of *cuculus canorus* as myself;" and yet his experience does not confirm the theory, but the contrary.

I cannot help feeling that we still want more positive information on this point. Were all the varied eggs alleged to be cuckoos' really laid by that bird? I can easily conceive an enthusiastic naturalist, with a favourite theory to maintain, imagine when he takes out of the nest of the hedge-sparrow, or tree pipit, an egg rather larger than the rest, but marked and coloured in a similar manner, that it is that of the cuckoo. I hold, however, that nothing less than *positive proof* that it was deposited by a cuckoo will suffice. I admit this may be difficult to obtain, but it is not the less necessary. A dogma like the one in question must be based on evidence that is not only unimpeachable, but above suspicion, and this I think the advocates of the theory have not yet furnished.

May I ask you to be good enough to allow my orthography of the word "cuckoo" to remain? With all deference to so high an authority as Prof. Newton, I prefer and always use the common mode of spelling the word to the one adopted by him, as better representing the call-note, from which the name is derived.

W. J. STERLAND

January 17

Dr. Livingstone's Discoveries

IN the conclusion of a letter which has lately appeared in your journal on the subject of Dr. Livingstone's recent letters, Dr. Beke gives the opinion that the river and lake chain which forms the main part of the great traveller's latest discoveries, is the head stream of the Nile. Though I am unwilling to differ from such an authority as Dr. Beke, yet there appear to me to be considerable difficulties in the way of his conclusions.

Will you allow me to show how it seems equally, if not more probable, that Dr. Livingstone, whilst he has ascertained the sources of the Nile, has also the merit of being the discoverer of the head streams of one of the great rivers which flow to the Atlantic, perhaps of the Congo. The Chambeze, the head stream of the lake chain in question, has its rise somewhere in the eastern part of the great plateau or ridge which skirts the whole side of Africa, next the Indian Ocean. Dr. Livingstone crossed it in lat. 10° 34′ south; from this it flows first westwards to Lake Bangweolo, then north to Lake Moero. The position of Lake Moero can only be determined as yet by reference to that of Lunda, the capital of the kingdom of the Cazembe, twelve miles beyond which town the lake is said to begin. Portuguese travellers are the only Europeans who are known to have previously visited this town, and the two routes from which we can assign it a position on the map, are those of Dr. Lacerda in 1798, and of Major Monteiro in 1831. These two travellers, with their escorts, have passed over almost the same route from Tete on the Zambesi to the Cazembe. From the former traveller there remain two astronomically fixed positions in the middle of this route, and the latter has published a volume which contains the distances and directions of his journey, but no astronomical positions. The route of Monteirò then, justified by the now ascertained position of Tete at the beginning, and by the positions formerly determined by Lacerda for its middle course, gives the place of the Cazembe town of Lunda, at its termination, in lat. 8° 40′ S., lon. 28° 20′ E.

Dr. Livingstone describes Lake Moero as beginning twelve miles below this position and extending for fifty miles to northward. Since he proceeded north from Cazembe town along the eastern shore of Lake Moero, in his attempt to reach Ujiji in the end of 1867, the great bulk of this lake must lie to westward of the meridian of Lunda. The centre of Moero would then be in the latitude of the south end of Tanganyika, and at about 120 miles to westward of its longitude. Dr. Livingstone has seen the river at its outflow from this lake and also at the point where it emerged from the "crack in the mountains of Rua," when, according to his own observation, the river turned to *north-north-west* to form Ulenge, a third lake or marsh in the country west of Tanganyika.

This north-north-westerly direction would carry this river quite out of the line of Tanganyika or of the Albert Nyanza; besides, both of these lakes appear to be closed-in on the western side by high mountains.

The levels of the river also appear to present a great obstacle to its joining the Nile lakes.

Leaving the Valley of the Loangwa, Dr. Livingstone tells us that he ascended to a great plateau which extends for 350 miles square, southward of Tanganyika. This table-land is at an elevation of from 3,000 to 6,000 feet above the sea. The valley of the Chambeze crosses this plateau from east to west, and the river descends from it into the great valley of the Lakes Bangweolo and Moero, not far west from the point where it was crossed by Dr. Livingstone. The valley of the Chambeze is no doubt one of the greatest hollows in this plateau, and so the bed of the river here may be taken to be at the lowest general height of the plateau given by Dr. Livingstone—that is, 3,000 feet, or 200 feet above the Tanganyika. From the point at which the Chambeze was crossed, its course is for perhaps 200 miles westward to Lake Bangweolo, and in this part of its flow from the plateau to the valley the fall of the river must be considerable. Between Bangweolo and Moero the course of perhaps 120 miles to northward seems to be through a more level part of the valley. Still, here there must be another descent to Lake Moero. According to the Portuguese traveller, Monteiro, the kingdom of the Cazembe extends on the east and north-east to the land of the Auembas, apparently the same as the Luwemba of Burton and Speke on the south-east of Tanganyika. His country is described as low and flat, and this would seem to be confirmed by the absence of current in the marshy rivers visited by the Portuguese to the east of Cazembe's town, and also by the Lake Liemba of Dr. Livingstone, which he has found to be the termination of a long river-like arm of Tanganyika, stretching south-south-east to the north edge of the before-mentioned plateau. Lake Moero, then, cannot be above the level of Tanganyika, else its outflow would surely be over this level country, and not through the mountains to northward. From Lake Moero the river flows on through a "rent in the Mountains of Rua." In passing through this gorge, it appears certain that the river must have a further and rapid descent, lowering its bed still more beneath the level of Tanganyika.

In his letter of 30th May, 1869, from Ujiji, which has the brevity of a telegram, Dr. Livingstone says: "Tanganyika, Nyige Chowambe (Baker's) are one water, and the head of it is 300 miles to south of this. The western and central lines of drainage converge into an unvisited lake west or south-west of this." If the expression "one water" here means that these two lakes are united by an extension of one into the other, and not by a river, then it is evident that the river and lake chain under consideration can never flow up to join either of them after having passed down through the rent in the Mountains of Rua; if it means that these lakes are joined together by a river, still the small difference in height between that computed for Lake Tanganyika by Mr. Finlay, of 2,800 feet (afterwards so curiously confirmed by Livingstone's height of Lake Liemba), and that found for the Albert Nyanza by Baker, would not give a sufficient lowness to the latter lake to allow this river to flow down to it through the five degrees of latitude which separate its outfall from the Mountains of Rua, from the southern end of the Albert Lake. Dr. Livingstone's statement in his letter above quoted from Ujiji, that the head waters of the Tanganyika and Albert Lakes are 300 miles south of that place, is not at all opposed to the view that the Chambeze River and its lake chain may join the Congo, for the streams which flow into his Lake Liemba may rise at this distance from Ujiji. In this case the sources of the Nile would be side by side with those of the Congo; and the man who has the claim to be called the greatest explorer that the world has ever known, has the double honour of having solved the two greatest of African problems.

74, Strand, W.C. KEITH JOHNSTON, Jun.

Physical Meteorology

ASSUMING with your correspondent that there is an ascending current in the heart of a cyclone, no doubt latent heat will play its part. I presume, however, your correspondent does not imagine that air is ever actually heated by such means to 370° F.

Suppose, for instance, that two cubic feet of saturated air, both at thirty inches pressure, but one at the temperature 32° F. and the other at the temperature 90° F., become mixed. The cubic foot at 32° F. will contain 2·37 grains of vapour, that at 90° F. 14·50 grains. Hence, after mixture the average weight of vapour in unit of volume will be 8·43 grains. This would saturate a temperature = 71·7° F. But this is greater than the mean between the two temperatures or 61° F. There will, therefore, be hardly enough heat to keep the mixture at 71°·7 F. and prevent deposition.

On the other hand, we cannot imagine the temperature of the mixture to fall as low as 61° F.

The temperature of the mixture will therefore, I presume, be greater than 61° and less than 71·7°.

B. STEWART

Veined Structure in Ice

FEW men have had better opportunities of examining glacial phenomena than Mr. Whymper, and his explanation of the veined structure is certainly an ingenious one. I venture, however, to doubt whether it can be regarded as generally satisfactory, although, possibly, it might explain some isolated cases.

The following, which, so far as my experience goes, are common facts in glaciers, appear to me difficult to reconcile with his explanation.

(1.) One common case in which the veined structure becomes conspicuous is after the glacier has been pressed into a narrower channel than has been occupied by its *névé*. The structure planes are then roughly parallel to the *sides* of the channel. Dr. Tyndall has pointed this out in his "Glaciers of the Alps," p. 387, and I have frequently observed the same thing myself. Three instances occur to me at this moment: one on the Gorner Glacier, under the Gorner Grat; another in the middle part of the Glacier de la Pilatte (Dauphine); a third on the upper part of the Mer de Glace. Did I search through my note-book I have no doubt I could find plenty more. If now, say in the second example, the veined structure was due to the crevasses in the ice fall below the Col du Sélé, surely its planes would hardly be twisted through a right angle in the comparatively short distance intervening between the ice fall and the rocky spur from the Crête des Bœufs Rouges which causes the "nip." Moreover, if the planes have been turned by the unequal motion of the centre and sides of the ice stream, ought we to find them so uniform in direction as they now are, often extending with a very general parallelism over the greater part of the glacier?

(2.) If the veined structure is the result of healed crevasses, how are we to explain the great number of these plates of different coloured ice on glaciers which are not remarkable for very numerous crevasses. For example, on the Roseg Glacier, near Pontresina, these plates of blue and white ice alternate with each other for at least several hundred yards as you walk up the glacier, and are commonly only an inch or so thick. I have in my notebook a diagram of a piece to exhibit the weathering of the two kinds of ice, in which are shown five plates, three blue and two white. One of the former is about an inch thick, and all the rest are thinner. Each of the white is about half an inch, and I remember that this was a fair sample of most of the ice near. If, then, the crevasses, from whose healing this platy structure has resulted, were formed simultaneously or in close succession, how are we to explain the thinness of the white portion, its layers being, if anything, thinner than the blue? Crevasses are not usually so near together as this, and if they were not thus formed is it probable that the plates would be so produced as to be, for about as far as one could trace them, parallel one to another, so accurately that my diagram looks like a bit from a cliff of midland lias?

Cambridge, Jan. 7 T. G. BONNEY

Personal Equation of Astronomical Observers

IN the number for November 18, 1869, of NATURE, "J." asks if an experiment has hitherto been tried to ascertain the value of the personal equation of astronomical observers. The fact is, that it has been tried in different manners, as by Mr. Wolf in Paris, and Mr. Hirsch in Neuchâtel, but first of all by Dr. F. Kaiser, Astronomical Professor, and Director of the Observatory of Leiden. The apparatus of Prof. Kaiser was first constructed in 1851, but was afterwards highly improved, so that it is fitted equally well for observations with or without the chronograph.

A description of the method and apparatus of M. Kaiser is to be found in the "Archives Néerlandaises des Sciences exactes et Naturelles," vol. i. p. 194, and of the improved one in the reports and communications of the Royal Academy of Science of the Netherlands (Verslagen en mededeelingen der Koninklijke Academie van Wetenschappen), Second Series, vol. ii.; the former is written in French, and titled: "Sur la détermination absolue de l'erreur personelle dans les observations astronomiques;" the latter, in German: "Uebereinen neuen Apparat zur absoluten Bestimmung von persönlichen Fehlern bei astronomischen Beobachtungen." H. VON DE STADT, Ph.D.

Arnheim, Netherlands, January 3

Anatomical Lectures to Female Medical Students

I HAVE great pleasure in hearing that the Professors of Anatomy in Scotland have not all forgotten that women ought to be treated with some degree of chivalry.

Professor Struthers, of Aberdeen, and Professor Bell, of St. Andrews, hearing that the five ladies who are studying at the Edinburgh University are excluded from the opportunity of studying anatomy there, have severally offered their services as instructors. Many a lady will rejoice that the numbers of those willing and ready to help in the good cause of fuller knowledge for women are increased by two professors, who have bravely come forward with much moral courage and chivalrous feeling.

Edinburgh, Jan. 22. A NON-MEDICAL WOMAN

NOTES

THE Physical Section of the Academy of Sciences at their last meeting recommended Professor Kirchhoff, of Heidelberg, to fill the place of correspondent of the section, vacant by the death of Principal Forbes. The other candidates were MM. Ångström, Billet, Dove, Grove, Henry (of Philadelphia), Jacobi, Joule, Lloyd (of Dublin), Riess, Stokes, Tyndall, Volpicelli, and Sir William Thomson.

IN our statement last week that "the Senate of London University has proposed to establish a Faculty of Science," "London University" should have been "University College, London;" the fact being that the Senate of the University of London—in advance of every other university of the kingdom—established a Faculty of Science *ten years ago;* constituting, at the suggestion, and with the advantage of the advice, of the ablest men of science in this country, a scheme for graduation in science, which has continued in efficient operation from that time to the present. And we may add that in the new building of the University the four Faculties—Arts, Sciences, Law, and Medicine—are typified by the four sitting statues over the portico, representing Milton, Newton, Bentham, and Harvey.

WE are happy to be able to announce that the council of the Chemical Society has decided to have a report of their proceedings and an abstract of the papers read before the society drawn up immediately after its meetings, and to offer copies of this report to the editors of journals who may be likely to wish to publish it. The days when the newest results of science were regarded as something secret—or, at all events, of no concern to the ordinary man of education—are gone by, we trust, for ever. It may now be confidently expected that the example of the Chemical Society in thus seeking a wide publicity for the reports of their proceedings will be followed by those societies—such as the Linnean and the Astronomical—which have not offered hitherto such facilities to those who endeavour to inform the general scientific public and the world of letters of the latest researches in science.

WE learn from the fifth annual report of the Sanitary Commissioner with the Government of India, just received, that the first scientific report on the inquiry into epidemic cholera in India, the instructions for which were prepared by the Army Sanitary Commission, has been presented. The reporters state that they have been making "careful and systematic examinations of cholera excreta, and the changes taking place in them during decomposition as compared with healthy excreta, and the changes occurring in them as well as in other fluids and solids during the same process. These changes have been studied as occurring under various circumstances, associated with various substrata and media. In addition to the above experiments, others on the effects of cholera excreta on growing rice plants have been entered upon. Careful daily observations have been made, and notes and *camera lucida* drawings of all the changes observed to occur have been accumulated. As far as the observations have as yet gone, they have not been confirmatory of those of Hallier. For, though fungi have frequently appeared on choleraic materials, yet—(1) several species have appeared; (2) the same species have occurred in abundance on other substrata in like circumstances; (3) the species observed have not belonged to the cholera series of Hallier. As yet, however, it would be premature to draw any definite conclusions in the matter, as any series of observations on such points is beset with innumerable difficulties and fallacies, necessitating careful and frequent repetition of each experiment before coming to a final decision as to the value of its results." Observations are being conducted at various stations to ascertain whether Pettenkofer's theory of the relation of cholera to subsoil water level is borne out in India.

THE Boston Society of Natural History, at its last meeting, passed the following vote:—

"That the net proceeds of the celebration of the centennial anniversary of the birth of Humboldt, together with the money received from the sale of Prof. Agassiz's Address, previous to Jan. 1, 1870, and the money subscribed at the solicitation of the society's committee, be given to the trustees of the Museum of Comparative Zoölogy at Harvard College, in trust, for the establishment of an endowment, under the title of the Humboldt Scholarship, the income of which is to be solely applied, under the direction of the Faculty, toward the maintenance of one or more young and needy persons engaged in study at said museum."

THE subject of the Ravizza prize of a thousand lire for 1870 is, the effect which emigration to foreign countries and removal to cities produce on the population of agricultural districts. Manuscripts are to be marked with a motto, and accompanied by a sealed letter containing the author's name. They must be written in Italian, addressed *Presidenza del Regio Liceo, Cesare, Beccaria, Milan*, and delivered not later than the last day of December next.

A MONTHLY Journal, devoted to social and sanitary economy, is advertised to appear on the 1st proximo, under the title of the *Food Journal*. Judging by the names included in the published list of contributors, we may confidently expect that the important subjects to be dealt with in this periodical will be treated of with ability, and in accordance with the most recent results of scientific research.

THAT interesting and useful periodical the *American Naturalist*, which is devoted to the popularisation of Natural History, commences a new volume in March next. The first article in the volume will be an illustrated paper by Mr. E. G. Squier, the eminent archæologist, on the Ancient Megalithic Monuments of Peru compared with those in other parts of the world. The second article will be on Sponges, by Prof. Leidy, of Philadelphia.

WE have received from the Mannheim Association for Natural Science the annual report published in February of last year, and giving an account of the society's operations during the year 1868-9. The usefulness of the Association appears to have been somewhat limited by the want of funds. To the same cause must doubtless be ascribed the fact that the only papers published with the report before us are on the meteorology of Mannheim. We are glad, however, to learn from the Secretary that the volume for 1870 will shortly appear, and that it is to contain several interesting astronomical, meteorological, and botanical communications.

M. DUMERIL, Member of the Institute and Professor at the Jardin des Plantes, commenced on the 15th inst. at the Museum of Natural History, a course of lectures on the general history of reptiles, batrachians, and fish.

MR. DYER, of Cirencester College, has been appointed by Earl De Grey to the Professorship of Botany in the Royal College of Science, Dublin.

IT was some time since announced that the prize offered by Lieut.-Colonel Scott, R.E., the secretary of the Royal Horticultural Society, for an essay on the Principles of Floral Criticism, would be awarded on January 19th. It is now stated that the award will not be made till Wednesday, May 4th, 1870.

WE note the appearance of a new edition of the very handy geological map of Germany, France, England, and the neighbouring countries, originally drawn up by Von Dechen in 1839. It will be found very useful to any continental tourists who have some geological knowledge, and who care to take an intelligent survey of the countries they travel through. Copies may be obtained of Messrs. Nutt, 270, Strand. The scale is 1:2,500,000.

A COMMITTEE has been formed at Liverpool for the purpose of establishing a Zoölogical Society. It is hoped that the corporation will grant a site for the society's garden in one of the public parks.

MELBOURNE has recently acquired a fresh utility and ornament in the shape of a turret-clock, the first manufactured in the colony, which for perfection of work and peculiarities of construction challenges the admiration of all horologists. The dials, six feet in diameter, consisting of frames of cast-iron—the rings, figures, and minute marks (eight inches long and one broad) all formed in one casting—are eighty feet from the level of Bourke Street. The weight is about 120 pounds, suspended on a barrel seventeen inches long and ten inches in diameter, revolving twenty-nine times a week, giving a downfall of about seventy feet. The pendulum swings once in two seconds, and consists of a dry and varnished pine rod fifteen feet six inches long, with a cylinder of lead weighing 320 pounds. As it was thought desirable to make the hands move by easily seen impulses every half-minute, so as to ascertain the time to a second, a special arrangement, called a spring *remontoire*, has been added, by means of which the wheels of the clock are detained for thirty seconds and escape at the half-minute, allowing the weight to move the hands over half a minute's space, and wind up a small clock-spring in the spindle, which revolves in two minutes. This keeps the pendulum and the escapement going while the rest of the works are held back. The following is a technical description of this *remontoire*:—"The wheel in the spindle, which revolves once in five minutes, drives a second pinion with eight teeth, the spindle of which projects through the back of the clock frame, and carries a little cylinder with two notches at the end, one broad and shallow, the other narrow and deep. At the end of the *remontoire* arms are two steel projections, one of which passes through the broad notch and the other through the narrow one. As the two-minute spindle revolves, with the notched cylinder, it brings a notch in a right position to let one of the arm projections through every half-minute, allowing the train to move the hands, and wind up the small spring. To effect this the pinion with sixteen leaves is loose on the two-minute spindle, and is only attached to one end of the spring. The clock is also supplied with Denison's double three-legged gravity escapement.

THE Mount Washington Railway, which ascends the White Mountains, New Hampshire, U.S., is about three miles in length, the average gradient being a little more than 1 in 4, which is increased in some places to the extraordinary extent of 1 in 3. The engine draws itself up the line by means of a "pinion," which works into a strong "rack" fixed between the rails, and the ascent of three miles is completed in about one hour.

M. MOHN, Director of the Observatory of Christiania, has recently surveyed the *névé* field of Fostedalsbrœn, which occupies 750 square kilometres. He finds that it feeds twenty-two glaciers of the first order and more than 200 smaller ones. The *névé* is seventy kilometres from the sea.

MESSRS. BELL AND DALDY have just issued the first part of a work bearing the title "Natural Phenomena and Chronology of the Seasons," and containing a chronological register of the remarkable frosts, droughts, thunderstorms, gales, floods, earthquakes, &c. which have occurred in the British Isles since A.D. 220. The author, Mr. E. J. Lowe, F.R.S., the well-known meteorologist, wishes it to be understood that his chief object in publishing what is confessedly a very imperfect record is to call attention to the subject, and elicit further information for a more extensive work, embracing the more remarkable natural phenomena of foreign countries. The compilation of a catalogue of this nature, if it is to be of any real benefit to science, involves an enormous amount of labour and much critical skill. The original authorities for the phenomena recorded should, in each case, be referred to so precisely that the quotations may be readily verified. It is hardly satisfactory to see the *Preston Herald* quoted in support of the assertion that 1,500 houses were unroofed and destroyed in London, in the year 944.

MR. JOHN H. MARTIN, secretary to the Maidstone and Mid-Kent Natural History Society, has just brought out the first number of a new publication, "Microscopic Objects figured and described," containing 16 wood-cuts and short descriptions of vegetable objects, from the yeast-plant to the spiral-vascular tissue from garden rhubarb. The work is intended, when complete, to contain about 200 figures, all of them original, to be issued in monthly numbers. It is proposed to commence with the primary forms of vegetable life, and to proceed onwards through the tissues to the woody structures of the Exogens and Endogens, next descending to the Acrogens, and so passing to the extreme limits of vegetable life, as the Desmidiæ, &c., thence to the lower forms of animal life, the Infusoria, and on through the Radiata to the Insects, which will be drawn and described in their various orders, and the minute organs figured separately.

THE *Architect* states that Lieutenant Cole, R.A., and three sappers, sent out by the Secretary of State for India to take casts of the Sanchi Tope, have arrived in Calcutta. For the benefit of those of our readers who have not had the privilege of seeing Mr. Fergusson's magnificent work "On Tree and Serpent Worship," we may mention that the Sanchi Tope, a monument of very high antiquity, is surrounded by walls and gateways covered with elaborate sculptured decorations of the greatest interest to the student of the early history of the human race.

THE *Field* of Saturday last contains some interesting notes on special agricultural training-schools in France, Germany, and Switzerland. At Rütte in the Canton of Berne, and at Santhoven in Bavaria, particular attention is given to the theory and practice of dairy operations, and the general treatment of cow stock. The school of Lézardeau, on the estate of Count Conédic, in the Department of Finisterre, offers special facilities for the study of draining and irrigation. In this school there is a technical library, a museum, a collection of meteorological instruments, a laboratory, and tools of all descriptions. The general course of study includes elementary mechanics, agricultural chemistry and botany, the pruning and grafting of fruit-trees, the making of roads, and other practical knowledge. At Görtz, in Austria, is a special institution for silkworm culture, supporting a journal exclusively devoted to that branch of industry. The *Athenæum* states that the Ottoman Government is giving its support to a project of M. Netter, of Constantinople, to found an agricultural school for Jews in Palestine.

We have been requested to notify that the following premiums have been placed at the disposal of the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce, for the term of seven years, by M. Septimus Piesse:—1. A premium of £5, for one pound of Otto of Bergamot, of the value of 16*s*. or more in the London market, being the produce of plants (*Citrus bergamia*) grown in Australia, New Zealand, Natal, any of the British West India Islands, or any other British Colony or Dependency. 2. A premium of £5, for one ounce of Otto of Roses, of the value of 20*s*. or more in the London market, being the produce of any variety of roses grown together in one plantation in Australia, New Zealand, Natal, any of the British West India Islands, or any other British Colony or Dependency. 3. A premium of £10, for a canister of Enflowered Butter or Fat, so scented with any kind or sort of flower, either by infusion or enfleurage, or by means of these processes jointly, of the weight of 3 lbs. or more, and of the value of 6*s*. per lb. in London. The said butter or fat to be enflowered or infused with flowers grown for the purpose in Australia, New Zealand, Natal, any of the British West India Islands, or any other British Colony or Dependency.

ON HAZE AND DUST

SOLAR light in passing through a dark room reveals its track by illuminating the dust floating in the air. "The sun," says Daniel Culverwell, "discovers atomes, though they be invisible by candle-light, and makes them dance naked in his beams."

In my researches on the decomposition of vapours by light, I was compelled to remove these "atomes" and this dust. It was essential that the space containing the vapours should embrace no visible thing; that no substance capable of scattering the light in the slightest sensible degree should, at the outset of an experiment, be found in the "experimental tube" traversed by the luminous beam.

For a long time I was troubled by the appearance there of floating dust, which, though invisible in diffuse daylight, was at once revealed by a powerfully condensed beam. Two tubes were placed in succession in the path of the dust: the one containing fragments of glass wetted with concentrated sulphuric acid; the other, fragments of marble wetted with a strong solution of caustic potash. To my astonishment it passed through both. The air of the Royal Institution, sent through these tubes at a rate sufficiently slow to dry it and to remove its carbonic acid, carried into the experimental tube a considerable amount of mechanically-suspended matter, which was illuminated when the beam passed through the tube. The effect was substantially the same when the air was permitted to bubble through the liquid acid and through the solution of potash.

Thus, on the 5th of October, 1868, successive charges of air were admitted through the potash and sulphuric acid into the exhausted experimental tube. Prior to the admission of the air the tube was *optically empty;* it contained nothing competent to scatter the light. After the air had entered the tube, the conical track of the electric beam was in all cases clearly revealed. This indeed was a daily observation at the time to which I now refer.

I tried to intercept this floating matter in various ways; and on the day just mentioned, prior to sending the air through the drying apparatus, I carefully permitted it to pass over the tip of a spirit-lamp flame. The floating matter no longer appeared, having been burnt up by the flame. It was therefore *organic matter.* When the air was sent too rapidly through the flame, a fine blue cloud was found in the experimental tube. This was the *smoke* of the organic particles. I was by no means prepared for this result; for I had thought, with the rest of the world, that the dust of our air was, in great part, inorganic and non-combustible.

Mr. Valentin had the kindness to procure for me a small gas-furnace, containing a platinum tube, which could be heated to vivid redness. The tube also contained a roll of platinum gauze, which, while it permitted the air to pass through it, ensured the practical contact of the dust with the incandescent metal. The air of the laboratory was permitted to enter the experimental tube, sometimes through the cold, and sometimes through the heated tube of platinum. The rapidity of admission was also varied. In the first column of the following table the quantity of air operated on is expressed by the number of inches which the mercury gauge of the air-pump sank when the air entered. In the second column the condition of the platinum tube is mentioned, and in the third the state of the air which entered the experimental tube.

Quantity of Air.	State of Platinum Tube.	State of Experimental Tube.
15 inches . . .	Cold . . .	Full of particles.
15 ,, . . .	Red-hot . .	Optically empty.
15 ,, . . .	Cold . . .	Full of particles.
15 ,, . . .	Red-hot . .	Optically empty.
15 ,, . . .	Cold . . .	Full of particles.
15 ,, . . .	Red-hot . .	Optically empty.

The phrase "optically empty" shows that when the conditions of perfect combustion were present, the floating matter totally disappeared. It was wholly burnt up, leaving not a trace of residue. From spectrum analysis, however, we know that soda floats in the air; these organic dust particles are, I believe, the *rafts* that support it, and when they are removed it sinks and vanishes.

When the passage of the air was so rapid as to render imperfect the combustion of the floating matter, instead of optical emptiness a fine blue cloud made its appearance in the experimental tube. The following series of results illustrate this point:—

Quantity.	Platinum Tube.	Experimental Tube.
15 inches, slow .	Cold . . .	Full of particles.
15 ,, ,, .	Red-hot . .	Optically empty.
15 ,, quick .	,, . .	A blue cloud.
15 ,, ,, .	Intensely hot .	A fine blue cloud.

The optical character of these clouds was totally different from that of the dust which produced them. At right angles to the illuminating beam they discharged perfectly polarised light. The cloud could be utterly quenched by a transparent Nicol's prism, and the tube containing it reduced to optical emptiness.

The particles floating in the air of London being thus proved to be organic, I sought to burn them up at the focus of a concave reflector. One of the powerfully convergent mirrors employed in my experiments on combustion by dark rays was here made use of, but I failed in the attempt. Doubtless the floating particles are in part transparent to radiant heat, and are so far incombustible by such heat. Their rapid motion through the focus also aids their escape. They do not linger there sufficiently long to be consumed. A flame it was evident would burn them up, but I thought the presence of the flame would mask its own action among the particles.

In a cylindrical beam, which powerfully illuminated the dust of the laboratory, was placed an ignited spirit-lamp. Mingling with the flame, and round its rim, were seen wreaths of darkness resembling an intensely black smoke. On lowering the flame below the beam the same dark masses stormed upwards. They were at times blacker than the blackest smoke that I have ever seen issuing from the funnel of a steamer, and their resemblance to smoke was so perfect as to lead the most practised observer to conclude that the apparently pure flame of the alcohol lamp required but a beam of sufficient intensity to reveal its clouds of liberated carbon.

But is the blackness smoke? The question presented itself in a moment. A red-hot poker was placed underneath the beam, and from it the black wreaths also ascended. A large hydrogen flame was next employed, and it produced those whirling masses of darkness far more copiously than either the spirit-flame or poker. Smoke was therefore out of the question.

What, then, was the blackness? It was simply that of stellar space; that is to say, blackness resulting from the absence from the track of the beam of all matter competent to scatter its light. When the flame was placed below the beam the floating matter was destroyed *in situ;* and the air, freed from this matter, rose into the beam, jostled aside the illuminated particles, and substituted for their light the darkness due to its own perfect transparency. Nothing could more forcibly illustrate the invisibility of the agent which renders all things visible. The beam crossed, unseen, the black chasm formed by the transparent air, while at both sides of the gap the thick-strewn particles shone out like a luminous solid under the powerful illumination.

But here a difficulty meets us. It is not necessary to burn the particles to produce a stream of darkness. Without actual combustion, currents may be generated which shall exclude the floating matter, and therefore appear dark amid the surrounding brightness. I noticed this effect first on placing a red-hot copper ball below the beam, and permitting it to remain there until its temperature had fallen below that of boiling water. The dark currents, though much enfeebled, were still produced. They may also be produced by a flask filled with hot water.

To study this effect a platinum wire was stretched across the beam, the two ends of the wire being connected with the two poles of a voltaic battery. To regulate the strength of the current a rheostat was placed in the circuit. Beginning with a feeble current the temperature of the wire was gradually augmented, but before it reached the heat of ignition, a flat stream of air rose from it, which when looked at edgeways appeared darker and sharper than one of the blackest lines of Fraunhofer in the solar spectrum. Right and left of this dark vertical band the floating matter rose upwards, bounding definitely the non-luminous stream of air. What is the explanation? Simply this. The hot wire rarefied the air in contact with it, but it did not equally lighten the floating matter. The convection current of pure air therefore passed upwards *among the particles*, dragging them after it right and left, but forming between them an impassable black partition. In this way we render an account of the dark currents produced by bodies at a temperature below that of combustion.

Oxygen, hydrogen, nitrogen, carbonic acid, so prepared as to exclude all floating particles, produce the darkness when poured or blown into the beam. Coal-gas does the same. An ordinary glass shade placed in the air with its mouth downwards permits the track of the beam to be seen crossing it. Let coal-gas or hydrogen enter the shade by a tube reaching to its top, the gas gradually fills the shade from the top downwards. As soon as it occupies the space crossed by the beam, the luminous track is instantly abolished. Lifting the shade so as to bring the common boundary of gas and air above the beam, the track flashes forth. After the shade is full, if it be inverted, the gas passes upwards like a black smoke among the illuminated particles.

The air of our London rooms is loaded with this organic dust, nor is the country air free from its pollution. However ordinary daylight may permit it to disguise itself, a sufficiently powerful beam causes the air in which the dust is suspended to appear as a semi-solid rather than as a gas. Nobody could, in the first instance, without repugnance place the mouth at the illuminated focus of the electric beam and inhale the dirt revealed there. Nor is the disgust abolished by the reflection that, although we do not see the nastiness, we are churning it in our lungs every hour and minute of our lives. There is no respite to this contact with dirt; and the wonder is, not that we should from time to time suffer from its presence, but that so small a portion of it would appear to be deadly to man.

And what is this portion? It was some time ago the current belief that epidemic diseases generally were propagated by a kind of malaria, which consisted of organic matter in a state of *motor-decay;* that when such matter was taken into the body through the lungs or skin, it had the power of spreading there the destroying process which had attacked itself. Such a spreading power was visibly exerted in the case of yeast. A little leaven was seen to leaven the whole lump, a mere speck of matter in this supposed state of decomposition being apparently competent to propagate indefinitely its own decay. Why should not a bit of rotten malaria work in a similar manner within the human frame? In 1836 a very wonderful reply was given to this question. In that year Cagniard de la Tour discovered the *yeast plant*, a living organism, which when placed in a proper medium, feeds, grows, and reproduces itself, and in this way carries on the process which we name fermentation. Fermentation was thus proved to be a product of life instead of a process of decay.

Schwann, of Berlin, discovered the yeast plant independently, and in February 1837 he also announced the important result, that when a decoction of meat is effectually screened from ordinary air, and supplied solely with air which has been raised to a high temperature, putrefaction never sets in. Putrefaction, therefore, he affirmed to be caused by something derived from the air, which something could be destroyed by a sufficiently high temperature. The experiments of Schwann were repeated and confirmed by Helmholtz and Ure. But as regards fermentation, the minds of chemists, influenced probably by the great authority of Gay-Lussac, who ascribed putrefaction to the action of oxygen, fell back upon the old notion of matter in a state of decay. It was not the living yeast plant, but the dead or dying parts of it, which, assailed by oxygen, produced the fermentation. This notion was finally exploded by Pasteur. He proved that the so-called "ferments" are not such; that the true ferments are organised beings which find in the reputed ferments their necessary food.

Side by side with these researches and discoveries, and fortified by them and others, has run the *germ theory* of epidemic disease. The notion was expressed by Kircher, and favoured by Linnæus, that epidemic diseases are due to germs which float in the atmosphere, enter the body, and produce disturbance by the development within the body of parasitic life. While it was still struggling against great odds, this theory found an expounder and a defender in the President of this Institution. At a time when most of his medical brethren considered it a wild dream, Sir Henry Holland contended that some form of the germ theory was probably true. The strength of this theory consists in the perfect parallelism of the phenomena of contagious disease with those of life. As a planted acorn gives birth to an oak competent to produce a whole crop of acorns, each gifted with the power of reproducing its parent tree, and as thus from a single seedling a whole forest may spring, so these epidemic diseases literally plant their seeds, grow, and shake abroad new germs, which, meeting in the human body their proper food and temperature, finally take possession of whole populations. Thus Asiatic cholera, beginning in a small way in the Delta of the Ganges, contrived in seventeen years to spread itself over nearly the whole habitable world. The development from an infinitesimal speck of the virus of small-pox of a crop of pustules, each charged with the original poison, is another illustration. The reappearance of the scourge, as in the case of the *Dreadnought* at Greenwich, reported on so ably by Dr. Budd and Mr. Busk, receives a satisfactory explanation from the theory which ascribes it to the lingering of germs about the infected place.

Surgeons have long known the danger of permitting air to enter an open abscess. To prevent its entrance they employ a tube called a cannula, to which is attached a sharp steel point called a trocar. They puncture with the steel point, and by gentle pressure they force the pus through the cannula. It is necessary to be very careful in cleansing the instrument; and it is difficult to see how it can be cleansed by ordinary methods in air loaded with organic impurities, as we have proved our air to be. The instrument ought, in fact, to be made as hot as its temper will bear. But this is not done, and hence, notwithstanding all the surgeon's care, inflammation often sets in after the first operation, rendering necessary a second and a third. Rapid putrefaction is found to accompany this new inflammation. The pus, moreover, which was sweet at first, and showed no trace of animal life, is now fetid, and swarming with active little organisms called vibrios. Prof. Lister, from whose recent lecture this fact is derived, contends, with every show of reason, that this rapid putrefaction and this astounding development of animal life are due to the entry of germs into the abscess during the first operation, and their subsequent nurture and development under favourable conditions of food and temperature. The celebrated physiologist and physicist Helmholtz is attacked annually by hay-fever. From the 20th of May to the end of June he suffers from a catarrh of the upper air-passages; and he has found during this period, and at no other, that his nasal secretions are peopled by these vibrios. They appear to nestle by preference in the cavities and recesses of the nose, for a strong sneeze is necessary to dislodge them.

These statements sound uncomfortable; but by disclosing our enemy they enable us to fight him. When he clearly eyes his quarry the eagle's strength is doubled, and his swoop is rendered sure. If the germ theory be proved true, it will give a definiteness to our efforts to stamp out disease which they could not previously possess. And it is only by definite effort under its guidance that its truth or falsehood can be established. It is difficult for an outsider like myself to read without sympathetic emotion such papers as those of Dr. Budd, of Bristol, on cholera, scarlet-fever, and small-pox. He is a man of strong imagination, and may occasionally take a flight beyond his facts; but without this dynamic heat of heart, the stolid inertia of the free-born Briton cannot be overcome. And as long as the heat is employed to warm up the truth without singeing it over-much; as long as this enthusiasm can overmatch its mistakes by unequivocal examples of success, so long am I disposed to give it a fair field to work in, and to wish it God speed.

But let us return to our dust. It is needless to remark that it cannot be blown away by an ordinary bellows; or, more correctly, the place of the particles blown away is in this case supplied by others ejected from the bellows, so that the track of the beam remains unimpaired. But if the nozzle of a good bellows be filled with cotton wool not too tightly packed, the air urged through the wool is filtered of its floating matter, and it then forms a clean band of darkness in the illuminated dust. This was the filter used by Schroëder in his experiments on spontaneous generation, and turned subsequently to account in the excellent researches of Pasteur. Since 1868 I have constantly employed it myself.

But by far the most interesting and important illustration of this filtering process is furnished by the human breath. I fill my lungs with ordinary air and breathe through a glass tube across the electric beam. The condensation of the aqueous vapour of the breath is shown by the formation of a luminous white cloud of delicate texture. It is necessary to abolish this cloud, and this may be done by drying the breath previous to its entering into the beam; or still more simply, by warming the glass tube. When this is done the luminous track of the beam is for a time uninterrupted. The breath impresses upon the floating matter a transverse motion, but the dust from the lungs makes good the particles displaced. But after some time an obscure disc appears upon the beam, the darkness of which increases, until finally, towards the end of the expiration, the beam is, as it were, pierced by an intensely black hole, in which no particles whatever can be discerned. The air, in fact, has so lodged its dirt within the lungs as to render the last portions of the expired breath absolutely free from suspended matter. This experiment may be repeated any number of times with the same result. It renders the distribution of the dirt within the lungs as manifest as if the chest were transparent.

I now empty my lungs as perfectly as possible, and placing a handful of cotton wool against my mouth and nostrils, inhale through it. There is no difficulty in thus filling the lungs with air. On expiring this air through the glass tube, its freedom from floating matter is at once manifest. From the very beginning of the act of expiration the beam is pierced by a black aperture. The first puff from the lungs abolishes the illuminated dust and puts a patch of darkness in its place, and the darkness continues throughout the entire course of the expiration. When the tube is placed below the beam and moved to and fro, the same smoke-like appearance as that obtained with a flame is observed. In short, the cotton wool, when used in sufficient quantity, completely intercepts the floating matter on its way to the lungs.

And here we have revealed to us the true philosophy of a practice followed by medical men, more from instinct than from actual knowledge. In a contagious atmosphere the physician places a handkerchief to his mouth and inhales through it. In doing so he unconsciously holds back the dirt and germs of the air. If the poison were a gas it would not be thus intercepted. On showing this experiment with the cotton wool to Dr. Bence Jones, he immediately repeated it with a silk handkerchief. The result was substantially the same, though, as might be expected, the wool is by far the surest filter. The application of these experiments is obvious. If a physician wishes to hold back from the lungs of his patient, or from his own, the germs by which contagious disease is said to be propagated, he will employ a cotton-wool respirator. After the revelations of this evening such respirators must, I think, come into general use as a defence against contagion. In the crowded dwellings of the London poor, where the isolation of the sick is difficult, if not impossible, the noxious air around the patient may, by this simple means, be restored to practical purity. Thus filtered, attendants may breathe the air unharmed. In all probability the protection of the lungs will be protection of the entire system. For it is exceedingly probable that the germs which lodge in the air-passages, and which, at their leisure, can work their way across the mucous membrane, are those which sow in the body epidemic disease. If this be so, then disease can certainly be warded off by filters of cotton wool. I should be most willing to test their efficacy in my own person. And time will decide whether in lung diseases also the woollen respirator cannot abate irritation, if not arrest decay. By its means, so far as the germs are concerned, the air of the highest Alps may be brought into the chamber of the invalid.

JOHN TYNDALL

SCIENTIFIC SERIALS

THE *Zeitschrift für Chemie* (No. 1) contains an account of some unfinished experiments by Muck on manganous sulphide, and a note by Dr. Baumhauer, of Bonn, on the action of aqueous hydric chloride on nitrobenzol. In the latter of these the author points out the interesting fact that dichloraniline is a principal product of the reaction. Robert Otto communicates several papers containing the results of experiments which he has performed, for the most part, with the co-operation of Eugen Dreher. The subjects of the papers are "Mercuric Diphenyl," under which title a tolerably exhaustive account of this body is given; "Mercuric Ditolyl," which was not so extensively examined; "On the deportment of Dibenzyl at a high temperature" (it splits into Toluol and Toluylene); "On the transformation of hydro-phenylic sulphide into phenylic sulphide" (the mercuric derivative decomposes thus at 180°:—$(C_6H_5)_2H_gS_2 = (C_6H_5)_2, S_2 + H_g$); "On mercuric dinaphtyl," from which it appears that the presence of ethylic acetate is very advantageous in the usual mixture whereby the body is prepared; "On mono-ethylic and mono-methylic mercuric acetate;" and "On the preparation of organic sulphur-compounds by means of sodic hyposulphite."—A. Geuther contributes a short article "On the volatile acids of croton oil." He finds that the oil contains no crotonic acid, which name is consequently a misnomer. Of the two metamers, $C_4H_6O_2$, he consequently designates the solid modification *tetranylic*, and the liquid variety *quartenylic* acid. Croton oil contains a metamer of angelic acid, for which the author proposes the name *tiglinic* acid.—Markownikoff finds that the butylic (fermentation) alcohol, when transformed into iodide, and then, by alcoholic potash, into olefiant, furnishes with hydric iodide the tertiary pseudo-butylic iodide.—Petrieff describes *solid* azoxytoluide (fusing at 57°).

THE *Annales de Chimie et de Physique* for December last contains a short note by M. Soliel on an ocular micrometer, the principle of which was discovered independently by Prof. Govi and himself. The rest of the number is wholly occupied by abstracts of foreign scientific papers.

THE *Annals and Magazine of Natural History*, fourth series, No. 25. The January number of this journal contains the conclusion of Mr. Wollaston's descriptions of the Coleoptera of St. Helena, to which we shall refer elsewhere. Mr. D. Sharp also publishes a paper on the species of *Philhydrus* found in the Atlantic Islands, which may be regarded as supplementary to and rectificatory of Mr. Wollaston's works on the Coleoptera of those islands. Dr. Lycett describes a byssiferous fossil *Trigonia* (*T. carniata* Ag.) Messrs. A. Hancock and R. Howse describe in considerable detail the remains of a fossil fish (*Janassa bituminosa* Schloth.) from the Permian marl-slate of Midderidge in the county of Durham. They identify with the genus *Janassa* the coal-measure form described by Messrs. Hancock and Atthey under the name of *Climaxodus linguæformis*, and regard the genus as belonging to the Rays, and probably allied to *Myliobates*. The known specimens consist chiefly of the teeth, which were originally described by Schlotheim as Trilobites, under the name of *T. bituminosus;* different examples have been described as fish-remains under various names, and the authors refer to their species the *Janassa angulata*, *Humboldti*, *bituminosa*, and *dictea*, *Dictea striata* and *Byzenos latipinnatus* of Count Münster, and the *Acrodus larva* of Professor Agassiz. This paper is illustrated with two excellent plates. Dr. Carl Semper describes the *Helix inæqualis* (Pfeiff.) from Australia as forming a new genus of Testacellidæ, to which he gives the name of *Rhytida*. Professor E. Perceval Wright describes and figures a new parasitic Crustacean, *Pennella orthagorisci*, obtained from a sun-fish in Cork Harbour; and Mr. John Gould describes a new Pigeon, *Otidiphaps nobilis*, forming the type of a new genus.—The only botanical paper in the number is the thirty-first instalment of the Rev. W. A. Leighton's "Notulæ Lichenologicæ," containing an analytical examination of certain new characters in the species of the genera *Nephroma* and *Nephromium*.—Besides the translations and abstracts of foreign papers which appear among the miscellaneous contributions, this number contains the first part of a translation of Professor Häckel's memoir on the organisation of sponges, and their relationship to corals, in which the author maintains that the corals (*Anthozoa*) are very nearly related to the Sponges, that the latter belong to the great group of the Cœlenterata, and that "the sole morphological character which sharply and decidedly separates" them from the rest of the Cœlenterata is to be found in the "deficiency of the urticating organs in all sponges."

THE *Moniteur Scientifique* for January 1st has much of its space occupied by an account of the legal inquiry resulting from the remarkable explosion of potassic picrate which occurred in the Place de la Sorbonne on the 16th June last. The evidence and the speeches of counsel are given at considerable length. M. Dubrunfant contributes an article on the Saline Analysis of Sugars, and on Melassimetry. There is also the usual account of the sittings of the Academy of Sciences; a Photographic Review, and a review of foreign journals—both very carefully written. A new feature in this serial, introduced this year, is a price-current of the principal products referred to in the papers it contains, and for the general use of subscribers. We cannot, however, help thinking that our able contemporary, in seeking to oblige its readers, has undertaken a task which, from the smallness of available space, it cannot adequately fulfil. A full price-current ought to have a periodical to itself.

Revue des Cours Scientifiques, January 22.—The first paper consists of extracts from an eloquent obituary notice of Trousseau, read by M. J. Béchard, the Secretary of the French Academy of Medicine, at the recent annual general meeting. "In this *éloge* of the man who is one of the most distinguished personifications of the old empirical medicine, M. Béchard has skilfully contrived to afford us a glimpse of the advent—possibly close at hand—of scientific medicine." A lecture by M. Lortet on the physiological effects of mountain climbing is the second paper in the present number of the *Revue*. We hope shortly to lay before our readers a full account of M. Lortet's observations. The other papers are one by Prof. Mayer, of Heilbronn, the recently elected Corresponding Member of the Institute of France, on the necessary consequences and inconsequences of the mechanical theory of heat, and a communication, lately presented to the Academy of Sciences, by M. St. Claire Deville, on the nascent state of bodies.

THE *American Naturalist*.—In the number for the present month there is an original article on the microscopic examination of shavings, and two others on the birds of Massachusetts; likewise a continuation of a review of Professor Huxley's Classification of Animals, in which the opinion is expressed that the publication of that book will not endanger the Cuvierian system. A reprint is also given from the *Popular Science Review* of the temperate and well-written article in which Prof. Cleland, of Glasgow, once more lays the ghost of phrenology, and gives, in a popular way, much solid information.

BOTANY

British Museum Herbarium

THE national Herbarium at the British Museum, though not equal in extent to that at Kew, is one of very great value to botanists from the numbers of "type-specimens" it contains; that is, specimens named by the original discoverer or describer, thus serving as a standard for reference. According to the official report lately issued by the Curator, Mr. J. J. Bennett, the herbarium has received large and important additions during the past year, by purchase and donation, from all parts of the world, including flowering plants, ferns, lichens, mosses, sea-weeds, the microscopic Diatoms, fossil plants, sections of wood, &c.; while collections previously received have been arranged and incorporated.

Wood for Gunpowder

ALTHOUGH the materials of which gunpowder is made have not varied since its first invention, there has been considerable variety in the kind of wood from which the charcoal has been obtained. Dense woods are always rejected and the lighter kinds chosen, especially those most free from silica, and capable of producing a friable porous charcoal which burns quickly and leaves the least possible quantity of ash; the kind now generally used by gunpowder manufacturers is known as "Dog-wood," and is usually described as being obtained from the small tree popularly known under that name, the *Cornus sanguinea.* Dr. Hooker has, however, recently discovered that this is a popular error, and that the wood is really almost universally obtained from the Buckthorn, or *Rhamnus frangula*; the former tree being now never used for this purpose, if indeed it ever was. Till a few years since, the bulk of the Buckthorn wood used in this manufacture was supplied from English plantations in Suffolk, Norfolk, Essex, and Kent, but the great increase recently in the demand for the finer descriptions of gunpowder has rendered this source insufficient; and it is now cultivated in immense districts of forest and marsh in North Germany, lying between Berlin and Frankfort, where it forms the natural undergrowth. From the high price obtained for the wood, 10*l.* to 15*l.* per ton, its cultivation would be exceedingly lucrative in this country, as it will grow in almost any soil.

Action of Ether on Plants

THE action of ether as an anæsthetic on the animal frame has induced Dr. Maxwell Masters to experiment on its effects on plants. He states that if a drop is placed gently on the leaf of the Sensitive plant, it produces a paralysing effect, rendering it insensible to subsequent contact. If, however, the ether impinges on the leaf with force, or is allowed to drop from a considerable height, contraction of the leaf immediately takes place, the impact of the falling drop counteracting any paralysing power. It is well known that in the contraction of the leaves of the Sensitive plant a certain amount of vital force is expended, and that if often repeated the plant becomes exhausted, and a time of rest is required before the phenomena are repeated.

Viridescence of Leaves

M. PRILLIEUX has established, as the result of a large number of observations on the leaves of barley, that viridescence is more rapid in diffused light than in the direct light of the sun, in contrast to the production of oxygen, which is more abundant the stronger the light. He introduced into a dark chamber a pencil of solar rays, and, by means of a lens, produced a diverging cone, in which he placed the barley at different distances from the lens, consequently under different intensities of light determinable with precision. He found that near the lens, that is, placed in a very intense light, the etiolated leaves scarcely became green, while at a greater distance the viridescence took place more rapidly, and attained its maximum at a distance of three or four metres, beyond which the activity decreased; so that in a too feeble light the effect was the same as in too strong a light. [L'Institut].

MÖLLER has prepared a beautiful microscopic slide, containing 300 distinct species of Diatoms, showing an extraordinary variety of form, and arranged with marvellous regularity. It forms one of the most interesting objects for the microscope we have seen.

THE "Prodromus Systematis naturalis Regni vegetabilis," the work of three generations of De Candolles, is now approaching completion, as it is not intended to continue it beyond the Exogens. The first section of the sixteenth volume, just published, includes two important monographs, the *Urticaceæ* by Weddell, and the *Piperaceæ* by Casimir De Candolle.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 20.—The following papers were read:—

"On the mechanical performance of logical inference," by W. Stanley Jevons, M.A. Lond., Professor of Logic, &c., in Owens College; communicated by Professor E. Roscoe, F.R.S. The author first referred to the general use of mechanical contrivances for the purpose of mathematical computation, and then contrasted this fact with the utter absence of machines for aiding logical operations. This absence he attributed to the incompleteness of the old logical doctrines. The problem of logical science in its complete generality was first solved by Boole. His logical views, when simplified and corrected, give us a method of indirect deduction of extreme generality and power, founded directly upon the fundamental laws of thought. A proof of the truthfulness and power of this system is to be found in the fact that it can be embodied in a machine just as the calculus of differences is embodied in Mr. Babbage's calculating machine. To explain the nature of the logical machine alluded to, it may be pointed out that the third of the fundamental laws of thought allow us to affirm of any object one or the other of two contradictory attributes, and that we are thus enabled to develope a series of alternatives which must contain the description of a given class or object. Thus, if we are considering the propositions,

Iron is metal,
Metal is element,

we can at once affirm of iron that it is included among the four alternatives:—

Metal, element,
Metal, not element,
Not metal, element,
Not metal, not element.

But according to the second law of thought, nothing can combine contradictory attributes, and this law prevents us from supposing that *iron* can be *not-metal*, while the first premise affirms that it is *metal*. The second premise again prevents our supposing that the combination *metal*, *not-element*, can exist. Hence the only combination of properties which the premises allow us to affirm of *iron* is *metal*, *element*. In a similar manner a complete solution of any logical problem may be effected by forming the complete list of combination in which the terms of the problem can manifest themselves, and then striking out such of the combinations as cannot exist in consistency with the conditions of the problem. The logical machine actually constructed represents the combination, 16 in number, of four positive terms, denoted by A, B, C, D, and their corresponding negatives, *a*, *b*, *c*, *d*. The instrument is provided with eight keys, representing these terms when appearing in the subject of a proposition, with eight keys, placed to the right hand of the former, representing the terms when occurring in the predicate of a proposition, and with the certain *operation* keys denoting the *copular* of the proposition, the *full stop* at the end of it, and the conjunction *or*, according as it occurs in the subject or predicate. There is also a key denoting the *finis* or end of an argument, which has the effect of obliterating any previous impressions, and making the machine a *tabula rasa*. If now each of the letter terms, A, B, C, D, be taken to represent some logical term or noun, and propositions concerning them be, as it were, played upon the machine, as upon a telegraphic instrument, the machine effects thereby such a classification and selection of certain rods representing the 16 possible combinations of the terms, that only those combinations consistent with the propositions remain indicated by the machine at the end of the operations. When once a series of propositions is thus impressed upon the machine, it is capable of exhibiting an answer to any question which may be put to it concerning the possible combinations which form any class. The machine thus embodies almost all the powers of Boole's logical system up to problems involving four distinct terms, and to represent problems of any complexity involving any number of terms only requires the multiplication of the parts of the machine. The construction involves no mechanical difficulties, and depends upon a peculiar arrangement of pins and levers, which it would not be easy to explain without drawings. In this arrangement of the parts the conditions of correct thinking are observed; the representative rods are just as numerous as the laws of thought require, and no rod represents inconsistent attributes. The representative rods are classified, selected, or rejected by the reading of a proposition in a manner exactly answering to that in which a reasoning mind should treat its ideas, and at every step in the progress of a problem the machine indicates the proper condition of a mind exempt from mistake. It is believed that this logical machine may be usefully employed in the logical class-room to exhibit the complete analysis of any argument or logical problem; and it is considered by the author superior for this purpose to a more rudimentary contrivance, the logical abacus, constructed by him for the same purpose. But by far the chief importance of the machine is in a theoretical point of view as demonstrating in the simplest and most evident manner the character and powers of a universal system of logical deduction, of which the first, although obscure solution, was given by Dr. Boole.

"On Jacobi's theorem respecting the relative equilibrium of a revolving ellipsoid of fluid; and on Ivory's discussion of the theorem," by I. Todhunter, F.R.S. Jacobi discovered the theorem that a fluid ellipsoid revolving with uniform angular velocity round its least axis might be in equilibrium. Ivory discussed the theorem, and made several statements regarding the limitations of the proportions of the axis. Ivory's statements contain various errors, and truths based on erroneous reasoning. The object of the present memoir is to correct Ivory's errors, to supply his imperfections, and to add something to what is already known respecting the theorem.

Geological Society, January 12.—Professor Huxley, LL.D., F.R.S., president, in the chair. Messrs. J. Aitken, J.P., president of the Manchester Geological Society; E. Allen, C. Cadle, A. W. Edgell, C. F. Leaf, F.L.S., and S. J. Smith, were elected Fellows. Prof. Otto Torell, of Lund, was elected a foreign correspondent. The following communications were read:—1. "On the geological position and geological distribution of the reptilian or dolomitic conglomerate of the Bristol area." By R. Etheridge, Esq., F.G.S., Palæontologist to the Geological Survey of Great Britain. The author noticed the history of our knowledge of the dolomitic conglomerates of the Bristol area from which the remains of dinosaurian reptiles have been obtained, and then described their mode of occurrence and distribution over the district near Bristol. He regarded these deposits as due to the action of the sea-waves of the later or middle Triassic periods upon the rocks of older Triassic (Bunter) or Permian age during the gradual elevation of the land, and as the probable representatives in point of time of the Muschelkalk, otherwise deficient in Britain. The author then noticed the influence of the conglomerate upon the production of certain minerals, such as calamine and hæmatitic iron-ores, and discussed at some length the probable course of the phenomena of denudation which furnished the materials for the formation of the conglomerate at different levels, in which he recognised two great periods of oscillation, the first witnessing a downward movement of the palæozoic lands and lasting throughout the deposition of the New Red marl and sands, and the second, during which the accumulations of the former were again, at least partly, denuded. With regard to the time at which the remains of thecodont reptiles were imbedded in the conglomerate, the author inferred from the evidence that this took place late in the period of the Keuper. The President inquired on what ground the author considered these reptiles to belong to a late period in the Keuper, and was informed that the author spoke especially with relation to the Keuper of the Bristol area, of which the beds containing them occupied the highest position. Prof. Ramsay considered these conglomerates not merely as of marine origin, but as breccias which had covered the old land surface, which had been worked up by the water of the New Red period. He objected to the term Sea having been introduced into the paper; as, though the tracts may have been islands and promontories, and though the water which surrounded them was salt, there was no open sea, but merely a large inland salt-lake, in which the New Red Marl was formed. The marl was less connected with the New Red Sandstone than with the Lias. The Muschelkalk being absent, it was constantly the case that the marl rested immediately on the palæozoic rocks without the intervention of the Bunter Sandstone. He thought that there were good grounds for connecting the Rhætic beds with the New Red Marl below and the Lias above. The probability was that the change in character was due to a gradual influx of the sea into the inland lakes. He thought that the Thecodont Saurians might also eventually be found even in beds of Liassic age. Prof. T. Rupert Jones remarked that Mr. Tawney and Dr. Duncan had already intimated the St. Cassian aspect and character of the Sutton beds. The freshwater character of some of the Keuper beds was, he remarked, indicated by the presence of *Estheriæ*, and he alluded to the fact of the Bristol palæosaurians having been erroneously used as Permian characteristics in Russia and Carolina. Mr. W. Boyd Dawkins had found at Cheddar that the Dolomitic conglomerate formed two great tongues running up ravines in the older rocks, which had probably been due to subaërial action. Prof. Morris alluded to some sections which seemed to corroborate the views of Mr. Etheridge, and pointed out the relation of the conglomerate beds to the overlying strata at those points. He also mentioned certain peculiarities in the structure of the conglomerate itself. Mr. Etheridge stated in reply that the marls in the Bristol area were the exception, the greater part of the New Red beds being sandstone.

2. "On the superficial deposits of portions of the Avon and Severn Valleys and adjoining districts." By Mr. T. G. B. Lloyd, C.E., F.G.S. The author, after describing the general characters of what he termed the Drifts of the Upper and Lower series, and the freshwater gravels of the Lower Avon, comprised within the district of the Avon Valley between Tewkesbury and Rugby, and of the Severn Valley above and below the town of Worcester, endeavoured to show that there was a balance of evidence in favour of the existence of an upper and lower platform of drift in the main valley of the Lower Avon, the upper one being of marine origin, and probably belonging to the same epoch as the stratified beds of gravel in the neighbourhood of Worcester, which contain marine shells and mammalian remains, whilst the lower one, of freshwater origin, had been derived from the former by fluviatile action, as supposed by the late Prof. Strickland. Further, that there was no evidence to warrant the supposition of the existence of high and low level river-gravels in those portions of the Severn and Avon Valleys under review, and that the apparent absence of any freshwater shells in the gravels of the Severn Valley between Bridgnorth and Tewkesbury led to the inference that the freshwater gravels of the Avon were not represented in the adjoining portions of the Severn Valley, although remains of some of the same species of mammalia occurred in both localities. After stating his opinion that the time had not yet arrived for indulging in theoretical speculations concerning the phenomena of the Drifts of the Upper and Lower series exhibited in so small an area as the one under consideration, the author concluded by expressing hopes that the facts which he had brought forward would contribute their share of help to the further elucidation of the question.

3. "On the surface-deposits in the neighbourhood of Rugby." By Mr. J. M. Wilson, F.G.S. The author commenced by noticing the general configuration of the surface of the district under review, which he stated to consist of an elevated plateau, bounded and rendered irregular in its outlines by valleys. The district consists chiefly of Lower Lias, with a few patches of Middle Lias. The surface-deposits on the plateau and on similar high lands in the neighbourhood consist of—1. Flinty or quartzose drift; 2. Sugary sand, with grains of chalk; 3. Clay, with pebbles, principally of chalk, and distinctly striated. The valleys bounding the plateau were described as belonging to two systems, those of the Avon and Leam. The bottom of each valley is generally a narrow strip of alluvial soil, bordered by sand in some places, and by drift in others. The author has bored down into the surface-deposits in the valley of Low Morton. In one boring, which reached a depth of 53 feet, he stopped in a greyish clay containing chalk-particles; in another, through similar clay to a depth of 57 feet, the rock was reached, and fragments of limestone were brought up.

Mr. Searles V. Wood, jun., had long been aware of the existence of the Middle Glacial Sand near Rugby. He pointed out the difference in the fauna of the sands of the Severn Valley below the glacial clay and those of similar deposits in the east of England, but notwithstanding thought they might be of the same age. Mr. Gwyn Jeffreys was doubtful as to the authenticity of some of the shells which had been brought to Mr. Maw. The fossil shells from the Severn Valley, Wolverhampton, Manchester, and Moel Tryfaen were nearly identical, and indicated raised beaches. He thought it possible that a definite line of such beaches might eventually be recognised through that part of England. Mr. W. Boyd Dawkins did not consider that there was any marked difference in the mammalian fauna of the Avon and Severn Valleys. He had failed to discover any traces of *Elephas antiquus* in either. Mr. Prestwich thought that the author had probably divided the superficial beds into too many separate deposits, though the facts brought forward were of great value. Mr. Evans mentioned that he had received information of the discovery many years ago of a flint implement in association with the bones of extinct mammals at Lawford. This implement had been exhibited at the time to the Geological Society, but had disappeared after the meeting. Mr. Lloyd and Mr. Wilson briefly replied.

Chemical Society, January 20.—Professor Williamson, President, in the chair. The following gentlemen were elected Fellows:—T. Bell, A. Bird, G. R. Hislop, E. Lapper, H. Seward. The first paper read was a note on the absorption of mixed vapours by charcoal, by John Hunter, M.A., Queen's College, Belfast. The author some time ago, published in the *Journal of the Chemical Society* (May 1868), the results obtained by absorbing the mixture of two vapours by means of cocoa-nut charcoal. He found that the absorption was increased when one of the vapours was at a temperature near to its point of condensation; and he explained the phenomenon by assuming that when a fragment of charcoal is introduced into a mixture of two vapours, the one which is nearest to its point of condensation is first absorbed, and this, in its condensed state, aids the absorption of the other. According to this view, a succession of condensations is going on. The theory is strikingly illustrated in experimenting with a mixture of water vapour and ammonia gas—obtained by heating an aqueous solution of ammonia of spec. grav. 0·88—when the mixture is much more largely absorbed than either the gas or the vapour separately. The mean of a set of experiments made at 100° C and 706·2 mm. pressure was 316·6 vols. of the mixture absorbed by one vol. of cocoa-nut charcoal. The President remarked that the results of the experiments were entirely in accordance with what was expected on theoretical grounds.—The next communication was "On the composition of iron rust," by Dr. Crace Calvert. The author had lately occasion to analyse rust obtained from two different places—from the outside of the Conway Bridge, and from Llangollen, North Wales—and he found both specimens to be composed as follows:—

Sesquioxide of iron	92·900
Protoxide of iron	6·177
Carbonate of iron	0·617
Carbonate of lime	0·295
Silica	0·121
Ammonia	traces
	100·000

This result induced the author to inquire to which of the constituents of the atmosphere the formation of rust is chiefly due. With the view of ascertaining this, carefully cleaned blades of steel and iron were put into tubes filled respectively with oxygen, oxygen and a little carbonic acid, oxygen and moisture, &c. The blades were introduced into gas-collecting cylinders, which were then filled above mercury with oxygen, &c. But this proved to be an unsatisfactory method, inasmuch as always some globules of mercury remained adhering to the iron, whereby a galvanic action was produced which of course induced a rapid oxidation. To avoid this the tubes were filled simply by displacement of atmospheric air. The blades were then left exposed to the action of the different agents for a period of four months. The results were as follows:—

Blades in dry oxygen	No oxidation.
„ moist „	Out of three experiments only in one a slight oxidation.
„ dry carb. acid	No oxidation.
„ moist „	Slight incrustation of a white colour. (Out of six experiments two did not give this result.)
„ dry carb. acid and oxygen	No oxidation.
„ moist carb. acid and oxygen	Most rapid oxidation.
„ dry oxygen and ammonia	No oxidation.
„ moist oxygen and ammonia	No oxidation.

These facts led the author to assume that it is the presence of carbonic acid in the atmosphere, and not oxygen or water vapour, which determines the oxidation of iron. The author next investigated the behaviour of iron in water in which successively oxygen, carbonic acid, a mixture of the two gases, &c., were conducted. He immersed only a part of the blade in the water. The results were analogous to those above mentioned, inasmuch as the most rapid oxidation took place when a mixture of oxygen with carbonic acid was introduced into the water. The action commenced immediately, and in a short time a dark precipitate covered the bottom of the vessel. Now the oxidation in this case was not due to a fixation of the oxygen dissolved in the water, but to oxygen liberated from the water by galvanic action; the occurrence of large quantities of hydrogen above the liquid in the bottle proved this sufficiently. A striking evidence in favour of the supposition that the iron is oxidised through the decomposition of the water, is to be found in the fact that when a bright blade was introduced into distilled water which had previously been deprived of all its absorbed gases by long-continued boiling, it became, in the course of a few days, covered here and there with rust. The spots upon which the rust appeared proved to be impurities in the iron. It is obvious they induced galvanic action, just as a mere trace of zinc placed on one end of the blade would establish a voltaic current.—Finally, Dr. Calvert investigated the state of iron in alkalies, and he discovered that not only the solution of caustic soda, but that of the carbonate of it as well, protects iron against any oxidising action.

Linnean Society, January 20.—Prof. Babington read a paper, being a revision of the Flora of Iceland. He gave an extempore sketch of the country, its climate and character, and then read the introductory part of his paper containing an historical account of what had been done towards ascertaining the vegetable products of the island. It appears there are about 450 species of phanerogamous plants (the exact number at present recorded is 467), of which only about 60 are not natives of Britain. None are peculiar to the island; all the remainder, with three exceptions, are to be found on the European continent, chiefly in Scandinavia; the three arctic plants not otherwise known as European are *Gentiana detonsa*, *Pleurogyne rotata*, and *Epilobium latifolium*. No woods are now to be found in the country, although some existed recently: they have been destroyed by the carelessness of the inhabitants. Now that more care is taken of their remains, it is expected that they will again spring up. The trees were all birch, nor is there any trace of the former existence of pine or other trees. Extensive woods of dwarf birch-trees are found in several places, and some fruticose willows exist, especially an abundance of *S. lanata*. No grain of any kind is grown on the island.

Zoological Society of London, January 13.—John Gould, F.R.S., V.P., in the chair. The secretary called attention to certain additions to the society's menagerie during November and December last, amongst which was particularly noticed a rare American monkey (*Pithecia ouakari*) from the Rio Negro, deposited by L. Joel, Esq., C.M.Z.S.—A letter was read from Lord Lilford, F.Z.S., relating to the exact locality of a specimen of *Otus capensis*, lately living in the society's gardens.—A letter was read from Dr. A. Ernst, of Caraccas, C.M.Z.S., containing some notes on animals recently obtained in the vicinity of that city.—The Rev. H. B. Tristram, F.R.S., exhibited a pair of tawny eagles (*Aquila nævioides*) obtained near Etawah, N.W. India, by Mr. W. G. Brooks, C.E., being the first authentic examples of this species received from that country.—Mr. Swinhoe exhibited and made remarks on some skins of tigers and leopards from various parts of China.—Mr. Gould exhibited a new and very remarkable pigeon, supposed to be from New Guinea, which he had recently described under the name *Otidiphaps nobilis*.—A communication was read from Mr. Henry Adams containing descriptions of a new genus, and of eighteen new species of land and marine shells from the Red Sea, Hainan, and other localities.—A communication was read from Dr. Cobbold containing the description of a new generic type of Entozoa, discovered in a specimen of the Aard-wolf (*Proteles cristatus*), which had recently died in the menagerie. To this were added remarks on the affinities of this Entozoön, especially in reference to the question of parthenogenesis.—A communication was read from Mr. Morton Allport, F.Z.S., containing a brief history of the introduction of the salmon (*Salmo salar*) and other *Salmonidæ* to the waters of Tasmania.—Dr. Murie read a paper containing additional memoranda on irregularity in the growth of salmon. Dr. Murie's observations were founded principally upon specimens hatched and reared in the society's fish-house.

The Institution of Civil Engineers, January 11.—Mr. C. B. Vignoles, F.R.S., president, in the chair. Five candidates were balloted for and declared to be duly elected, viz.: Mr. A. A. Langley, engineer and manager to the Hereford, Hay, and Brecon Railway; Mr. R. White, first-class engineer upon the Great Southern of India Railway; and Mr. E. Wragge, chief engineer on the Toronto, Grey, and Bruce, and the Toronto and Nipissing Railways in Canada, as members; and Mr. W. Rawlinson, engineer and manager of the Brazilian Street Railway Company, and Mr. C. Willman, Middlesbrough, as associates.—A report was brought up from the council, stating that, under the provisions of Sect. IV. of the Bye-laws, the following candidates had recently been admitted students of the Institution:—W. F. Alphonse Archibald, B.A., A. J. Hess, A. Innes Liddell, W. Allingham Magnus, and H. Goulton Sketchley.

Statistical Society, January 18.—William Newmarch, F.R.S., president, in the chair. The following gentlemen were elected Fellows:—Messrs. Iltuduo Thomas Prichard, Henry Hoare, David Maclagan, and Josiah Samuel Parker. Professor Levi read a paper on "the statistics of joint-stock companies from 1814 to the present time; and of companies with limited and unlimited liability formed since the year 1856."

DUBLIN

Royal Zoological Society of Ireland, January 11.—Dr. Banks in the chair. Rev. Dr. Haughton read the report for 1869, from which it appeared that the number of visitors to the Gardens was 9,000 more for 1869 than for 1868, and that the receipts for 1869 exceeded those of 1868 by 137*l*. It would appear that there are now in the Gardens 143 mammals, 219 birds, and 25 reptiles—specimens, not species, we presume—and that their health and condition are excellent. The fact is mentioned that since 1857 twenty lions and 31 lionesses have been bred in the Gardens. The Earl of Mayo was elected president for this year.

Royal Geological Society of Ireland, January 12.—Mr. W. Andrews in the chair. The secretary read a paper by Dr. L. Lindsay on further researches in the gold-fields of Scotland. Rev. Professor Haughton read a paper by Mr. J. D. Latouche on a spheroidal structure occurring in some Silurian Rocks of Wales. As supplementary to the views put forward in Mr. Latouche's paper, Dr. Haughton stated that this spheroidal structure shows on a small scale what cleavage does on a large one, and that he believed that the latent structure was brought out by the weathering, not caused by it; indeed, the cleavage stream of force might be compared to that of a great river—it might flow along for miles through a country in an even uninterrupted course, then some small obstacles came in its way, and as the result a series of eddies were formed. Spheroidal structures were representatives of these eddies of force, and the ordinary cleavage planes were representatives of the uninterrupted stream—the one was the other on an immense scale. Dr. Haughton also showed that it followed rigorously from the mathematical laws of cleavage, that the parallipipedal blocks formed by cleavage must have themselves an internal spheroidal structure, of a concentric kind. This was the latent structure brought out by weathering in the manner shown in the beautiful drawings of Mr. Latouche.—Dr. Macalister exhibited a portion of a skull which had been dug up recently, while some repairs were being made to the vaults of Trinity College Chapel. This fragment was found laid along with other bones, and had evidently been dug up when the foundations of the chapel were being laid, and then, with the other bones found on that occasion, again buried. The skull was of a low type. Rev. Dr. Haughton agreed with Dr. Macalister as to the low type of the skull. Mr. J. J. Lalor did not agree with Dr. Macalister that this skull was of a low type. He had made a series of accurate measurements of skulls in conjunction with Dr. Carpenter, of London, and therefore could speak on the subject. Absence of forehead was no evidence of absence of brain capacity; lowness of skull was considered a mark of beauty by some. He could not venture to say whether it was the skull of a man or a woman, but its brain capacity did not authorise one in saying that it was a low skull; it might have been the skull of a Provost, and certainly was one of more than ordinary capacity. Dr. Macalister in reply stated that he saw no reason to alter his view on the subject, as it had been based on careful measurements and on exact reasoning, neither of which he thought admitted of contradiction.

Institution of Civil Engineers of Ireland, January 12.—Mr. J. Ball Greene, C.E., in the chair. Mr. B. Stoney read a paper by Mr. C. P. Cotton on a novel means of transit for minerals in the county of Sligo. An extensive barytes quarry was worked on the side of a steep hill, the mineral had to be lowered a depth of over 1,000 feet, and this was effected by means of boxes swung on ropes, forming a wire rope railway. Mr. A McDonnell read a paper on workshop machinery driven by rapidly moving ropes.

Royal Dublin Society, January 18.—Mr. John Adair in the chair. Professor Macalister read a paper on "The Curves in the Spine considered from an æsthetical point of view." Dr. J. Emerson Reynolds read some notes on "the determination of the flashing point of petroleum oils, as settled by Act of Parliament." The author described in detail the apparatus directed to be employed, and pointed out the difficulties and sources of error to be guarded against in using the Government test. He suggested the adoption of an uniform mode of estimating the flashing point of mineral oils, which experience proved to be that most suited for affording reliable results; and further proposed that in all doubtful cases—a special method—which he indicated, should be employed in order to serve as a test of the accuracy of the parliamentary process.—A drawing of the Nebulæ in Argos, and Dr. Monckhoven's new light for photography were exhibited.

MANCHESTER

Literary and Philosophical Society, January 11.—Ordinary Meeting.—Mr. E. W. Binney, F.R.S., F.G.S., vice-president, in the chair. The chairman described the aurora borealis, as observed by him at Cheetham Hill on the evening of Monday, the 3rd inst., at 7-30 P.M. Dr. Joule, F.R.S., said he had noticed some remarkable disturbances of the magnetic dip on the 3rd inst., which no doubt were connected with the auroral display. He had also noticed similar disturbances of the dipping needle during the gale on Saturday, the 8th inst.—Letters were read from Mr. A. H. Green and Mr. E. Hull, defending the accuracy of the Geological Survey map in the matter of the red rock fault referred to in Mr. Binney's paper, read before this society on November 16th (see NATURE, No. 7).—The chairman, with all respect to Messrs. Green and Hull, again denied the correctness of their map and sections so far as the "red rock fault" was concerned. He stated that he was prepared to maintain his position on the ground where the sections were exposed between Stockport and Macclesfield.—Dr. Joule exhibited his current meter, and with it, in connection with a galvanometer, made an experiment to determine the horizontal intensity of the earth's magnetism in absolution measure; the result gave 3·83 as the value of this element in the hall of the society. The current employed was produced by a single cell of a Bunsen's battery.

Microscopical and Natural History Section, January 3.—R. D. Darbishire, B.A., F.G.S., in the chair.—Mr. J. Sidebotham read the following paper:—"Notes on the pupa and imago of *Acherontia atropos*." The peculiar cry or squeak of the death's-head moth is very well known. It has been by some observers thought that this sound is produced by the friction of the joints of the prothorax and mesothorax; this conclusion is, in the opinion of the author of the paper, much strengthened by the following circumstance. A few weeks ago, when he was replacing some damp moss on some pupæ, he heard the peculiar cry of the moth, but much weaker. On examining the pupæ he selected the one from which the cry proceeded, and placed it in the palm of his hand; when at rest there was no sound, but the pupa at once produced it on being touched or pressed gently; on taking hold of it between the finger and thumb, if the head alone were confined, there was no sound, but if the tail, the motion of the joints was more energetic and the sound louder. In five days afterwards a very fine female moth emerged from the pupa, apparently none the worse for his experiments. The fact of the pupa ever producing this cry, disproves all ideas as to its being produced by expelling air through cavities, against a membrane, since in the pupa state all the muscles are as it were bound up in a horny case, and only those able to move which work the joints of the thorax and body, and besides this the amount of air which could be taken through the spiracles of the pupa would be obviously insufficient to produce such a volume of sound.

PARIS

Academy of Sciences, January 17.—M. de Verneuil presented and made some remarks upon a geological map of the Ural, published by M. de Moeller, a Russian officer of Mines. He stated that M. de Moeller had referred the sandstones of Artinsk—regarded as Permian by MM. Murchison, Keyserling, and himself—to the Carboniferous series, on the ground of their containing *Goniatites*, *Nautili*, and *Productus Caccrini*. M. de Verneuil was not inclined to accept this change, as it is possible that a mixture of Carboniferous and Permian types may occur in the same deposit, as has been found to be the case at Nebraska. A memoir was presented by M. B. Renault on some silicified plants of the environs of Autun. He noticed the structure of the stem in *Zygopteris* and *Anachoropteris*, studied by him in two new species, which he named *Zygopteris Brongniartii* and *Anachoropteris Decaisnii*; also that of the stems of some *Lycopodiaceæ*.—M. Delaunay presented a report on a memoir by M. Puiseux, on the secular acceleration of the movement of the moon.—M. Ricour presented a second note on the dispersion of light, and M. Delaurier a memoir containing an account of experiments on electricity, with objections to the electro-chemical theory.—M. Faye presented a note by M. A. Wüllner on the spectra of the simple gases, in which he disputes the results announced by M. Dubrunfant at a former meeting of the Academy (Dec. 13, 1869). A memoir was read by M. Duméry on the results obtained and obtainable on railways by traction on a single rail, in which the author maintained that railways on this principle can be constructed nearly 50 per cent. cheaper than ordinary railways, and can also be worked very advantageously.—M. Baudrimont stated that he had prepared artificial garnets with bases of magnesia, lime, strontian, baryta, and oxide of lead, and had them cut ten years ago. He forwarded specimens for the inspection of the Academy.—M. Maumené read a memoir on a general theory of chemical action, and the necessity of its employment in order to avoid error. No abstract of this memoir is given.—M. Becquerel and M. Dumas remarked upon the electro-chemical deposition of nickel; and M. Wurtz communicated a paper by M. A. Rossi on the synthesis of normal prophylic alcohol by means of æthylic alcohol. The author's process consisted in converting æthylic alcohol, first into cyanide of æthyle, and then into propionic acid; from the latter he prepared propionic aldehyde, and obtained propylic acid by the action of nascent hydrogen upon the aldehyde.—M. P. Levert forwarded for the Bréant prize a note on the action of bitters, especially sulphate of quinine, upon the economy, in the cure of fevers of all kinds; M. A. Marinier exhibited a collyrium for the treatment of affections of the eyelids, and a filtering injector; and M. Guyot presented a notice on the toxical effects of some products of the phenic group, including phenic acid, rosolic acid, and coralline.—A memoir on the "mulberry-tree and the silkworm, considered in themselves and in their relations," by M. Tigri, was read. The author treated of the production of disease with presence of *Bacteria* in the silkworm (*Maladie des morts-flats*), which he ascribed to alterations in the condition of the mulberry-leaves.—M. Robin presented a communication from M. S. Feltz, in which the author denied that the leurocyta, or white corpuscles of the blood, traverse the walls of the capillary vessels, as stated by many writers.—In a note on the movements of the grains of chlorophyll in vegetable cells under the influence of light, M. E. Roze referred to the observations of M. Prillieux, communicated to the Academy on the 3rd January, and stated that by examining the leaves of *Fernaria hygrometrica* under a tolerably high power, he observed that the chlorophyll grains were united by filaments of a viscous, transparent plasma, which undergo a slow displacement, and carry with them the chlorophyll grains.—M. Anez communicated a note on the development and habits of *Phylloxera vastatrix*, and M. Rouby a description of an artificial mineral spring, of which the titles only are given.

MILAN

Royal Lombardian Institute, November 25, 1869.—Professors Garovaglio and Gibelli presented a memoir on the Eudocarpeæ of Central Europe and Italy, containing a monographic revision of the species of that group of lichens.—Dr. Andrea Verga presented a communication on chloral. He stated that the hydrate of chloral prepared in the Laboratory of the Society of Encouragement at Milan was in brilliant prismatic crystals, whilst that obtained from Paris formed a white, opaque mass. — A further note on the production of Infusoria in glass vessels sealed hermetically and heated above 212° F. was communicated by Professor G. Cautoni. The author referred to previous experiments of his, in which vibrios were produced in great numbers in rich solutions of organic materials heated to 212°, 221°, 230°, and even 242·6° F. in vessels hermetically sealed and enclosed in a Papin's digester. He now gave the results of fresh experiments made with an aqueous solution of the so-called Liebig's extract of meat, containing about one part of the latter to about 35 parts of water, heated to various temperatures from 212°—244·4° F. maintained for about ten minutes in the digester. The vessels, heated to 230° and more, showed no traces of vibrios in a fortnight, nor were any produced in them for twelve or fifteen days after their interior had been brought into communication with the air by breaking the sealed extremity of their necks. The solutions which had been heated to 212° and 221°, on the contrary, produced, in two days, an abundance of vibrios and *Leptothrix* whilst still in sealed vessels. The author remarked that the above-mentioned liquid contained considerably less of protein matters than solution of natural flesh or yolk of egg, which might tend to lower the limit of temperature for the production of Infusoria. He referred to some other experiments, and argued from them in favour of heterogenism.—Dr. G. Bizzozero presented a report upon the investigations of Dr. G. Milani on some pathological alterations of the lymphatic glands.

COPENHAGEN

WE have received the "Oversigt over det Konglige Danske Videnskabernes Selskabs Forhandlingar" for the first half of the year 1869, which contains only one strictly scientific paper of importance, namely, a Crystallographico-chemical investigation of the double haloid salts of platinum, by M. Haldor Topsöe. The remaining papers are chiefly of antiquarian interest, and consist of a discussion of the plant known to the ancients under the name of *Silphion* or *Silphium*, by Prof. A. S. Oersted, with an appendix on the Vase of Arcesilas, by M. J. L. Ussing, and a dissertation by the latter on the Apollo Belvedere. The *silphium* is regarded by M. Oersted as a species of *Narthex*, allied to the *Asafœtida*, and is named by him *Narthex silphium*. Of the last two papers, abstracts in French are given.

PHILADELPHIA

American Philosophical Society, January 7. —A memoir on Fossils from the Marshall Group of Michigan and adjoining States, by Prof. Alexander Winchell, Director of the Geological Survey of Michigan, was read by Prof. J. P. Lesley. Prof. Cope read a paper on New Etheostomine Perch from Tennessee and North Carolina. Professor Cope gave the results of investigations on the structure of the extinct Saurian, the *Megadactylus Probyzelus* of Hitchcock, from the red sandstones of the Connecticut valley in Massachusetts. He mentioned that in 1867 he had stated it as his belief that the so-called bird-tracks of the above formation were those of Dinosauria, and that in the following year that view had been confirmed by Prof. Huxley. He stated that at the same time he proposed a system of the Dinosauria which was very similar to one very recently proposed by the same excellent authority. The *Megadactylus* was the only species whose remains had been found in the beds and locality in question, in sufficient preservation for determination, and it was clearly one of those which had made the tracks. The fore limbs were four-toed, the hind limbs three-toed, and with a long metastarsus. The animal was a Dinosaur, and a true representative of the sub-order Symphypoda, which was typified by the *Compsognathus* of the Solenhofen beds. As in the latter the astragalus and calcaneum were coössified with the tibia and fibula, and the carpal bones were much reduced. The bones were pneumatic, and possessed of excessively thin walls. The ischiatic bones were projected far backwards, were in contact for much of their length, forming a solid style which supported the animal when in a sitting position. Length about four feet. He also stated that the red sandstone beds in Pennsylvania and North Carolina contained remains of Dinosauria. The Cadontia (Belodon) and Labyrinthodonts, nearly allied to those of the Keuper of Germany. They occurred in the lower part of the series, which he had already parallelised with the Keuper. On the other hand, the occurrence in the upper part of the series of Symphypoda in Massachusetts and Pterosauria in Pennsylvania *Rhabdopelix longis pinis* Cope) rendered it highly probable that an approach to the lias was to be found in those strata, while the intermediate portion of the whole might be found to represent the time intervening between the Triassic and Oolitic (Purassic) periods.—Prof. Lesley remarked that these investigations threw the first rays of light on a very dark part of American geology. Prof. Marsh gave an account of the impressions of the ischiatic bones behind the tracks on specimens in the museum, Yale College, which he had always referred to as such, though some believed they were made by the tail.

BOSTON

Society of Natural History, November 3, 1869.—Mr. W. H. Dall made a few remarks upon the distribution of marine animals, asserting that their range was influenced more by the temperature of the water than by the depth or other conditions. He showed that the floating-ice line of Behring Sea (which passes between the Pribyloff and St. Matthew groups of islands, touching the continent near Kuskoquim Bay) governed the distribution of the fish and molluscs of those waters. It is the northern limit of all the more southern forms, some of which range as far south as Monterey. It is the southern limit of almost all the truly arctic species. The fur seal is never found to the north of it, though often erroneously spoken of as coming from Behring Strait; the polar bear never passes to the south of this line; the cod invariably keep to the south, and the mullet to the north, of it. It is also the limit of distribution of many fuci and seaside plants. Where the water is cooled by northern currents, or by glaciers, deep-water species of molluscs, especially brachiopods, are found at or even above low-water mark. Where the surface-water is warm, these molluscs, which in the north are found near the shore, are only obtained at a depth of many fathoms.

Section of Microscopy, November 10.—Mr. R. C. Greenleaf in the chair. Dr. H. Hagen called the attention of the section to the statements of Professor Listing, of Göttingen, who had recently (Nachr. d. kgl. Gesell. der Wissench., 1869, No. 1, and Poggendorff's Annalen, 1869, T. xvi. p. 467) given some suggestions concerning the further improvement of the microscope. In all microscopes the dioptric arrangement is now analogous to the astronomic spy-glass; they have but one real image, from which the virtual image is formed and brought to the eye of the observer. Professor Listing proposes to have two real images, and in this way to form three successive augmentations instead of two, as before. It is well known that by a prolongation of the draw tube, or by increasing the distance between the objective and the eye-piece, the image becomes successively greater, but the definition and penetration is by no means better. Professor Listing has made some experiments, and states that with an eye-piece of his construction (a double eye-piece with four lenses, similar to those of terrestrial telescopes) the magnifying power of the instrument, and also to nearly the same degree the penetration, is raised, by a tube of 420 millimetres, 20, 28, 55, 97, and 137 per cent. (the latter, of course, with diminution of the field), more than the same objective (Hartnack's, No. 7) and eye-piece (No. 3) with a tube 200 millimetres in length. The object was *Pleurosigma angulatum*, and Professor Listing assures us that the latent power of the objective is developed by this means in an astonishing manner. He also remarked that the so-called Erectors have long been used, but always with a low power and a short tube. The most advantageous form for the eye-piece would be, for the two superior glasses, achromatic lenses from 15 to 20 millimetres in diameter, and with a diaphragm between, having an aperture of from 8 to 9 millimetres. For the two inferior lenses, a common Huyghen's eye-piece would be the best. Such a combined eye-piece, with a tube 420 millimetres long, would raise the power of the instrument 97 per cent. The use of an achromatic condenser adapted for oblique illumination is necessary for high powers. The experiment was only successfully made with the best objectives of English artists, or with the excellent new Hartnack objectives. According to his calculation, an objective of one millimetre distance will give the first real image at a distance of 200 millimetres from the second chief point of the objective, and combined with an eye-piece in Listing's manner, having a power of 25 diameters by itself, and a tube 405 millimetres long, the magnifying power of the whole instrument would be 5,000 diameters. In the common arrangement of the microscope, the dioptric cardinal points are in the same order as in a concave lens, and the focal distance of the whole microscope (not of the objective) would be equal to —·5 millimetres, with a magnifying power of 400 diameters for a visual distance of 200 millimetres. In the Listing instrument the order of the cardinal points would be inverted and analogous to a convex lens, with a focal distance of the whole microscope equal to × ·04 millimetres, with a magnifying power of 5,000 diameters. In the first case the objective would have a focal distance of 3 millimetres, in the last of 1 millimetre. The difference between the two chief points of the whole microscope is in both cases nearly equal to the whole length of the tube. In the last arrangement the whole microscope is analogous to a convex lens with very short focal distance.

DIARY

THURSDAY, JANUARY 27.

ROYAL INSTITUTION, at 3.—On the Chemistry of Vegetable Products: Prof. Odling.

ROYAL SOCIETY, at 8.30.—Temperature of Strata in Sinking of Rosebridge Colliery: E. Hull.—Action of Rays of High Refrangibility upon Gaseous Matter: Prof. Tyndall, F.R.S.—Eclipse of Sun as observed in United States: J. N. Lockyer, F.R.S.—Theory of Continuous Beams: Mr. Heppel.—Remarks on Heppel's Continuous Beams: Professor Rankine.

ZOOLOGICAL SOCIETY, 8.30.—On Cooking Pits and Kitchen Middens, containing Remains of Dinornis, New Zealand: Professor Owen, F.R.S.

ANTIQUARIES, at 8.30.

LONDON INSTITUTION, at 7.30.

FRIDAY, JANUARY 28.

ROYAL INSTITUTION, at 8.—Graham's Scientific work: Prof. Odling.

QUEKETT MICROSCOPICAL CLUB, at 8.

SATURDAY, JANUARY 29.

ROYAL INSTITUTION, at 3.—On Meteorology: Mr. Scott.

MONDAY, JANUARY 31.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.

INSTITUTE OF ACTUARIES, at 7.

LONDON INSTITUTION, at 4.

MEDICAL SOCIETY, at 8.

TUESDAY, FEBRUARY 1.

ROYAL INSTITUTION, at 3.—On the Architecture of the Human Body: Prof. Humphrey.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Statistics of Income, Expenditure, and Railway management, and their bearing upon future Railway policy: J. T. Harrison, C.E.

PATHOLOGICAL SOCIETY, at 8.

ANTHROPOLOGICAL SOCIETY, at 8.—Negro Slaves in Turkey: Major F. Millengen.

SYRO-EGYPTIAN SOCIETY, at 7.30.

WEDNESDAY, FEBRUARY 2.

SOCIETY OF ARTS, at 8.—On Recent Improvements in Small Arms.

PHARMACEUTICAL SOCIETY, at 8.

OBSTETRICAL SOCIETY, at 8.

THURSDAY, FEBRUARY 3.

LINNEAN SOCIETY, at 8.—Revision of the genera and species of capsular gamophyllous *Liliaceæ*: J. G. Baker, Esq., F.L.S.—On a new form of Cephalopodous ova: Dr. Collingwood, F.L.S.

BOOKS RECEIVED

ENGLISH.—Lichenes Britannici: Crombie (Reeve and Co.)—Elementary Introduction to Physiological Science (Jarrold and Son).—The American Naturalist, No. 11.—The Spherical form of the Earth, a Reply to Parallax; J. Dyer (Trübner and Co).—On the Geographical Distribution and Physical Characteristics of the Coal Fields of the North Pacific Coast: Robert Brown.—Fresenius' Analysis, Quantitative, fifth edition (Arthur Vacher).—Fresenius' Analysis, Qualitative, seventh edition (Arthur Vacher).

FOREIGN.—Ueber die Gährung und die Quelle der Muske'kraft: J. Von Liebig.—Bulletins de la Société d'Anthropologie de Paris.—Pflüger's Archiv für Physiologie — Centralblatt für die medicinischen Wissenschaften, January, 1870.

CONTENTS

ERRATA.—Page 269, first column, last line: for "plan" read "position."—Page 269, second column, second line: for "supplemented" read "supplemented as soon as possible."—Page 269, second column, fourth line: for "should" read "should not"

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH

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25, Devonshire Place, Portland Place, London,
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THURSDAY, FEBRUARY 3, 1870

THE ATMOSPHERIC-GERM THEORY

WE have heard much during the last week or two concerning the presence of organic matter in the atmosphere, and the degree to which this is filled with "germs" of living things. It would have been better, perhaps, had it been always pointed out more distinctly that the two expressions were by no means uniformly convertible. There is unquestionably much mere organic *débris* in the atmosphere which nobody could regard as germs of living things.

The transition, in the minds of many at the present day, however, from the idea of organic matter in the atmosphere, to the identification of this with germs of actual animal and vegetable organisms, occurs only too easily. The air is supposed by them to be teeming with potential living things most varied in kind. Each square foot of atmosphere is thought to contain representatives of innumerable varieties, which are only awaiting the advent of suitable conditions in order to commence their growth and development. Men talk most glibly about germ-theories of disease, and the share which germs take in the origin of epidemics, as though these were proven facts of science rather than, as they are at present, mere questionable hypotheses. And, just as these germ-theories concerning epidemic disease have grown out of the more general *panspermic* doctrine, so did this doctrine itself grow out of the great "spontaneous generation" controversy somewhat more than a century ago. As it was with the derived, so was it with the original doctrine: in each case it was produced, not so much on account of any *direct* evidence in favour of the existence of such germs, but rather on account of the inherent difficulty in the explanation of the subject to which it referred. Previous to the period mentioned, however, no such doctrine had been started. There were, of course, the old pantheistic doctrines of Anaxagoras and his followers—the notion of the universal diffusion of an active principle or νοῦς pervading all things, which was itself the cause and source of all the life on our globe: there was also the doctrine of Leibnitz, concerning "Monads," as centres of force and life existing in all things; but anything like the present "panspermic" doctrine was still wanting.

The Aristotelian notions concerning the "spontaneous generation" of even complex living things, received a severe blow by the experimental demonstration of Rédi, in 1638, before one of the Italian academies. He showed that the larvæ found in putrefying flesh had been deposited there by flies, and had not been engendered (as had been previously supposed) by changes taking place in the flesh itself. Hence a very desirable modification of their views was necessitated on the part of the heterogenists. It was not, however, till about a century after this that the "spontaneous generation" doctrines were again prominently brought before the scientific world. Then, too, they appeared in a form more suited to our present notions. The long controversy carried on between Needham, the English champion of heterogeny, and the Abbé Spallanzani, resulted in the promulgation by the latter of the celebrated "panspermic" doctrine. The question pressing for solution was, What is the mode of origin of the myriads of the lowest forms of life which so soon teem in organic solutions? According to Needham many of these lowest living things had been evolved *de novo* owing to changes taking place in the organic matter of the infusion; according to Spallanzani they had been ultimately derived from "germs" which, floating everywhere in the atmosphere, had, in spite of all precautions, gained access to the solutions. Spallanzani did not pretend that he had seen these "germs," their existence was a mere postulation and no other evidence of their reality was alleged than the occurrence of the very phenomena which their presence was supposed to explain. His position was interpretable in this way. He seemed to think that such new evolution of life was impossible. If living things occurred, therefore, they *must* have originated from pre-existing germs. Against unchangeable convictions of this kind, occurring either then or now, of course no amount of experimental evidence would be of any avail. Spallanzani preferred to believe that the atmosphere carried with it everywhere myriads of germs of elementary organisms, or, at all events, sundry *principes préorganisés*, invisible and imaginary though they might be. On this subject he says*:—"The infusorial animalcules undoubtedly take origin, in the first place, from certain *principes préorganisés;* but these *principes*, are they eggs, germs, or other similar corpuscles?" To which he most honestly adds:—"If it is necessary to offer facts in reply to this question, I frankly acknowledge that we have no certain knowledge on the subject."

Bonnet was the contemporary of Spallanzani, and he was also the advocate of a doctrine similar in its tendency, though infinitely more extravagant. Bonnet's leading notion of the "emboîtement des germes" is thus illustrated in one of the earlier chapters of his work †:—"The sun, a million times larger than the earth, has for an ultimate constituent a globule of light, of which several thousand millions enter at once into the eye of an animal twenty million times smaller than a flesh worm .... But reason can penetrate even further. From this globule of light it can see issue another universe having its sun, its planets, its plants, its animals, and amongst these last an animalcule which is to this new world what that, of which I have just spoken, is to the world which we inhabit." Now, it would certainly be wrong to restrain any man in the exercise of his fancy, but it surely is deplorable when we find the results of such exercise—such mere figments of the imagination as this—warping the reasonings of succeeding generations when they come gravely to argue about questions of fact.

Such, then, has been the origin of the "panspermic" doctrine. Its first supporters commenced with assumptions, which could only be supported by the occurrence of the very phenomena that were the subjects in dispute, and to explain which the assumptions had been started. This was the doctrine of which M. Pasteur first attempted the experimental verification. How far he succeeded in the attempt is another question. On the part of those who first promulgated the "panspermic" doctrine, there certainly was nothing but mere fancy and hypothesis.

* Opuscles de Physiques, animale et végétale. Pavie, 1787. Tom. I. p. 230.

† Considerations sur les Corps Organisées. Amsterdam: 1772.

ENGLISH SPORT IN THE FIFTEENTH CENTURY

The Debate between the Heralds of France and England. Translated and edited by Henry Pyne. (London: Longmans and Co. 1870.)

IT is not easy to obtain an accurate knowledge of the fauna of England before the sixteenth century, or to ascertain with anything like precision the distribution of wild animals throughout our country. Contemporary authorities are few, and allusions in them to the facts of Natural History are vague and scanty: vague enough to whet our curiosity, and rare enough to augment the interest attaching to them. We are, therefore, grateful when we can derive from any fresh and well-accredited source a side-light upon this obscure subject, and such we seem to have found in a few incidental remarks that occur in a very early tract, bearing the unsuggestive title of "A Debate between the Heralds of France and England." This debate, now for the first time translated into English, appears from internal evidence to have been written by Charles, Duke of Orleans, about the year 1460, and to have been first published in Paris in 1500. Its author, taken prisoner at the battle of Agincourt, was detained in England for some five-and-twenty years, dividing the period of his captivity between London and the Castles of Windsor, Pontefract, Ampthill, Bolingbroke, and Wingfield. To a man of quick observation, as the Duke undoubtedly was, this lengthened exile gave ample opportunity of forming a tolerably correct opinion of the relative merits of the land of his birth and the land of his captivity. Patriotism has, of course, occasionally coloured his views, but on the whole his judgments are wonderfully impartial, and his statements may be accepted with very little qualification. It must, however, be borne in mind that the Duke's acquaintance with England was almost wholly confined to the eastern side, which has very little in common with the rest of the country, and has probably undergone far fewer changes in later times. Thus, in his estimate of the capabilities of our country for sporting purposes, he makes the English Herald say: "England is a level country, well cultivated, and not covered with trees or bushes, which might hinder the game from being easily found and caught; and it has also many partridges, quails, and other birds, as well as hares in great abundance. And with regard to the sport of fowling, no one can imagine a more delightful country, for there are numerous little streams which flow into the great rivers, where it is a fine thing, during the season, to see what a profusion there is of wild fowl." This description is true enough of the eastern counties, especially if we understand the term "wild fowl" to include snipes, plovers, bitterns, and other fen-haunting birds. But, in lauding the superior merits of French sport, the Duke gives some further details, which are not without their value, as illustrating what we may call the antiquarian side of Natural History. "In France," he remarks, "we have not only all the wild animals which you (English) have, as stags, roes, and deer, but we have many other animals for the chase besides these: for we have wild boars or wild black swine, and we have also wolves and foxes, while you have none." Now, it is hardly necessary to observe that the popular story of the extermination of wolves in England by Edward I. must be received with some reservation. There seems some ground to believe that in the valley of the Findhorn, in Scotland, wolves have bred as late as the seventeenth century, and that even in the wilder parts of England—the fells of Yorkshire, and the forest of Dartmoor—they have existed in the fifteenth, and perhaps in the sixteenth century, if we are to give any credence to local traditions. Certain it is that in 1280, John Giffard, the Baron of Brimsfield, had license from King Edward to hunt wolves with dogs and nets in all forests in England; we have also little doubt that a diligent search through the public records would disclose similar grants of later date. Some ten years ago a young wolf was caught in a vermin-trap at Ongar, in Essex, but its occurrence was explained by the fact that the master of a neighbouring hunt had recently imported some fox-cubs from France, and that the wolf had been included in the hamper by mistake. The comparatively small amount of woodland and covert in the East of England would render the breeding of wolves, to any extent, an impossibility, and in a less degree the same remark applies to foxes also. Fox-hunting, in the modern sense of that term, is a sport of recent growth, and such a thing as the preservation of foxes for hunting purposes cannot boast of any antiquity at all. Gervase Markham, indeed, classes the hunting of the fox and the badger together, and describes them as "chases of a great deal lesse use or cunning than stag and hare-hunting, because they are of a much hotter scent, and are not so much desired as the rest,"—an observation which may be balanced by the French Herald's remark, that wolves and foxes "are bloodthirsty animals, so that it requires persons of great courage to overcome them." Wild swine in England were either destroyed or domesticated at a very early period. Pannage was too valuable a privilege to be otherwise than jealously guarded against such unwelcome intruders. Charles I. turned out in the New Forest some boars and sows which he had imported from Germany, and fifty years ago their descendants might be recognised by the smallness of their hind-quarters and greater development of sinew.

The next position asserted by the French Herald in the Debate, if true at the time, has since been curiously reversed. He claims precedence for his country, not only in respect of hares and game-birds generally, but especially or exclusively for the great red-legged or Grecian partridges, and an abundance of pheasants. Hares have always been common in England, but the prevalence of red-legged partridges throughout the stubbles has not been a long-standing grievance to the Suffolk sportsman, for, if Pennant be right, they were introduced from France, as late as the year 1770, and, perhaps from their dislike to a humid soil and atmosphere, have never spread themselves far inland.

With regard to English pheasants, the Duke's experience must, we think, have been exceptionally unfortunate. The bills of fare, in olden times, invariably make mention of them, and Mr. Pyne refers to a statute passed in 1494, prohibiting their destruction by unlicensed persons, and clearly implying that they were common enough. Goshawks and tercelets for hawking purposes were, no doubt, imported from France in the fifteenth century—the accuracy of the French Herald's statement on this point being confirmed by several passages in the *Paston Letters.*

We are rather surprised that no mention of the bustard should be made in the tract. Though now extinct in England, the bird was by no means uncommon in the open country at the commencement of the present century. We can only suggest that the cause of its omission from the Herald's list and its gradual extinction in England, is one and the same. Being slow to take wing, the bird is of little or no use for sporting purposes, and nature has implanted in it a rooted aversion to those enclosures which, in a land like ours, alone are sacred to game.

CHARLES J. ROBINSON

POPULAR LECTURES ON PHYSIOLOGY

Populäre Physiologische Vorträge gehalten in Akademischen Rosensaale zu Jena, 1867-1868-1869. Von Prof. Dr. Joh. Czermak. (Wien, 1869. London: D. Nutt.)

THE daily increasing recognition of the importance of Physiology as an element of liberal culture, no less than as a distinct branch of science, may be said to be intimately connected with the gradual displacement of the old vitalist conception. The old conception of Life as something essentially mysterious and removed from out the circle of natural causes, has been set aside in favour of the conception of Life as something more complex, indeed, but not otherwise more mysterious than other natural phenomena, and dependent upon the physical and chemical agencies recognised in operation in other provinces of research. The consequence of this changed view has been to disclose the need of an incessant application to Physiology of those instruments and methods which have enlarged and given precision to our views of Nature; and a further consequence has been that the problems are found to be more capable of popular exposition, that is to say, the great results of research can now be *shown* to an intelligent public, and made thus to form an element in general culture.

It is under this second aspect that Prof. Czermak's Lectures call for remark. Himself an original investigator and inventor, he here gives excellent examples of the kind of teaching that may become generally effective—namely, an intelligible exposition, for the laity, of the painfully-acquired results of science. This exposition is not confined to an oral statement of results, which statement might be imperfectly apprehended and quickly forgotten, but is accompanied by a visible demonstration which fixes it in the memory as with a burin. In his first lecture he expounds the action of the heart, and the influence of the nervous system on the circulation. In this he exhibits the instrument formerly invented by him, the Cardioscope, which enables an immense audience to *see* the rhythmic beating of the heart when taken from the body; and by the directions and the plates here supplied teachers and private students may easily furnish themselves with the ingenious contrivance. Indeed, we may say at once that this volume will be especially useful to teachers who will gain from it several effective aids for their lectures.

The second lecture is on the Ear and Hearing, and gives a lucid account of all but the very latest discoveries (the startling and *disturbing* discovery which robs the Corti apparatus of its former significance being subsequent to the publication of this volume). The third and fourth lectures are on the Voice and Speech, accompanied like the others with excellent and instructive diagrams, and a very intelligible explanation of the instrument with which Prof. Czermak's name has been carried all over Europe and America—the Laryngoscope.

A mere glance at this volume, and the elaborate application of mechanical aids which it suggests, will indicate at once the great change which has come over physiological investigation in the last twenty years. Not to speak of such works as those of Richerand and Majendie in France, or of Elliotson and Mayo in England, where there is scarcely a trace of the physical and chemical investigation now considered indispensable, let even the great work of Müller be opened at the places where the heart, the ear, and the voice are treated, and compared with these lectures, addressed, be it observed, to a miscellaneous audience of ladies and gentlemen, not to students in a class-room, and the contrast will, as the French say, leap at the eyes. The changed direction is one that attempts to reduce physiological problems to visible and measurable processes, which leave no room for vagueness or inexactness, and which, without getting rid of the mystery of Life, reduces the phenomena of Life to what Prof. Huxley finely names the "realm of *orderly* mystery."

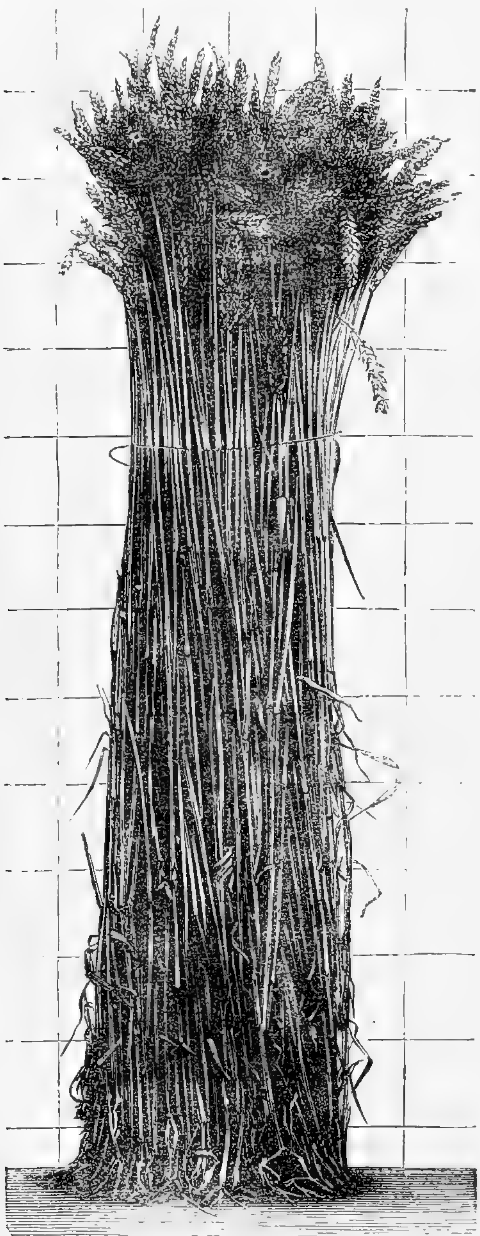
GEORGE HENRY LEWES

AGRICULTURAL CHEMISTRY IN FRANCE

L'Ecole des Engrais Chimiques; premières notions de l'emploi des agents de fertilité. By M. Georges Ville. 12mo., pp. 108, with one plate; price one franc. (Paris: Libraire Agricole de la Maison Rustique, 1869.)

INTELLIGENT visitors to the last annual meeting of the Royal Agricultural Society, held at Manchester, could hardly fail to draw one very important conclusion from the sight of that vast array of implements, machines, and produce, namely, that year by year farming is brought more and more under the application of scientific principles. It is found, too, that farm labourers, not quite so stupid as was thought, are capable of managing agricultural machines, and of adapting themselves to the improved style of work which these necessitate. And among our farmers the number of those increases who know that, however much plants may differ in appearance and properties, they have a character in common, and owe their formation to certain elements which suffice for their requirements, as the letters of the alphabet suffice for the requirements of writing and printing. And their sons at school will learn that of these plant-forming elements, the more important are, carbon, hydrogen, oxygen, nitrogen, phosphorus, sulphur, chlorine, silicon, calcium, magnesium, potassium, sodium, and iron. Schools and colleges have taken the subject in hand, and have demonstrated that the study of the sciences on which agriculture may be said to depend, involves no small amount of intellectual culture—a culture fraught with lasting interest.

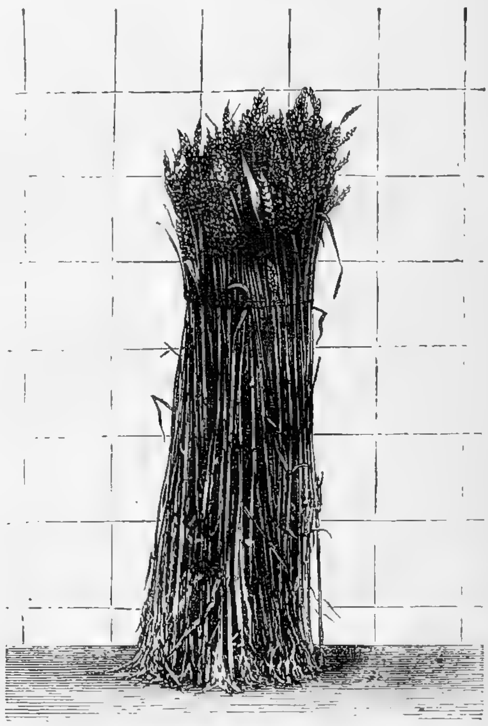
On the Continent, also, a movement has begun for the improvement of agriculture, and it will be instructive to look at what has been accomplished in France. Among the subjects on which lectures are given by the able professors at the Museum of the Jardin des Plantes is *la chimie agricole*—agricultural chemistry—and, in the hands of Prof. G. Ville, who has been experimenting thereon for the past twenty years, it has produced surprising results. Having established his propositions single-handed, and at his own cost, a portion of the imperial domain at Vincennes was allotted to him, as an experimental farm, and the crops he there produced, the *Conférences Agricoles* he there held among the crops, together with his numerous



Comparative size of wheatsheaf produced from soil completely manured.

published works, and the effect of his lectures, have made such an impression, that his method of cultivation has been adopted at more than five hundred places in France; while from Spain, Portugal, Italy, Belgium, and Germany, and from the French colonies, farmers and cultivators have resorted to Paris and to the experimental farm at Vincennes, to acquaint themselves with the method which under ordinary circumstances would more than double their harvest.

Prof. Ville's method of instruction is as simple and definite as his method of fertilisation, as if he had in view the large number of small peasant proprietors in France, and wrote and lectured for their especial benefit. You may sow wheat, he says, in soil wanting nitrogenised matter, phosphates, potash, and lime, and it will grow and bear grain, but the stalk will be very short, thin, and weak, and the vegetation precarious. Mix with the soil a substance composed of carbon, hydrogen, and oxygen, the result will be exactly the same. And why? Because plants take all the carbon they need from the carbonic acid of the atmosphere, and hydrogen and oxygen from water. Hence, to add these three elements to the soil is useless; on the other hand, if some substance containing assimilable nitrogen be added, a salutary effect is at once produced, for plants derive nitrogen partly from the soil, partly from the air. But this effect is as nothing compared with that of manures affording certain mineral elements: mix these as well as the nitrogenised matter with calcined earth, and its fertility will equal that of the richest soil. The vegetation, no longer thin and starved, acquires vigour and activity, the plant grows straight and strong, is of a rich green colour, and produces a well-formed ear filled with large and heavy grain.



Comparative size of wheatsheaf produced from soil without manure.

Many of the mineral elements required by the plant already exist in the soil; consequently, to render it productive the farmer has to discover which of the fertilising elements are wanting, and apply them to his field. To do this, it is not necessary that he should be an analytical chemist: the vegetation of his fields will do it for him. He has only to sow or plant a small experimental plot, and the appearance of the crop will tell him what is deficient in the soil. And in making his experiments, he is not restricted to any special kinds of plants, for the method may be applied to the sugar cane, the sorgho, and other natives of the tropics, to maize, beetroot, the Jerusalem artichoke, the potato, colza, and other varieties of cabbage, and to flax and hemp. Whether saccharine, or oleaginous, or fibrous, or starchy, the plants may be developed to the utmost limit of their productiveness by proper treatment.

The complete fertiliser, or *engrais complet*, as Prof. Ville calls it, varies slightly in composition according to the nature of the crop required. For wheat it is composed of acid calcium phosphate (superphosphate of lime), potassium nitrate (nitre), ammonium sulphate, and calcium sulphate (gypsum). These materials require to be skilfully mixed, so as to retain all their beneficial properties when spread upon the land. The "engrais complet" is to be regarded as the typical fertiliser—the standard by which to judge of the value and the lastingness, so to speak, of any chemical manure. A field properly treated with this will return three or four crops of wheat in immediate succession, without further manuring in the meantime.

For the proper carrying on of the experiments, it would be necessary to have—

1. The complete compost.
2. Compost without potassium salts.
3. " without phosphates.
4. " without nitrogenised matter.

These are to be applied to the experimental plots of land. If then, number 2, or 3, or 4 produces the same effect as number 1, it is evident that the substances represented by those numbers exist already in the soil, that the vegetation has profited by them, and that there is no need to apply them to the land. If, on the contrary, the compost in which any one of the four substances is wanting produces a deficient crop, there is a certain proof that this particular element of productiveness is deficient in the land.

Here, then, is a method of analysing the soil of fields and gardens which even an intelligent labourer might practise. He could hardly continue the practice without learning, better than from books, the true principles of agricultural science. He could determine step by step the loss of any one or more of the fertilising elements, and consequently ascertain which was required to restore the fecundity of the soil.

In support of this argument, Prof. Ville brings forward some remarkable results obtained on his experimental farm at Vincennes, giving tables showing the cost of cultivation and the yield of each experimental plot. He also places before his readers a series of figures in which the results obtained with wheat are displayed in a most forcible manner. The two examples here given indicate the limits of his experimental system. The sheaves are represented on the same scale, so that the results of good feeding and starvation may be readily compared. The intervening figures may be imagined.

If the experiment be made with peas, there is a marked difference in the result: the nitrogenised matter which tells in the culture of wheat has little or no effect on leguminous plants; the reason being that wheat takes up from the soil most of the nitrogen it requires, and that leguminous plants derive it mainly from the air. To produce a good crop of the latter we must employ a manure containing an excess of potassium salts, and for turnips we require an excess of calcium phosphate.

These are important facts, for they show that besides variation and rotation of crops, there can be also rotation of manures. Take any average field, and apply to it the materials which act on the required crop, and so pass from one to the other until the land shall have received all the materials which make up the complete compost.

This, briefly sketched, and with omission of certain practical details, is Prof. Ville's system for the improvement of agriculture in France. The five million small proprietors, who own each from 3 to 14 hectares, have herein a simple and efficacious method, by which their profits may be largely increased, and their own condition materially ameliorated. To quote the Professor's words, "The tiller of the soil is always in presence of a Power superior to himself. Seasons, temperature, rain, and sunshine, which enter so largely into the success of his labours, are above his influence. He learns that skill, foresight and economy are required of him; he knows also that when he has done all that depends on himself he must be resigned and wait. By temperament, as much as by condition, he becomes above all the friend of order, and, in case of need, its firmest support."

OUR BOOK SHELF

Landwirthschaftliche Zoologie. Von Dr. C. G. Giebel. 8vo. pp. 827, with 510 woodcuts. Glogau, 1869. Carl Fleming. (London: Williams and Norgate.)

ALTHOUGH the study of economic zoology ought to be of some importance in this country, we can point to very few English publications relating to it,—Curtis's "Farm Insects," and the translation of Kollar's "Garden Insects," by Westwood and Loudon, being almost the only special works on the subject that we can call to mind, and these are now of old date. This may perhaps be due to the fact that the advantage of attempts at the practical application of zoological and, especially, of entomological knowledge, is very frequently doubtful, but it is certain that in many cases an acquaintance with the natural history of animals must be most valuable to the farmer or gardener, by enabling him to distinguish beneficial from injurious creatures; it is therefore much to be regretted that we possess no good treatise which would place the necessary knowledge within reach of our English agriculturists.

There is another point of view in which the study of economic zoology is of great importance. From the very nature of their relations to man and the organisms which he has taken under his care, useful and injurious animals acquire a remarkable prominence, and thus the phenomena of their existence are brought near to us and, as it were, magnified in such a manner as to render their investigation comparatively easy. Accordingly, there can hardly be any better means of acquiring a practical general knowledge of natural history and, especially, of the intimate and intricate relations of organised beings, than the study of the enemies and benefactors of the farmer and gardener.

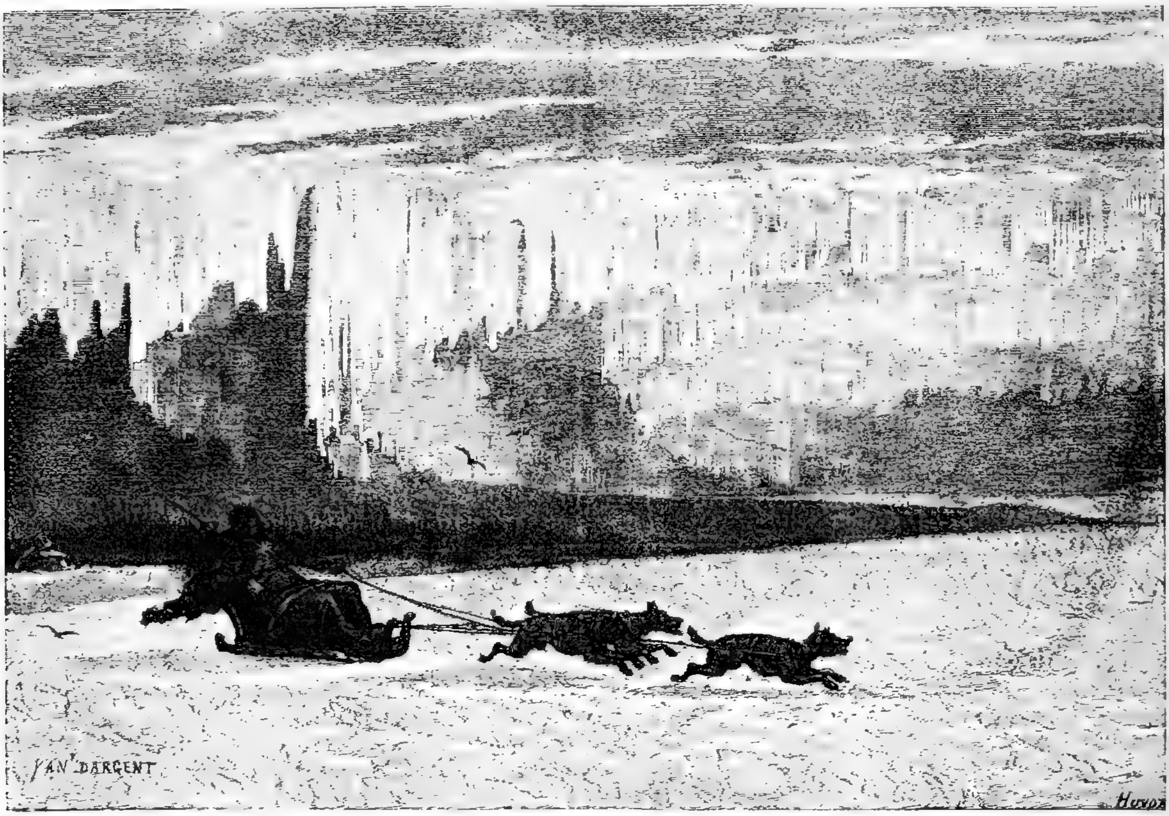
Dr. Giebel seems to have taken this view of the matter, and his "Agricultural Zoology" is really a complete natural history of terrestrial animals, the illustrative examples being drawn from domestic animals, or from species which exert a more or less direct influence upon the results of agricultural operations. Of all these, the natural history is given by Dr. Giebel in considerable detail, and in this way we get most of the families of mammalia, birds, insects, and arachnida legitimately illustrated, whilst by stretching a point here and there, even the classes of reptiles, fishes, and mollusca are more or less represented. Under the Vermes we find a good account of the curious natural history of the Entozoa. Either as a practical guide for the cultivator, or as a first book in the study of general zoology, Dr. Giebel's volume will be found of great value, and we can only repeat our expression of regret that we have nothing like it in our own language.

History of Meteors and of the Grand Phenomena of Nature. By J. Rambosson. (London and Edinburgh: Williams and Norgate.)

NOTHING is more sublime, or more engrossing, or at times more awful than the phenomena of Nature on the large scale; and yet nothing is more prosaic than most of the treatises on meteorology.

Those terrible statisticians with their columns of figures have certainly succeeded marvellously in creating a distaste for the study of the greater natural phenomena. A cyclone at sea is one of the most glorious and awful sights that can be imagined, yet in the pages of meteorological journals it becomes a barometric difference of an inch and a half, a wind equal to 12, and a sea disturbance equal to 9.

But M. Rambosson, with that talent for elucidation which so many Frenchmen and so few Englishmen possess, has spared neither trouble nor expense in order to produce a thoroughly popular and, at the same time, thoroughly scientific description of the grander class of natural phenomena.



THE AURORA BOREALIS

Being himself a traveller as well as a man of science, his descriptions and illustrations are particularly good; and no student can read the book without retaining a vivid impression of the aspects of Nature in her wilder moments. Some of the illustrations remind one of Gustave Doré; that of a hurricane on land and sea, Fig. 3, is particularly good; so is that of a hurricane in the desert, Fig. 33; also his pictures of lightning, Figs. 62, 63, 64; on the other hand, some few illustrations might possibly be dispensed with.

It has often occurred to us that while the student of chemistry and of physics is made acquainted in the laboratory with the forces with which he reasons, so the student of meteorology should, if possible, like the author of this book, be brought face to face with the grander class of natural phenomena; failing which, a well illustrated book, like that of M. Rambosson, is an admirable substitute for the personal experience which few can have.

B. S.

Our Own Birds. A Familiar Natural History of the Birds of the United States. By W. J. Baily. Revised and edited by G. D. Cope, Cor. Sec. Acad. Nat. Sci. With illustrations, after Audubon. (London: Trübner).

ALTHOUGH the object of this work is not to treat ornithology scientifically, but rather to present the subject in a pleasing manner to the young, Mr. Cope's name on the title-page is a guarantee of its scientific accuracy; and although the birds of the United States are mainly dealt with, the volume will doubtless be welcome to many young naturalists in this country, for the habits and interesting peculiarities of each bird are fully dwelt upon. Some of the illustrations are admirable.

MR. BATES'S ADDRESS TO THE ENTOMOLOGICAL SOCIETY

IN printing the following extracts from the address delivered to the Entomological Society on the 24th ult. by the President, Mr. H. W. Bates, we must express our regret that we cannot find space for the insertion of the whole of that able and interesting discourse.

Referring to the "Transactions" of the Society, Mr. Bates remarked:—The volume for the past year comprises twenty-seven memoirs, of which twenty-five belong to the department of systematic or descriptive Entomology, and two only—welcome contributions from Mr. Jenner Weir and Mr. Butler, on the selection of insects as food by insectivorous animals—to other branches of the science. To those who might object that too large a share of our work is occupied by mere descriptions, I would remark that many original and valuable observations on relationships, geographical distribution, and other deeply interesting philosophical questions, are contained in some of our descriptive papers. In fact, it is not at all a necessary consequence that a descriptive treatise should be nothing more than a string of dry definitions. It will become, I hope, more and more the practice of entomologists to give, together with their descriptions, the new data on relationships, distribution, comparison of faunas, &c., which the handling of such subjects most usually brings forth.

In speaking of the contributions of importance which have been made to the science in this country outside the Entomological Society, the President alluded to the examination by Mr. Wollaston of the largest collection of insects which has yet been made in St. Helena. This suggested the following observations: As you are aware, the great interest which attaches to the fauna and flora of oceanic islands arises from the problems involved in the modes in which they obtained their species of animals and plants, and those are rendered more complicated by the existence on some island of anomalous forms, representative, it is considered, of types ages ago extinct on continents. Such islands, however, differ greatly from each other as to degree of peculiarity in their productions; and it often happens that species identical, or nearly so, with those found in the nearest continent, form nearly the whole of their present inhabitants. Thus the investigation of the origin of their faunas and floras is necessarily exceedingly complex. Geology has to be invoked to ascertain whether the islands are of recent or ancient elevation above the sea-surface, and whether the supposition is admissible of a recent connection with the nearest continental land. Oceanic hydrography, deep-sea soundings, and the force and direction of currents and winds, have to be studied in reference to the depth of the surrounding seas; for these must all be taken into consideration in discussions on the probable derivation of the curious mixture of forms which is often found on these isolated spots. On the other hand, it must be noted that the fauna and flora themselves throw light on the geographical and geological relations of the islands to the nearest land. In fact, the classification of islands into oceanic and continental, is founded quite as much on resemblance or difference in organic productions, between islands and the mainland, as on relative proximity. Thus Great Britain is classed as a continental island, quite as much because its fauna and flora are nearly identical with those of continental Europe as because it is separated only by a shallow sea, and is now known to have been actually connected in recent geological times. In these investigations entomology is now generally admitted to have great importance, owing to the large number and variety of species which it offers, as elements in the elaborate comparisons which have to be instituted.

The following remarks well illustrate the high scientific importance of studying the geographical distribution of insect life:—The idea of the value of localities in connection with specimens or species, with some entomologists, I am afraid does not reach very far. They like to know in what countries the different forms are found, and perhaps, as in French collections, show the distribution by writing the specific names in their cabinets on labels coloured according to the part of the world the species inhabit; the primary divisions of the world, as Europe, North and South America, Africa, Australia, perhaps the West Indies, and so forth, being considered sufficient. This brings out the leading facts of distribution very well, such as the restriction of many genera and groups of genera to each of the great divisions, and the distinctive facies which all the products from one region possess; but we seldom see it carried further, and it remains a pretty association of geography with natural history, and no more. Results infinitely more suggestive are brought about if the student labels each *specimen* with its locality, instead of recording it on the ticket which bears the specific name placed below all the specimens, and if he is fortunate enough to be able to amass a large suite of specimens, accurately so ticketed, of genera abounding in local varieties and closely-allied species, indications of the conditions under which varieties, local races, and perhaps species, are formed in nature, are revealed by this method, and a field of investigation is opened which connects the study of a few insect species with some of the most difficult problems that are now engaging the attention of philosophers. The most common event that happens, when a student works at a series of species in this way, is the discovery that even the most constant species vary in some parts of their area of distribution; the next, that a small well-marked difference in a species is generally a local difference, and embraces all the individuals of the district in which it occurs. As the collection increases, further curious facts come out. It is found, for instance, that some highly-variable species give rise to one set of varieties in one area, another distinctly different set in another area, and so on; and further, that in some areas one, or perhaps more, of these variations will be better marked than, and preponderate in number over, the other varieties of the same species. Still further, it is found that in some districts one such variety alone occurs, having apparently prevailed over all the others. To be properly impressed, however, with the great truth and reality of these facts, the student should himself have travelled as an entomological collector over an extent of country embraced by many local varieties of variable species; otherwise his attention will not be sufficiently excited to the curious facts nature presents to him, and he will not take the trouble to amass and obtain the exact localities of numerous specimens of common variable species. Perhaps the most important result of this attention to distribution of varieties is, that a fine gradation of forms or degrees of variation will be found, from the "sport" or variety, such as is liable to be produced in the same brood, to the well-segregated race living in company with another race referable to the same stock. As such, most authors, perhaps rightly, consider these latter as good and true species; and thus the formation of species out of mere variations is illustrated by the facts of geographical distribution.

But it is not this branch of the subject with which we are so much concerned, when we wish to compare the productions of the different Andean valleys and their vertical ranges, as that relating to the nature of barriers to distribution. It has been received as a principle in zoological and botanical geography, that grand physical barriers, such as mountain ranges, form an impassable limit to the faunas and floras of the plains on each side of them. It is repeated, in almost every manual of physical geography, after Humboldt, who, I believe, was the originator of the statement, that the species are all different on the two sides of the Andes of South America. Such a fact, if well established, would be interesting in many ways. First, it would throw light on the geology of the country, as proving that the Andes must have existed as a ridge, sufficiently lofty to prevent the creatures of the plains crossing it, before the origin of the species which now people the plains on each side. Now, it is possible that this broad and important generalisation may have been made on a too slender foundation of facts. Of course, in those parts of the Pacific coast-region (two-thirds of the whole line within the tropics), where the conditions of soil, climate, and vegetation are totally different on the two sides of the Andes, no community of species is possible. A lofty mountain barrier would be here unnecessary, for a few steps of level road, in many parts of the world, would suffice to bring the traveller from the domain of one fauna to that of another—for instance, from an arid plain to a luxuriant forest along some river-valley. This would be a difference of "station," and not of area of distribution,—a distinction long ago recognised in Botany. The question is, then, limited to this: In those parts of the Pacific coast-region, such as Guayaquil, where a humid forest-country exists on both sides of the Cordillera, are the species of the two sides entirely distinct? This would test the efficacy of mountain-barriers better than almost any other case. For the species, at least of insects, which inhabit humid forests near the equator, are probably unable to exist at a higher altitude than 4,000 or 5,000 feet, and no pass over the Cordillera exists of half this depression, throughout the whole line of the Andes from Bolivia to the Isthmus of Darien. The species could not voluntarily pass over, nor by gradual migration along the coast could they well double the end of the chain near the mouths of the Atrato and Magdalena, and so pass to the eastern side; for the Sierra Nevada bars the way.

Insects, I believe, would offer better data in discussing this question of barriers than almost any other group of land animals, or than plants; they are more limited in range than the species of birds, afford a much larger body of facts than reptiles, mammals and shells, and are not so much subject to accidental means of transportation as plants. But although many Entomological collectors have visited Guayaquil and the Cordillera, we have no published lists and no authentic information about localities. Mr. Buckley's journey offers us, then, the chance of obtaining the details so much required, since he collected assiduously all the way up from the level of the sea to the edge of the snow, and the same conversely on the opposite side, writing the locality on the envelope of every specimen.

I am inclined to think that the efficacy of physical or geographical barriers in limiting the distribution of animals and plants has been much over-estimated, and that this circumstance has vitiated much of the reasoning that has been employed in discussing various difficult problems in Natural History. By physical barriers, of course, are meant barriers of the inorganic world, such as a continuous mountain-range with regard to species of the plains and, conversely, a continuous plain with regard to species of the mountains (*e. g.* Parnassius, Erebia, Oreina, Nebria, &c.) The sea is thus a barrier to land-species, a water-shed to freshwater species, a continuous tract of forest to species of the savannah or steppe, and so on. Barriers of the organic world, which of course are "physical" also, are quite a different set of agencies. They are the hindrances offered to the dissemination of a species by other species already in full possession of the domain and well adjusted to its conditions by constitution and habits. To this may be added the limitations to distribution observable without any physical obstacle being perceptible. There are certain classes of facts which seem to me to indicate that these less obvious kinds of barrier are far more effective than those more imposing ones of mountain, desert, sea, and so forth.

One set of these facts is exemplified by the well-known case of distribution of insects between the east and west in the southern part of our own island. I am not aware that comparative lists have yet been published; but it will not be disputed that many hundreds of species of Coleoptera, for instance, are known in the east, many of them abundant, which are totally unknown in the west, and a smaller number are known in the west which are not found in the east. In In cases like these a difference of climate may be the cause of the limitation. But there is another set of facts requiring quite a different explanation: this is the limited ranges of closely-allied species in the plains of Tropical America. I have already elsewhere recorded the fact that, in the forest plains of the Amazons, where there are no differences of level worth mentioning, and no physical barriers, the species of a large number of genera are changed from one locality to another, not more than 200 or 300 miles apart. This is most distinctly marked on the Upper Amazons, where the country may be mapped out into areas of a few hundred square miles each, every one containing numerous species of such genera as Ithomia, Melinæa, Eubagis, Doryphora, Erotylus, &c., &c., allied to but quite distinct from their representatives in the others. From what I have seen of Mr. Buckley's collections on the eastern side of the Andes, I think the same limitation of areas must occur there also; and judging from the few species I know as coming undoubtedly from the Guayaquil side of the Cordillera, the butterfly faunas of these areas in the uniform country of the east are pretty nearly as distinct from each other as the species east of the Andes are distinct from those west of the mountains. We here again feel the want of facts, such as Mr. Buckley collected, but which have not yet been published, to teach us exactly what species are found east and what west of the mountains, and how the great multitude of closely-allied species are distributed in the narrow tract explored on the east. My own observations in the level plain, a few hundred miles further east, show distinctly, however, that the most effective possible barriers are there opposed to the spread of hosts of species without any physical barrier which is perceptible by our senses. The explanation of the fact, I believe, is this, that there really are subtle differences of physical conditions from place to place, even in a uniform region; slight differences in soil, humidity, succulence of foliage, and so forth, which require in each a re-adjustment of the constitution of any new immigrants from adjoining areas; but that each area being kept well stocked with allied species already adjusted to its minute conditions, such migration rarely occurs. Thus a limit is put to the spread of species by species themselves, which produces similar results on the actual distribution of forms throughout the world, to those produced by mighty physical barriers such as the Andes.

There is yet one other consideration remaining. If these barriers are not required to explain the limitation of faunas, it does not follow that they do not act as barriers all the same; but it is, I think, difficult to prove it. If 1,200 miles of sea do not form a sufficient barrier against the stocking of the Azores with insects from Western Europe, I do not think sixty miles of mountain should be assumed to prevent for tens of thousands of years, the transport of species, in the egg state, by birds or currents of air, from one side to the other. I may add, in conclusion, that if the efficacy of barriers of this nature has been overrated, some important conclusions regarding changes on the earth's surface will have to be reconsidered; such, for instance, as that of the extension of a glacial epoch over nearly the whole earth—a hypothesis conceived by Darwin to explain the existence of the same genera and sometimes the some species in high latitudes, both in the northern and southern hemisphere, whilst absent from the intervening zones. I believe that, with some very obvious exceptions, such as Mammals and Batrachians, there can be no limit placed as to the dissemination of a species, provided there are unoccupied areas suitable to it, in any part of the earth, and provided also time sufficient be allowed for the process.

THE GRESHAM LECTURES

TWO lectures were delivered in Gresham College on the evenings of the 14th and 15th January, by Dr. Symes Thompson, the Gresham Professor of Medicine.

The first of these lectures embraced a theme admirably adapted to fulfil the popular object with which this City professorship has been established, and as eminently suited to the present season: it treated of "Catching Cold."

The Professor first described, by reference to large drawings, the structure and arrangement of the parts concerned in the disorder—laying open the arcana of the nose, frontal sinuses, throat, voice-box, and chest, and showing the intimate relations by which these parts are connected, and the way in which modern science has found means to bring their inmost recesses under observation, and contrasting the precise knowledge of the present period with the ante-Schneider days, when all catarrhal defluxions were held to be outpourings of the brain. It was demonstrated that the ordinary cold is simply, in the first instance, congestion of the warm, moist, blood-charged membrane, which lines all these cavities and is continuous throughout the series of them; but that this congestion is apt to pass on, under unfavourable circumstances, to inflammation, and to consequent derangement of structure. The congestion merely means that more blood is thrust upon, and retained in, the minute channels and vessels of the membrane, than those channels and vessels can healthily accommodate The first cause of this forced engorgement is that cold is extensively applied to the internal skin, which then, under the constringing and contracting influence, drives its own blood out, partly into these surcharged tracts of mucous membrane. The injurious effect known as "cold" is now sure to be realised if this external chill is experienced when the general system is weakened by exhaustion. It is also, in some persons, more apt to be produced at certain regular periods.

The prevention of colds is to be accomplished by keeping the skin in a healthy and vigorous state, so that it may at once resume its proper and normal condition when chills have been suddenly applied to it: then the internal congestions are avoided or removed simultaneously with the external contraction and stagnation. The habitual use of cold bathing in the early morning is one very powerful means to this end: it trains the vessels of the skin to rise vigorously into renewed action after the application of a chill. The relaxing influence of over-heated apartments should be avoided, because that saps the power of vigorous reaction; but, in cold weather, the utmost care should be taken to have the entire skin efficiently protected by warm clothing. The powers of the system in periods prone to the production of colds, and most especially when the temperature of the external air is between 32 and 40 degrees of Fahrenheit's heat scale (for that is the condition in which the danger is found to be most certainly incurred), should be most carefully maintained by the judicious use of sustaining food, and by the avoidance of every kind of injurious derangement or excess. When once internal congestion has been set up, and the cold has been "caught," the thing to be done is immediately to bring back vigorous circulation and exhalation in the skin. The Turkish bath is one of the most convenient and certain of all contrivances for ensuring this object: in its absence the vapour bath, or hot air bath may be employed. The action of the bath is to be reinforced by the administration of stimulants, first and foremost amongst which stands concentrated food. Indeed, the Professor's pet stimulant seems to be "Whitehead's Solid Essence of Beef," a New South Wales preparation, in which the nutritious principle of an ox is condensed into about nine pounds of easily transportable material, in which thirty pounds of beef are concentrated into one pound of little cakes, each about the size of an ordinary silver five-shilling piece, and weighing half an ounce. One cake is calculated to prepare two large breakfast cups of good beef-tea. This preparation differs from Liebig's Extract of Meat chiefly in containing the gelatinous as well as the fibrinous constituents of the flesh. The Gresham Professor scattered the little round cakes, out of neat half-pound cases, liberally to his audience, recommending them to begin at once to fortify themselves against the inclement atmospheric influences. He gave one very interesting instance of the value and power of this preparation by alluding to a case that had fallen within his experience on the very day of the lecture. A patient had been brought into the Brompton Hospital in a sinking state, resulting from inability to take food. He was at the time all but pulseless and cold, and evidently on the brink of the grave. He was placed in bed, and a cupfull of the beef-tea prepared from the "solid Essence" administered. The preparation was retained in the stomach, and in ten minutes from the time of its administration, there was steady warmth all over the skin, and restored circulation.

There is one expedient both for preventing and curing "colds." which was not alluded to upon this occasion, but which is nevertheless as powerful as any of the measures which were described, and it may sometimes be drawn upon in circumstances when those plans cannot be adopted, in consequence of the sufferer being compelled by the exigencies of life to continue to meet exposure to chilling influences. This is abstinence from drink, and liquid food of any kind, until the internal congestion is removed. The remedial action through the skin does its work by drawing away the superabundance of the circulating fluid from the overcharged part. But this desirable result is even more certainly ensured if the general bulk of the circulating fluid, or blood, is diminished by withholding supplies of the more liquid, or watery, ingredient; which may be done where the digestive power is unimpaired, without in any way diminishing the richer, or more immediately nourishing portion. The instant the general bulk of the circulating blood is diminished, the excess contained in the congested and overcharged membranes is withdrawn and the cold is relieved. Somewhat severe thirst sets in; but curiously enough, simultaneously with the occurrence of this thirst, the congested internal membranes grow moist, and exhale gently and naturally in consequence of the relief of the overcharged vessels. All that is then necessary is to keep the supply of drink down to the point which enables some measure of thirst to be maintained; and during its maintenance there is not the slightest chance of the recurrence of the cold. Dr. Thompson dwelt emphatically in his lecture, upon the fact that, whereas certain ailments, such as the eruptive fevers, bring with them an almost complete immunity from the recurrence of the affection, it is just otherwise with ordinary colds. The more frequently they occur, the more frequently they may be looked for. They bring with them increased susceptibility of the internal membranes to congestive derangements. Under such circumstances diminution of drink, sustained at the point of persistent moderate thirst, is the most powerful and certain preventive of congestive disorder, and the most sure remover of undue internal susceptibility, that can be adopted.

The second lecture was mainly devoted to a description of stimulants, and an experimental explanation of the way in which the amount of the saccharine, acid, and spirituous ingredients of wines may be ascertained. There is one very noteworthy peculiarity in all these lectures, which renders them peculiarly fit for the class of audience at which the Gresham College is aimed: Dr. Symes Thompson is a master of the art of giving a clear notion of the whereabouts of a fact, or principle, to popular apprehension. It is to be extremely regretted that in a vast metropolis like ours, and, indeed, in all our large towns, such courses as these Gresham Lectures are not more common. It is absolutely impossible to over-estimate the good they can do, not only, as in this case, in showing what "to eat, drink, and avoid," but generally in inducing thought and work. Further lectures of the Gresham course are announced for the months of April, June, and September.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Where are the Nebulæ?

MR. PROCTOR's interesting paper in your last number reminded me of an essay on "The Nebular Hypothesis," originally published in 1858, and re-published, along with others, in a volume in 1863 ("Essays: Scientific, Political, and Speculative." Second Series), in which I had occasion to discuss the question he raises. In that essay I ventured to call in question the inference drawn from the revelations of Lord Rosse's telescope, that nebulæ are remote sidereal systems—an inference at that time generally accepted in the scientific world. On referring back to this essay, I find that, besides sundry of the reasons enumerated by Mr. Proctor for rejecting this inference, I have pointed out one which he has omitted.

Here are some of the passages:—

"'The spaces which precede or which follow simple nebulæ,' says Arago, 'and, *à fortiori*, groups of nebulæ, contain generally few stars. Herschel found this rule to be invariable. Thus, every time that, during a short interval, no star approached, in virtue of the diurnal motion, to place itself in the field of his motionless telescope, he was accustomed to say to the secretary who assisted him, "Prepare to write; nebulæ are about to arrive."' How does this fact consist with the hypothesis that nebulæ are remote galaxies? If there were but one nebula, it would be a curious coincidence were this one nebula so placed in the distant regions of space as to agree in direction with a starless spot in our own sidereal system? If there were but two nebulæ, and both were so placed, the coincidence would be excessively strange. What, then, shall we say on finding that they are habitually so placed? (the last five words replace some that are possibly a little too strong). . . . . When to the fact that the general mass of nebulæ are antithetical in position to the general mass of stars, we add the fact that local regions of nebulæ are regions where stars are scarce, and the further fact that single nebulæ are habitually found in comparatively starless spots, does not the proof of a physical connection become overwhelming?"

The reasonings of Humboldt and others proceeded upon the tacit assumption that differences of apparent magnitude among the stars result mainly from differences of distance. The necessary corollaries from this assumption I compared with the hypothesis that the nebulæ are remote sidereal systems in the following passage:—

"In round numbers, the distance of Sirius from the earth is a million times the distance of the earth from the sun; and according to the hypothesis, the distance of a nebula is something like a million times the distance of Sirius. Now, our own 'starry island, or nebula,' as Humboldt calls it, 'forms a lens-shaped, flattened, and everywhere-detached stratum, whose major axis is estimated at seven or eight hundred, and its minor axis at a hundred and fifty times the distance of Sirius fom the earth.' And since it is concluded that our solar system is near the centre of this aggregation, it follows that our distance from the remotest parts of it is about four hundred distances of Sirius. But the stars forming these remotest parts are not individually visible, even through telescopes of the highest power. How, then, can such telescopes make individually visible the stars of a nebula which is a million times the distance of Sirius? The implication is, that a star rendered invisible by distance becomes visible if taken two thousand five hundred times further off!"

This startling incongruity being deducible if the argument proceeds on the assumption that differences of apparent magnitude among the stars result mainly from differences of distance, I have gone on to consider what must be inferred if this assumption is not true; observing that "awkwardly enough, its truth and its untruth are alike fatal to the conclusions of those who argue after the manner of Humboldt. Note the alternatives":—

"On the one hand, what follows from the untruth of the assumption? If apparent largeness of stars is not due to comparative nearness, and their successively smaller sizes to their greater and greater degrees of remoteness, what becomes of the inferences respecting the dimensions of our sidereal system and the distances of the nebulæ? If, as has lately been shown, the almost invisible star, 61 Cygni, has a greater parallax than α Cygni, though, according to an estimate based on Sir W. Herschel's assumption, it should be about twelve times more distant—if, as it turns out, there exist telescopic stars which are nearer to us than Sirius, of what worth is the conclusion that the nebulæ are very remote, because their component luminous masses are made visible only by high telescopic powers? . . . . On the other hand, what follows if the truth of the assumption be granted? The arguments used to justify this assumption in the case of the stars, equally justify it in the case of the nebulæ. It cannot be contended that, on the average, the *apparent* sizes of the stars indicate their distances, without its being admitted that, on the average, the *apparent* sizes of the nebulæ indicate their distances—that, generally speaking, the larger are the nearer, and the smaller are the more distant. Mark, now, the necessary inference respecting their resolvability. The largest or nearest nebulæ will be most easily resolved into stars; the successively smaller will be successively more difficult of resolution; and the irresolvable ones will be the smaller ones. This, however, is exactly the reverse of the fact. The largest nebulæ are either wholly irresolvable, or but partially resolvable under the highest telescopic powers; while a great proportion of quite small nebulæ are easily resolvable by far less powerful telescopes."

At the time when these passages were written, spectrum-analysis had not yielded the conclusive proof which we now possess, that many nebulæ consist of matter in a diffused form. But quite apart from the evidence yielded by spectrum-analysis, it seems to me that the incongruities and contradictions which may be evolved from the hypothesis that nebulæ are remote sidereal systems, amply suffice to show that hypothesis to be untenable.

37, Queen's Gardens, Jan. 31 HERBERT SPENCER

Kant's View of Space

IN answer to my invitation, Mr. Lewes now "freely admits that Kant nowhere speaks of Space and Time as 'Forms of Thought,'" but still contends that 'Kant would not have disclaimed such language, as misrepresenting his meaning.' As well might he argue that although Euclid never uses the word *epipedon* (our English word *plane* or *plain*), to signify a curved surface (επιφανεια), he would not have remonstrated against the use of the term *cylindrical epipedon* or conical *epipedon*, to denote the surface of a cylinder or cone, in a professed exposition or criticism of his Elements of Geometry, because in common life we speak of rough or undulating plains, or because a plane admits of being bent into the shape of a cylindrical or conical surface. I think the ladies who are getting up their Planes and Solids at St. George's Hall would be of a different opinion from Mr. Lewes in this matter, and with good reason on their side.

Mr. Lewes, reiterating a statement contained in his previous letter, goes out of his way to affirm that he "uniformly speaks of Space and Time as forms of Intuition in his pages of exposition" of Kant's doctrine in his "History of Philosophy." Were the fact so, it would not in any material degree excuse the inaccuracy of subsequently styling them "forms of Thought;" and, moreover, the real point at issue is not Mr. Lewes's general accuracy or inaccuracy, but whether a mode of speech which he, along with others, employs, is right in itself and ought to be persisted in.

However, as Mr. Lewes has thought fit to put in a sort of plea in mitigation of former wrong-doing, I have taken the trouble of looking through his *exposition* and *criticism* of Kant in his History (ed. 1867), and in no single instance have I come upon the phrase *forms of intuition* applied to Space and Time, either in the one or the other; although he states he has *uniformly spoken of them* as such in the former. I have marked the word *intuitions* as occurring once, and *forms of sensibility* several times, but *forms of intuition* never. If *form of sensibility* is as good to use as *form of intuition*, *form of understanding* ought to be as good as *form of thought;* but Mr. Lewes owns that the former is indefensible, whilst he avers that the latter is correct. If Mr. Lewes has ever called Space and Time *forms of intuition* in the History, it will be easy for him to set me right by quoting the passage where the phrase occurs, although that circumstance would not in any degree better his own position, and still less excuse the assertion of his *uniform* use of the term.

If Mr. Lewes cannot quote correctly from his own writings, it will surprise nobody that he misquotes the language of an opponent. He repeats, "Intuition without thought is mere sensuous impression," and adds, "Mr. Sylvester demurs to this." "My words are" (NATURE, Jan. 13, 1870): "To such a misuse of the word energy it would be little to the point to urge that *force without energy is mere potential tendency.* It is just as little to the point in the matter at issue for Mr. Lewes to inform the readers of NATURE that *intuition without thought is mere sensuous impression.*" So that, according to Mr. Lewes, to say that a proposition is *little to the point* is *demurring to its truth.*

I should not hesitate to say if some amiable youth wished to entertain his partner in a quadrille with agreeable conversation, that it would be *little to the point*, according to the German proverb, to regale her with such information as how

> "Long are the days of summer-tide,
> And tall the towers of Strasburg's fane,"

but should be surprised to have it imputed to me on that account that I demurred to the proposition of the length of the days in summer, or the height of Strasburg's towers.

In another passage, Mr. Lewes gives me credit for "saying correctly that Intuition and Thought are not convertible terms"—a platitude I never dreamed of giving utterance to; but that I am "incorrect in assuming that they differ as potential and actual"—words which, or the like of which, in any sort or sense, never flowed from my pen. Surely this is not fair controversy, to misquote the words and allegations of an opponent. It seems to me too much like fighting with poisoned weapons. I decline to continue the contest on such terms; and, passing over Mr. Lewes's very odd statement about *species and genus* with reference to Intuition and Thought, shall conclude with expressing my surprise at his and Mr. G. C. Robertson's confident assumption that Kant uses in the title of his book *pure reason* in a far wider sense than in the body of his work, simply because to arrive at the Pure Reason he has to *go through* the Critick of the Sensibility and of the Understanding. If in a history of the Reign of Queen Victoria the author should find it expedient to go back to the times of the Norman and Saxon conquests, would it be right to infer therefrom that he used in his title-page the name Victoria in a generalised sense, to include not only her most Gracious Majesty, but also the Tanner's daughter and Princess Rowena?

Perhaps by this time many of the Naturalistic readers of the journal who regard the human intelligence as forming no part of the scheme of Nature, wish Space at the bottom of the sea; but the more the subject is canvassed, and the greater the number of English authorities brought forward to back up Mr. Lewes in wresting the words of Kant from their proper scientific signification, the higher meed of praise seems to me to accrue to Dr. Ingleby for stemming the tide of depravation, and banishing, as I feel confident this discussion will have the effect of doing, from the realm of English would-be philosophy, such a loose and incautious way of talking as that of giving to Space and Time the designation which the Master has appropriated to the categories of his system, and to them alone. J. J. SYLVESTER

P.S.—I should be doing injustice to the very sincere sentiments of respect I entertain for Mr. Lewes's varied and brilliant attainments (which constitute him a kind of link between the material and spiritual sides of Nature), and of gratitude for the pleasure the perusal of his "History of Philosophy" has afforded me, were I to part company with him without disclaiming all acrimony of feeling, if perchance any too strident tones should have seemed to mingle with my enforced reply. In naming him in the original offending footnote (the fountain of these tears), my purpose was simply to emphasise the necessity of protesting against what seemed to me an unsound form of words, *àpropos* of Kant, which went on receiving countenance from such and so eminent writers as himself and the others named; and I should be false to my own instincts did I not at heart admire the courageous spirit with which, almost unaided and alone (like a good knight of old), he has done his best to defend his position and maintain his ground against all oppugners.

J. J. S.

It is hardly possible to exaggerate the importance of the question now under discussion in NATURE, "What was Kant's view of Space?" A mistake there is simply fatal. I therefore rejoice to find the columns of that paper are so generously thrown open to those who, like myself, are not primarily concerned with physical science. But this question, like all others in philosophy, has a proclivity to indefinite expansion, and unless its discussion be rigidly restricted to the main issue involved in it, the conductors of NATURE will have to ostracise it. Their space is not an infinite form, but a quantum to be carefully economised. It is, for example, an unwarrantable waste of that commodity to make Hegel the exponent of Kant on a point where Hegel taught that Kant was wrong.

It is fortunate for our interests, as students of Kant, that Mr. Lewes, while committing the strange oversight of criticising Kant's Intuition from Hegel's standpoint, in his last letter (NATURE, Jan. 27) enables us to *démêler* the main issue from the mass of questions which entangle it. He evidently, if tacitly, slights the plank I threw to him, viz., that Thought, in its ultimate relation to Intuition, borrows, or has reflected on it, the forms peculiar to Sense. What are Kant's *Begriff vom. Raume, Begriff der Zeit*, but this? (With these expressions, compare the following:—Also ist die ursprüngliche Vorstellung vom Raume Anschauung *à priori* und nicht Begriff. Transac. Æsth. s. 3, 4.) This reflection of form is not what Mr. Lewes is after. He maintains that, according to Kant, "the activity of mind is threefold—Intuitive Thought, Conceptive or Discursive Thought, and Regulative Thought." (Is not Regulative Thought discursive?) So, then, the main issue between Mr. Lewes and (I think) Professor Croom Robertson on the one hand, and Professors Sylvester and Huxley, Mr. W. H. S. Monck, and myself on the other, is plainly this. *Did Kant mean to teach that man has Intuitive Thought, i.e., Intellectual Intuition?* Now *that* I must be understood emphatically to deny; and in the event of the shortcomings of better men than myself, I hold myself prepared to establish the negative of that question, understanding by Thought the *genus* of which Understanding and Reason are *species.*

Ilford, Jan. 31 C. M. INGLEBY

Dust and Disease

THE extremely important discoveries brought to light by Professor Tyndall will call forth great exertions on the part of thinking persons to carry his plans into operation, and I have no doubt, when due precautions are taken to sift infected air as it passes into the lungs of those whose duties take them where contagion abounds, we shall have the happiest results.

So great will be the tide of interest in this direction, that I am anxious to cast into it a theory I have long held, in hopes that it may drift in some one's way to be turned to use; I commend it to the travelling portion of your readers especially.

Whilst travelling in some very unhealthy parts of Africa, more particularly amongst the marshes bordering on the Shiré and Zambesi rivers, it was often necessary to camp at night just where the canoe happened to be moored when daylight failed us. Reeds, rushes, and mud were never many feet off, and the accumulation of scum, decaying vegetation, &c., lodged in the sedge, made the situation as delightful to mosquitoes as it was trying to the constitution of the European.

Still, with all this, as long as it was possible to rig up a mosquito curtain, I am convinced that really less danger existed in thus sleeping in the midst of miasma than in other places where less of it was supposed to be present, but where the traveller felt no necessity to stretch this thin covering over him.

I have in this way done canoe journeys of twenty to twenty-five days in length without a day's illness from fever, and I could instance similar experiences on the part of others.

Now the reason I assign is this: the mosquito curtain is to miasma, what the Professor's cotton-wool respirator is to the poison of scarlatina, we will say.

The curtain, after being used once or twice, saturated with dew, folded up whilst damp and crammed into the limited space generally provided for it in the safest place, becomes just so much affected by this treatment that each thread loses its smooth glaze, and is soon fluffy and fuzzy for want of a better expression.

The little honeycomb holes in the fine "net" are now a series of small six-sided sieves, each covered over with the fine filaments of cotton which have got disturbed and frayed up. Dew, falling upon a surface of this kind, quickly turns it into an exquisitely fine strainer—in fact almost a film of water—through which all the air has to pass which is breathed by the person reposing beneath it.

Now, it is an old notion that the miasma which produces the bilious remittent fever (the pest of this part of Africa in question) and various other diseases of the tropics, cannot pass across water.

I believe that acting upon this theory, the Admiralty provides that boats' crews shall sleep in their boats anchored off shore in malarious rivers. However, be this as it may, I have a strong belief that the "wet sieve" *does* stop the poison in some way or other, and that it is a great safeguard to the voyager in these places.

The whole subject of miasm is in the dark; it is lawless as a cause of disease; it baffles the most astute, but the day may be coming when such hints as these of Prof. Tyndall's shall fit into an organised attack upon it, and we shall be able to overcome it in a measure.

A curtain, properly made, and taken care of with that instinct which alone is begotten by the buzz of mosquitoes, is perhaps the most valuable possession a man can have a gainst deadly attacks in the night whilst men are asleep: were its merits studied more, we should not find men stuffing their companions so perpetually with quinine, to the keeping up an unhealthy tone by this abuse alone, and to the confusion of this most invaluable medicine when it is really called in to do its duty upon the fever-stricken patient.

Chatham, Jan. 24 HORACE WALLER, F.R.G.S.

Scenery of England and Wales

THE willingness you have hitherto shown to give authors an opportunity of defending themselves against being misunderstood, induces me to hope that you will allow me to disclaim being the author of certain statements, and to deny the truth of other statements, on which an anonymous reviewer in your last number mainly founds the charge of boldness he brings against me for writing the work entitled "Scenery of England and Wales," &c.

In one part of the review *I am made to say* that I "purposely refrained from reading;" in another it is assumed that my reading has "consisted mainly of the recent journals and magazines;" and further on it is asserted that I wrote the book "without reading."

The facts are, that for many years I devoted more or less time to reading on the subject of Denudation, and that, as stated in the Preface, until lately I purposely refrained from "reading *very much* (a distinct thing from not reading) lest a bias should be given to my opinions."

My reason for not quoting the remarks of the late Principal Forbes on the glaciers of Norway, was not, as implied by your reviewer, because I underrated the *denuding power of glaciers*, but because Forbes said very little on the subject.

Mrs. Somerville's estimate of the velocity of the Rhone may be incorrect, and perhaps, likewise, her statement that the declivity of the river is 1 foot in 2,620; but this is no reason why your reviewer should leave the reader to suppose that I misquoted Mrs. Somerville. In other parts of the work I have referred to the velocities of many currents besides the one off the southern promontory of Shetland.

The argument against denudation by currents, derived from the non-displacement of *barnacles*, would, I think, never be brought forward by any one acquainted with the fact that sea-waves often remove stones and large blocks while barnacles in the immediate neighbourhood are left undisturbed—that waves and currents, by their insinuating, undermining, overturning, and removing action, can carry on the work of denudation within a few inches of an unabraded rock-surface—and that a certain amount of resistance to be overcome is necessary to enable all denuding agents to produce effects which can be immediately perceived. On the western shore of Morecambe Bay, sea-waves and currents detach and remove fragments of limestone rock by a lateral process, while the brink of the unremoved mass of rock retains its glacial polish; and many other instances illustrative of this subject might be stated.

The fact that for more than twenty years I have *confined* my observations to England and Wales, and devoted nearly my whole time to visiting, revisiting, and studying every part of the country, is no reason why I should not have ventured to write a work on the Scenery of England and Wales in connection with Denudation. The country stands almost alone as regards the variety and importance of its geological phenomena, including surface-features and types of scenery. My work is not confined, as your reviewer asserts, to a defence of marine denudation, for more than a third of it is devoted to the consideration of the real or assumed effects of atmospheric agents; and instead of being put forward in a self-confident spirit, as your reviewer would likewise lead the reader to suppose, I have stated in the Preface that "my object will be gained if I have said enough to stimulate the geologist and intelligent tourist to further observation." D. MACKINTOSH

"Correlation of Colour and Music."

ANALOGIES between tone and tint are a tempting subject; and sound and light have enough admittedly in common to make it rash to say that the connection may not extend to their effects on the ear and eye; but that your correspondents (Jan. 13th and 20th) are seeking for unity in a direction in which it is not to be found, seems to me to be rendered pretty certain by the very evidence to which one of them, Dr. de Chaumont, appeals (Jan. 20th); I mean by that of "the researches of Helmholtz and others."

I have often wondered at the small attention paid to the general law which these researches have established. Even M. Jamin, in his *Cours de Physique*, dismisses Newton's theory of compound colours as "empirical," and apparently of no significance. It is as much and as little empirical as the Newtonian astronomy; both consist of general laws applied by means of particular constants: the evidence for the laws is in both cases equally inductive, and the determination of the constants equally empirical.

Stated without reference to the geometrical and dynamical analogies which I suspect have had something to do with obscuring its significance and tainting it with "empiricism," the fundamental law of composition of colour is this:—

Of any four colours whatever, either there is one which may be matched by a compound of the other three, or there are two which may be compounded so as to match a compound of the other two.

It is obvious that if negative values of an ingredient can be admitted, these alternative cases are the same; and the geometrical and dynamical analogies depend on the fact that, if *addition of vectors* is substituted for *composition of colours*, the proposition remains true, becoming in fact a very elementary one. And it follows that all colours may be co-ordinated, by means of three independent variables, with reference to any three colours whatever.

Accordingly, when differently coloured lights reach the eye together, the combination produces a single resultant colour varying according to the proportions of the ingredients, and completely superseding them; whereas, when two sounds of different pitch are sounded together, we still hear both: and, though we hear certain other tones besides, these other tones have each a pitch determined by the pitches, but independent of the intensities, of the original sounds.

The truth is, that the ear and eye deal with impressions in totally different manners. The ear deals with a complex musical sound exactly as a system of resonators does; it sensibly decomposes the sound into certain simple tones, just as the complex harmonic motion which produced the sound is theoretically decomposed by Fourier's theorem into the simple harmonic motions which would produce the simple tones. In order to understand the manner in which the eye deals with a compound colour, we must turn our attention to that particular unidimensional series of colours which constitutes the spectrum. As this is what your correspondents have done, the issue will be all the closer.

By the law above stated, all the colours of the spectrum might be co-ordinated with reference to any three colours chosen in the spectrum or out of it. But it has been ascertained by Mr. Maxwell* (to whose labours we are chiefly indebted in England for what we know of the composition of colours) that there are three colours in the spectrum to which all the rest stand in relations giving these the character of "primary" colours. They are the particular red, green, and blue, whose wave-lengths are, in Fraunhofer's measure, respectively 2328, 1914, 1717: and they divide the spectrum into three parts, in each of which every colour, it appears, may be matched by a compound of the two (out of these three) between which it lies. This is very accurately the case between 2328 and 1914 and between 1914 and 1717: it is much less accurately the case on the red side of 2328 and on the violet side of 1717; but in this region observation is difficult, and various eyes variable; and it seems probable that, as Mr. Maxwell infers, every colour in the spectrum, and therefore every colour in nature, is, as felt by us, a compound of three elementary sensations of colour excited separately by those three rays.

Now it must be observed that this result does tend to justify so much of the anticipations mentioned by Mr. Barrett as Sir John Herschel and Mr. Grove had long ago committed themselves to: it shows that the spectrum, like the musical scale, does in a manner return into itself. Beyond this the analogy fails.

In the first place there are, in music, no fixed tones with reference to which other tones possess any general properties at all; much less the property of being matched by combinations of them. In relations of tone, the constant quantities are not constant tones, but constant intervals between tones. Still, no doubt, if the three primary colours stood (as Dr. de Chaumont seems to think they do) in the arithmetical relations of tonic, fourth, and fifth, the fact would be as remarkable as two numerical coincidences could make it. But the case is not so. The ratio 2328 : 1914 (or 1·211) corresponds not to the interval of a fourth, but to an interval about two-ninths of the way from a minor third (6 : 5 or 1·2) to a major third (5 : 4 or 1·25); and the ratio 2328 : 1717 corresponds not to the interval of a fifth, but to an interval about a third of the way from a natural fourth (4 : 3 or 1·333) to a sharp fourth (45 : 32 or 1·406); intervals which, I presume, one can make nothing of.

Mr. Barrett's principal argument depends upon Prof. Listing's demarcation of the colours answering to the names red, orange, &c.: much too vague a basis, I should have thought, for exact inference, even if Mr. Barrett had not been obliged to sacrifice a boundary to obtain his most important interval; moreover the, correspondences in Table IV. are somewhat exaggerated for orange and yellow by errors of computation. Mr. Barrett does certainly get a good fourth, fifth, and sixth; but these coincidences seem to me to offer a simpler and more effectual key than that which he has applied to the lock. What this key is will be evident on substituting for the numbers in Table I. or II., the reciprocals of the same numbers. Take Table I. and divide ten millions by each of the numbers. The results, with a column of differences, are as follows:—

1382·3	
	162·8
1545·1	
	162·6
1707·7	
	162·5
1870·2	
	162·7
2032·9	
	162·5
2195·4	
	162·5
2357·9	
	162·9
2520·8	

I suppose this speaks for itself. Professor Listing has simply divided his spectrum into seven equal parts upon some scale which varies inversely as the wave-length. Such a scale would of course be furnished by comparative rapidities of vibration; but it is no use guessing. Whatever led him to this particular measure, it is evident what his measure virtually was, and it nearly corresponds with the ratios of the musical scale because these approximately form a "harmonic" progression.

The other suggested analogies are less definite. "The juxtaposition of two colours nearly alike is *bad*," but surely not what would be called *discordant*, except for the sake of finding an analogy between colour and music. The fact probably depends upon the extreme sensitiveness of the eye to the effect called *relief*; a sensitiveness shared in a different degree by the ear, but shared also by all modes of feeling, even the least material, as men count materiality. The best results of juxtaposition are generally those given by complementary colours: but the relation between complementary colours is one which depends partly on relief and partly on the laws of composition above stated, and has nothing corresponding to it in music. But indeed I am surprised that anybody should even look for an analogy between the effect of *simultaneous* sounds and the effect of *contiguous*, not *coincident*, colours.

For these reasons I venture to think it is only by the unphilosophical restriction of the word *physical*, which excludes biological relations, that "harmony in colour and music" can be said to "have a common physical basis."

With regard to the coloured bands within the rainbow, it is not doubtless without solid reasons that Mr. Grove can have decided against identifying the phenomenon he describes with

* Phil. Trans. 1860, pp. 57—84. On the theory of compound colours and the relations of the colours of the spectrum.

the phenomenon usually attributed to the interference of the two rays which, distinct at incidence, coincide on emergence. However this may be, the fact can have nothing to do with the present question. It is impossible, when the most refined spectroscopic observation hardly gives us one octave, that the rainbow should disclose three or four.

Hyères, Jan. 25 C. J. MONRO

Flight of Birds

WITH reference to an abstract of a paper by Mr. Southwell on the flight of birds, which appeared in your paper a few weeks back, I venture to make the following note and inquiry.

A late brother of mine who had been round the Cape, and had frequently observed carefully the flight of the albatross, told me that though he had watched individual birds on several occasions for many minutes together, he had seldom or never seen any of them flap their wings. Has this fact been observed by other persons, and if it be authenticated, has Mr. Southwell any explanation to offer? J. H.

Turdus Whitei

IT may interest some of your ornithological readers to know that a specimen of White's Thrush, *Turdus Whitei*, was killed near here on the 7th inst. It was shot by Mr. J. Beadon, of Gotten House, and presented by him to Mr. Cecil Smith, of Lydeard House, for his collection. This is, I believe, the fourth occurrence of this bird in Britain; it is, I think, even less known on the Continent. W. BIDGOOD

Museum, Taunton, Jan. 15

THE SARS FUND

WE are glad to find that the appeal made in our pages by Mr. Gwyn Jeffreys, on behalf of the family of the late Professor Sars of Christiania, is being warmly seconded in Paris by M. Alglave, the Editor of the *Revue des Cours Scientifiques*. In the last number of the *Revue* Mr. Gwyn Jeffreys' article is reprinted *in extenso*, and an announcement made that subscriptions to the Sars Fund will be received at the office of that journal. But M. Alglave has not waited for the publication of his notice before beginning his good work; he has already collected the sum of 2,026 francs (81*l.*), and publishes with the notice a first subscription-list containing the names of many of the most eminent naturalists in France. We have now the pleasure of giving in our advertising columns a list of the contributions already promised to Mr. Gwyn Jeffreys. Sars belonged to the best type of scientific men, the genuine lover of science, contented to work in obscurity without thought of honours or reward. His family have a special claim to help, inasmuch as the distress in which they are left is not due to neglect or extravagance on the part of the lamented Professor, but is solely attributable to his having devoted himself to studies, which, notwithstanding the most self-denying labours, did not enable him to make any provision for the future. Those of our readers who have visited Norway, who know the genuine unworldly ways of the Norwegians, and who have enjoyed the enthusiastic welcome so readily given to the English, have now a graceful opportunity of reciprocating the kindly feeling shown them by the countrymen of Sars.

NOTES

LORD DE GREY will to-morrow receive the Council of the British Association, as a deputation to urge upon her Majesty's Government the desirableness of a Royal Commission being issued to inquire into the present state of Science in this country.

THE Royal Society and the Royal Astronomical Society have both appointed committees of council, to report upon the steps which it may be desirable to take in connection with the total eclipse of the sun, visible in Algeria, Spain, and Sicily, in December next.

IT is proposed to celebrate the fiftieth anniversary of the Royal Astronomical Society by a dinner on the day of the annual meeting, February 11.

THE lectures annually delivered in the theatre of the Royal College of Surgeons were commenced yesterday by Professor Erasmus Wilson, F.R.S., who will deliver six lectures on Dermatology. To illustrate that of yesterday, there were a large number of exquisitely-prepared models, duplicates of those prepared for the Hôpital St. Louis, Paris. Professor Wilson's course will be followed by Professor Flower, F.R.S., Conservator of the Museum, who will deliver 18 lectures introductory to the study of the anatomy of the class mammalia.

THERE is a terrible rumour to which we are compelled to refer, though it has reached us in a—let us hope—doubtful way. The news is, that Livingstone has been murdered and burnt ninety days' journey from the Congo.

THE Zoölogical Society of London have now in the press a memoir by Dr. O. Fiusch, of Bremen, one of their corresponding members, upon the birds collected by Mr. William Jesse during the recent Abyssinian expedition. This memoir, which was read before the society at one of their meetings last year, will appear in their quarto Transactions, and will be illustrated by coloured figures of the new or little-known species. It will be in the recollection of some of our readers that Mr. Jesse was selected by the Zoölogical Society, at the request of the Treasury, to accompany the Abyssinian expedition as zoölogist, and that the society undertook the task of bringing the results of his investigations before the public. Dr. W. Peters, of Berlin, has undertaken to prepare a memoir upon some of the rarer mammalia obtained by Mr. Jesse during the expedition, which will likewise appear in the Transactions. Mr. W. T. Blanford, who was sent out by the Indian Government as geologist to the expedition, is preparing a separate work upon his discoveries, which will be published by Messrs. Macmillan.

AT its last meeting (January 24), the Academy of Sciences elected a new correspondent for the Physical section in the place of the late Professor Forbes. M. Kirchhoff, who was the successful candidate, obtained forty votes; Mr. Lloyd and Sir William Thomson received one vote each.—A committee of the three sections of Astronomy, Geometry, and Navigation selected the following candidates for the vacancy in the *Bureau des Longitudes*:—1. M. de la Roche Poncié; 2. M. Gaussin.

IT is no secret that the present *régime* at the Observatory of Paris has been rather more autocratic than could be patiently endured, even in a country subjected to eighteen years of personal government. Matters have at length reached a crisis, and the Minister of Public Instruction is placed in the awkward position of having to dismiss from the public service one of the most eminent of modern astronomers, or accept the resignation of the whole of the rest of the staff of the Observatory.

THE chair of Chemistry at the University of Tübingen has been offered to Prof. Fittig.

WE regret to have to announce the death of a naturalist of great promise, Dr. Wilhelm Keferstein, Ordinary Professor of Zoölogy and Comparative Anatomy in the University of Göttingen. He died on the 25th ult., at the early age of 37.

THOSE of our readers who are acquainted with the grand series of ethnographical photographs contained in the four volumes already published of the work entitled the "People of India," will be glad to hear that four more instalments completing the volume are now in progress. The publishers are Messrs. W. H. Allen and Co., of Waterloo Place.

M. SCHAFARIK, Professor of Chemistry in the Polytechnic Institute of Bohemia, writing on the 15th ult. to the Bohemian newspaper *Politik*, announces the discovery of a diamond in a granite quarry in the Dlaschkowitz estate of Count Schönborn, about eight miles north-west of Prague. The stone weighs 57 milligrams, is of a light yellow colour, and nearly cubtical in shape, the edges and corners being slightly rounded. In hardness it equals the East Indian, and exceeds the Brazilian diamonds. After the careful examination which the stone has been subjected to, by Prof. Schafarik, there can be little doubt of its genuineness; but that simple fact will hardly justify us in believing that a diamond has really been found associated with basalt and other minerals of plutonic origin, seeing that the beds which, in other parts of the world, have yielded this precious stone, are all sedimentary deposits. The Dlaschkowitz diamond had confessedly passed through the hands of a lapidary (who was unable to polish it on account of its hardness) before it reached M. Schafarik, and it would be reasonable, for the present, to suppose that an East India diamond had by some accident become mixed up with the various Bohemian stones sent to the lapidary. It has been suggested in Bohemia that the Dlaschkowitz diamond is nothing but zircon; but the stone does not agree with that mineral, either in specific gravity or in hardness. To those of our readers who are interested in the diamond discoveries in the Cape Colony we may commend an article "On the Diamond Regions of South Africa" in the *Field* newspaper of the 22nd ult.

In a recent number of NATURE we gave an account of some experiments by Lenz on the occlusion of hydrogen by electro-deposited iron. It will be remembered that in the discussion that followed the reading of M. de Jacobi's paper before the British Association at Exeter, Mr. W. Chandler Roberts stated that electro-type iron occluded at least twenty times its volume of hydrogen. The extraction of the gas was followed by a contraction of the metal. This Mr. Roberts considered important, from its connection with the behaviour of Palladium under similar conditions.

THE last bulletin of the Association Scientifique de France publishes three accounts of shocks of earthquakes at Marseilles and Toulon on the morning of the 18th ult. M. Stephan, of Marseilles, speaks of a smart shock at 2.50 A.M., the direction of the oscillation being from north to south, and lasting three seconds. Another slight shock, having the same direction, was noted by him at 3.5 A.M. M. Ferrier, of Marseilles, observed prolonged oscillations at 2.45 A.M. According to him, there were twenty or twenty-five oscillations from south-west to north-east, the intensity of the oscillations being all equal, and the duration of each one-third of a second. M. Zurchen, writing from Toulon, mentions two violent shocks at 3.7 A.M. There was an interval of two seconds between them. The oscillations appeared to be from north to south.

IN the matter of sewage, as in so many other particulars, the metropolis allows itself to be outdone by provincial towns. Leamington, for example, has had its sewage examined by Dr. Letheby; one sample after it had passed the charcoal filter, the other before being subjected to that process, although it had undergone chemical influences. In one of these, Dr. Letheby found only 8·40 grains of organic matter (in solution), and in the other, only 9·40 grains; whereas, ordinary London sewage contains 15·08 grains. Again, of mineral or organic matters in suspension, the two Leamington samples yielded none whatever, but on the other hand, the London sewage contained 22·04 grains of mineral, and 16·11 grains of organic matters in suspension. Now, why is there this contrast? And yet nearly all the towns of the Thames valley are under strict orders from the conservators to discontinue draining into the river at a given time.

ACCORDING to the *Avenir* of Auch, 130 tumuli, one of them containing a hundred skeletons, have just been discovered in the *landes* of Ossun.

PROF. R. S. BALL will commence a series of twenty lectures on Mechanics, in the Royal College of Science, Dublin, on the 7th of February. It is expected that this course will be found useful to artisans, as well as to students commencing the study of mechanics.

THE Natural History Museum of the Royal Dublin Society has been open for the last few months on one evening in each week to the public. The success that has attended this experiment has been something quite unexpected. The artisan class have flocked into the Museum in such numbers as to inconveniently fill it; the building, which can scarcely accommodate 2,000, being on at least one evening overcrowded with upwards of 3,000. In the meanwhile, the Department of Science and Art is greatly to blame in not increasing the number of porters, whose duty it is to regulate the movements of this great crowd as it circulates up staircases not four feet wide, and along the narrow slender galleries. If we except one porter, who acts as "turnstile" (counting the number of visitors), and another who takes the pennies for sticks and umbrellas, there are not *three* porters to do the duty of a dozen. The success of the experiment ought not to be endangered for the sake of a little expense.

ON Saturday last M. Murez resumed his lectures at the College of France, on the mechanism involved in the flight of birds. His lectures of last year on this subject were published in the *Revue des Cours Scientifiques.*

MR. HULL's paper read last week at the Royal Society has a value beyond that of recording the temperature of the strata through which the shaft of a coal-mine was sunk near Wigan. A mine 808 yards deep, nearly half-a-mile, is the deepest in the world, penetrates the "crust" of the globe farther than any other mine, and so has an especial interest for those who concern themselves about our supplies of coal. Geologists have told us that if we dig down through the "old red" we shall find coal-beds of greater extent than those which we have worked so profitably for the last two hundred years. This, however, did not comfort those uneasy people who looked forward to the exhaustion of coal; for the "old red" is so thick, it would never pay to raise coal from such a depth! And here the Rose Bridge Colliery, near Wigan, above referred to, becomes of especial importance. It may be regarded as an experiment towards a solution of the question of very deep mining. Already the proprietor finds that the cost of "getting" the coal is greater than when the mine was but 600 yards deep. This is the natural consequence of increase of temperature and increase of pressure. The temperature of the coal at the bottom of the mine, as stated in Mr. Hull's paper, is ninety-three degrees and a half! How long will the timber props last in such a temperature and under such a pressure as they have to bear? If the mine yields a profit under such circumstances, then some enterprising coalowner may be tempted to go deeper.

WE learn from the *Athenæum* that the sixth and concluding part of the first volume of annals of the Public Museum of Buenos Ayres has been issued, and that the work still bears the name of Dr. Burmeister as editor. The papers contained in this part, which is handsomely illustrated like its predecessors, are as follows:—"Descripcion de Cuatro Especies de Delfines de la Costa Argentina," and "Catologo de los Mamiferos Argentinos con los del Museo Público."

THE election of the new Council (Commission Centrale) of the French Geographical Society took place on the 7th ultimo with the following result:—President, M. de Quartrefages; Vice-Presidents, MM. d'Avezac and E. Cortumbert; General Secretary, M. Mannoir; Assistant Secretaries, MM. R. Cortambert and C. Delamarre.

SCIENTIFIC SERIALS

POLLI'S *Annali di Chimica applicati alla Medicina* (No. 1, 1870) has a long preface relating to *miasma palustre* and the use of febrifuges; these topics being discussed in view of the competition for which the Royal Institute of Lombardy has offered a prize in 1872. The competition is restricted to a discussion of the use of sulphites and hyposulphites in intermittent fevers. The editor adds to his preface a list of thirty-seven memoirs which have been published on these subjects between 1863 and 1869. Carlo Pavesi contributes a note on a speedy method of preparing mercurial ointment, in which the use of oil of turpentine as an ingredient is specially recommended. Belardi draws attention to the fact that pharmaceutical preparations of bismuth are liable to contain antimony. Pagano gives an illustration of the therapeutic value of magnesic sulphite; and Moretti records some clinical observations on the use of the same salt as well as sodic sulphite.

THE *Moniteur Scientifique* (January 15th) contains an unnecessarily tedious article on Sodic Bromide, by Casthélaz, which does not contain any original matter. M. E. Kopp contributes extracts from foreign journals (practical chemistry). M. J. Personne compares the process of Roussin for preparing hydrated chloral, which he condemns as imperfect, with that given in Dumas' *Traité de Chimie*, which he eulogises (it yields 185 per cent.) M. Jonglet reports ably on the progress of the sugar industry in France.

THE *Astronomische Nacrichten*, No. 1788, January 19, 1870, contains (1) Observations with the Reichenbach Circle at the Warsaw Observatory, by C. Deike, Second Assistant at the Observatory; (2) Observations of Comet III., 1869, by Argelander; (3) and (4) Elements and Ephemeris of the same Comet, by Bruhns and Von Littrow. Von Littrow states that the comet will hardly be visible after the end of January, as its brilliancy on 13th January only amounted to one-fifth the brilliancy at the time of its discovery. The fifth paper in the present number is by Peters, and gives Elements and Ephemeris of Felicitas (109) from January 30th to 22nd March. In the sixth and last paper Dr. Oppolzer communicates a definitive determination of the orbit of the planet (64) Angelina.

Annales de Chimie et de Physique, January.—M. Achille Cazin contributes a memoir on "internal work in gases." It contains a theoretical discussion and an experimental proof of such work, the latter being in principle a repetition of Joule's experiment, in which air is allowed to flow from a full into an exhausted receiver. M. Boussingault determines carbon in iron by mixing the filings with mercuric chloride and a little water, allowing the mixture to repose in contact with aqueous hydric chloride for about an hour, filtering and igniting the precipitate (carbon, mercurous chloride, &c.) in hydrogen. Successive ignitions in air and hydrogen then give the *combined* carbon; successive ignitions in oxygen and hydrogen next give the graphite. This number also contains an unfinished paper, by M. Vicaire, on the "temperature of flames and dissociation."

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 27.—The following papers were read: "Observations on the temperature of the strata taken during the sinking of the Rose Bridge Colliery, Wigan, Lancashire, 1868-69." By Edward Hull, M.A., F.R.S., Director of the Geological Survey of Ireland. The manager of the Rose Bridge Colliery, Mr. Bryham, sensible of the value of observations of the temperature of the strata in what is probably the deepest colliery in the world, certainly in Britain, made a series of observations with as much care as the circumstances of the sinking of the shaft would admit, and entrusted them to Mr. Hull for publication. The mode of taking the observations was as follows:—On a favourable stratum, such as shale, or even coal, having been reached, a hole was drilled with water in the solid strata to a depth of one yard from the bottom of the pit. A thermometer was then inserted for the space of thirty minutes, the hole having been sealed and made air-tight with clay. At the expiration of the half-hour the thermometer was taken up and the reading noted. While the temperatures of the strata were being measured, observations were carried on *pari passu* on those of the open pit during the descent. These are given in the Table annexed. By a comparison of the results in the two columns, it will be observed that, as the depth increased, the differences between the corresponding temperatures in the pit and the strata tended to augment; in other words, the temperature of the strata was found to augment more rapidly than that of the open pit. The effects of the high temperature and pressure on the strata at the depth of 2,425 feet are making themselves felt, and cause an increase in the expense both of labour and timber for props. This colliery, in fact, will be in a position to put to the test our views and speculations on the effects of high temperature and pressure on mining operations. In order to obtain the average rate of increase of heat, as shown by the experiments at Rose Bridge Colliery, we may assume (in the absence of direct observation) the position and temperature of the *invariable stratum* to be 50 feet from the surface and 50° F., which is probably nearly the mean temperature of the place. With these data, the increase is 1° F. for every 54·57 feet, which approximates to that obtained by Professor Phillips at Monkwearmouth of 1° F. for about every 60 feet. If, on the other hand, for the purpose of comparison, the measurements for the *invariable stratum* as obtained at Dukenfield be adopted, the rate of increase is found to be 1° F. for every 47·2 feet as against 1° F. for every 83·2 feet in the case of Dukenfield itself. So great a discordance in the results is remarkable, and is not, in the opinion of the author, attributable to inaccuracy of observation in making the experiments. On the other hand, he suggests that it is due, at least in some measure, to dissimilarity in the position and inclination of the strata in each case.

THERMOMETRICAL OBSERVATIONS AT ROSE BRIDGE COLLIERY.

Date.	Depth, in yards.	Strata.	Temperature in open pit.	Temperature in solid strata.
			F. °	F. °
July 1854	161	Blue shale	...	64·5
August 1854	183	Warrant earth	...	66
May 1858	550	Blue shale	...	78
July 1858	600	Warrant earth	...	80
May 18, 1868	630	"Raven" coal	73	83
July 24, 1868	665	Linn and wool	75	85
April 29, 1869	673	"Yard Coal" mine	76	86
November 18, 1868	700	Strong Blue Metal	76	87
February 22, 1869	736	Do.	76	88½
March 12, 1869	748	Shale	77	89
April 17, 1869	762	Linn and wool, or strong shale	78	90·5
May 3, 1869	774	Strong shale	80	91·5
May 19, 1869	782	Blue metal	79	92
July 8, 1869	801	Strong blue shale	79	93
July 16, 1869	808	Coal (Arley mine)	79	93½

Remarks.—All holes vertical in solid at bottom of pit drilled with water one yard deep, and thermometer remained thirty minutes in hole made air-tight with clay.

"On the Theory of Continuous Beams." By John Mortimer Heppel, Mem. Inst. C.E. Communicated by W. J. Macquorn Rankine, F.R.S. The chief object of this communication was to remedy some acknowledged defects in the theory of the above-mentioned subject. The principal steps by which it has reached its present state of development were also noticed, and may be briefly recapitulated as follows:—The great defect in the theory up to the present time has been that, in order to avoid an inextricable complexity, it has been necessary to consider the load in each span as uniformly distributed over it, and the moment of inertia of the section as uniform throughout each span. The method now given treats these conditions rigorously; and although the equations obtained are such as necessarily require some laborious computation to obtain numerical results, they are by no means inextricable.

"Remarks on Mr. Heppel's Theory of Continuous Beams." By W. J. Macquorn Rankine, C.E., LL.D., F.R.S. The author states that the advantages possessed by Mr. Heppel's method will probably cause it to be used both in practice and in scientific study. With a view to the instruction of students in engineering science, he proposes an abridged way of stating the theoretical principles of Mr. Heppel's method, considering at the same time that Mr. Heppel's more detailed investigation forms the best model for numerical calculation. He then uses Mr. Heppel's improved form of the "Theorem of the Three Moments" to test the accuracy of the formulæ which he obtained in another way, and published in "A Manual of Civil Engineering," for the case of an uniform continuous beam with an indefinite number of equal spans, the successive spans being loaded alternately with an uniform fixed load only, and with an uniform travelling load in addition to the fixed load; and he finds the results of the two methods to agree in every respect.

"Remarks on the recent eclipse of the sun as observed in the United States," by J. N. Lockyer, F.R.S.

By the kindness of Professors Winlock, Morton, and Newton, I have been favoured with photographs, and as yet unpublished accounts, of the results of the recent total eclipse of the sun observed in America. I am anxious, therefore, to take the opportunity afforded by the subject being under discussion, to lay a few remarks thus early before the Royal Society.

The points which I hoped might be more especially elucidated by this eclipse were as follows:—

1. Is it possible to differentiate between the chromosphere and the corona?

2. What is the real photographic evidence of the structure of the base of the chromosphere in reference to Mr. W. De la Rue's enlarged photographs of the eclipse of 1860?

3. What is the amount of the obliterating effect of the illumination of our atmosphere on the spectrum of the chromosphere?

4. Is there any cooler hydrogen above the prominences?

5. Can the spectroscope settle the nature of the corona during eclipses?

With regard to 1, the evidence is conclusive. The chromosphere, including a "radiance," as it has been termed by Dr. Gould (the edge of the radiance as photographed being strangely like the edge of the chromosphere in places viewed with the open slit), is not to be confounded with the corona.

On this subject, in a letter to Professor Morton, Dr. B. A. Gould writes:—"An examination of the beautiful photographs made at Burlington and Ottumwa by the sections of your party in charge of Professors Mayer and Haines, and a comparison of them with my sketches of the corona, have led me to the conviction that the radiance around the moon in the pictures made during totality is not the corona at all, but is actually the image of what Lockyer has called the chromosphere.

"This interesting fact is indicated by many different considerations. The directions of maximum radiance do not coincide with those of the great beams of the corona; they remain constant, while the latter were variable. There is a diameter approximately corresponding to the solar axis, near the extremities of which the radiance upon the photographs is a minimum, whereas the coronal beams in these directions were especially marked during a great part of the total obscuration. The coronal beams stood in no apparent relation to the protuberances, whereas the aureole seen upon the photographs is most marked in their immediate vicinity; indeed the great protuberance, at 230° to 245°, seems to have formed a southern limit to the radiance on the western side, while a sharp northern limit is seen on all the photographs at about 350°, the intermediate are being thickly studded with protuberances which the moon displayed at the close of totality. The exquisite masses of flocculent light on the following limb are upon the two sides of that curious prominence at 93°, which at first resembled an ear of corn, as you have said, but which, in the later pictures, after it had been more occulted, and its southern branch thus rendered more conspicuous, was like a pair of antelope's horns, to which some observers compare it. Whatever of this aureole is shown upon the photographs was occulted or displayed by the lunar motion, precisely as the protuberances were. The variations in the form of the corona, on the other hand, did not seem to be dependent in any degree upon the moon's motion. The singular and elegant structural indication in the special aggregations of light on the eastern side may be of high value in guiding to a further knowledge of the chromosphere. They are manifest in all the photographs by your parties which I have seen, but are especially marked in those of shortest exposure, such as the first one at Ottumwa. In some of the later views they may be detected on the other side of the sun, though less distinct; but the very irregular and jagged outline of the chromosphere, as described by Janssen and Lockyer, is exhibited in perfection."

2. The second point is also referred to in the same letter. I think the American photographs afford evidence that certain appearances in parts of Mr. De la Rue's photographs, which represent the chromosphere as billowy on its under side, are really due to some action either of the moon's surface or of a possible rare lunar atmosphere, so that it is not desirable to confound these effects with others that might be due to a possible suspension of the chromosphere in transparent atmosphere, if only a *section* of the chromosphere were photographed.

Dr. Gould writes:—"You will observe that some of the brighter, petal-like flocculi of light have produced apparent indentations in the moon's limb at their base, like those at the bases of the protuberances. These indentations are evidently due to specular reflection from the moon's surface, as I stated to the American Association at Salem last month. Had any doubt existed in my mind previously, it would have been removed by an inspection of the photographs."

Where the chromosphere is so uniformly bright that the actinic effect on the plate is pretty nearly equal, the base of the chromosphere is absolutely continuous in the American photographs; but in the case of some of the larger prominences, notably those at + 146 (Young) and − 130 (Young), there are strong apparent indents on the moon's limb.

3. I next come to the obliterating effect of the illumination of our atmosphere on the spectrum of the chromosphere.

This is considerable; in fact, the evidences of it are very much stronger than one could have wished, but hardly more decided than I had anticipated. Professor Winlock's evidence on this point, in a letter to myself, is as follows:—"I examined the principal protuberances before, during, and after totality. I saw three lines (C, near D and F) before and after totality, and eleven during totality; *eight were instantly extinguished on the first appearance of sunlight.*"

This effect was observed with two flint prisms and seven inches aperture. Professor Young, with five prisms of 45° and four inches aperture, found the same result in the part of the spectrum he was examining at the end of the totality.

He writes:—"I had just completed the measurements of 2,602, when the totality ended. *This line disappeared instantly*, but 2,796 [the hydrogen line near G] was nearly a minute in resuming its usual faintness."

These observations I consider among the most important ones made during the eclipse; for they show most unmistakably that, as I have already reported to the secretary of the Government-Grant Committee, the new method to be employed under the best conditions must be used with large apertures and large dispersion.

On the 4th point the evidence is negative only, and therefore in favour of the view I have some time ago communicated to the Royal Society.

5. We next come to the question of the corona, a question which has been made more difficult than ever, in appearance only, I think, by the American observations.

I propose to discuss only the spectroscopic observations of Professors Young and Pickering in connection with Dr. Gould's before-quoted remarks.

[After this discussion, for which we have not space, the author continues:—]

I have first to do with the continuous spectrum, deduced from Professor Pickering's observations.

I think in such a method of observation, even if the corona were terrestrial and gave a dark line spectrum, the lines visible with such a dim light would in great part be obliterated by the corresponding bright lines given out by the long arc of chromosphere visible, to say nothing of the prominences, in which it would be strange if C, D, E, *b*, F, and many other lines were not reversed. This suggestion, I think, is strengthened by the statement that two bright lines were seen "near C" and "near E;" should we not rather read (for the "near" shows that we are only dealing with approximations) C and F, which is exactly what we might expect?

But even this is not all that may be hazarded on the subject of the continuous spectrum, which was also seen by Prof. Young under different conditions.

Assuming the corona to be an atmospheric effect merely, as I have before asserted it to be, in part at least, it seems to me that its spectrum should be continuous, or nearly so; for is it not as much due to the light of the prominences as to the light of the photosphere, which it may be said roughly are complementary to each other?

With regard to the aurora theory, I gather from Prof. Young's note that, if not already withdrawn, he is anxious to wait till the next eclipse for further facts. I consider the fact that I often see the line at 1,474, and often do not, is fatal to it, as it should be constantly visible on the proposed hypothesis. The observation of iron-vapour, as I hold it to be at this elevation, is of extreme value coupled with its simple spectrum, *seen during an eclipse*, as it entirely confirms my observations made at a lower level in the case, not only of iron but of magnesium.

Geological Society, January 26.—Professor Huxley, LL.D., F.R.S., president, in the chair. Thomas Daniel Bott, Esq., 20, Osborne Villas, Talfourd Road, Peckham; Edwin Buckland Kemp-Welch, Esq., 3, Beaumont Terrace, Bournemouth; James Parkinson, Esq., F.C.S., Sarum House, Church Road, Upper Norwood, S.; Henry Sewell, Esq., Villa del Valle, Mexico; and Thomas F. W. Walker, Esq., M.A., F.R.G.S., Athenæum Club, London, and 6, Brock Street, Bath, were elected Fellows of the society. The Rev. Dr. Oswald Heer, of Zurich, was elected a foreign member of the society. The following communication was read:—"On the crag of Norfolk and associated beds." By Joseph Prestwich, Esq., F.R.S., F.G.S. The author commenced by referring to his last paper, in which he divided the Red Crag into two divisions—a lower one, of variable oblique bedded strata, and an upper one of sands passing up into the clay known as the Chillesford clay. In 1849 he had alluded to the possibility of this clay being synchronous with the Norwich Crag. He has since traced this upper or Chillesford division of the Red Crag northwards, with a view to determine its relation to the Norwich Crag. He has found it at various places inland, but the best exhibition of it occurs in the Easton Bavant Cliffs. He there found in it a group of shells similar to those at Chillesford, and under it the well-known bed of mammaliferous or Norwich Crag, with the usual shells. The author also showed that in this cliff and the one nearer Lowestoft traces of the Forest-bed clearly set in upon the Chillesford clay. He next traced these beds at the base of Horton Cliff, and then passed on to the well-known cliffs of Happisburgh and Mundesley. He considered the Chillesford clay to pass beneath the Elephant bed, and to represent some part of the Forest-bed. The same clay may be traced to near Weybourne. The crag under these beds he referred to the Chillesford sands. Mention was then made of the sands and shingle above the Chillesford, to which the author proposed the names of "Southwold Sands and Shingle." These usually are very unfossiliferous, but at two or three places near Southwold the author found indications of an abundance of shells (*Mytilus*, &c.) and Foraminifera in some iron sandstones intercalated in this series. In the Norfolk cliffs these beds contain alternating seams of marine and freshwater shells. The inland range of the beds to Aldeby, Norwich, and Coltishall was next traced, and the Chillesford clay shown to be present in each section, and the sands beneath to be referable to the Chillesford sands, as already shown by other geologists on the evidence of the organic remains. Mr. Gwyn Jeffreys, who had carefully examined the shells of the Norwich Crag for the author, stated that a considerable number of Arctic species were found in the Norfolk Crag which did not occur in Suffolk. While, therefore, the Norwich Crag seems to be synchronous with a portion of the Suffolk Crag, that portion is the upper division, and, therefore, the triple arrangement proposed by Mr. Charlesworth and advocated by Sir C. Lyell, together with the fact of the setting in of a gradually more severe climate, pointed out by the late Dr. Woodward and by Sir C. Lyell, are confirmed. Mr. Prestwich then referred to the origin of the materials of the Southwold shingle, and showed that, with few exceptions, they came from the south. In it he had found a considerable number of worn fragments of chert and ragstone from the Lower Greensand of Kent. He considered this a convenient base-line for the Quaternary period; as then commenced the spread of the marine gravels over the south of England, and soon after commenced the great denudations which give the great features to the country. Mr. Gwyn Jeffreys observed that no littoral shells occur in the Coralline Crag, while in the Red Crag they abound. In the Norwich Crag there is also evidence of littoral conditions, but in certain places the shells exhibit a deep-water character. In the Norwich Crag, after eliminating as derivative or extraneous certain species (as had already been done by the late Dr. Woodward), he finds, exclusive of varieties, 140 species, of which 123 are living, and 17 are supposed to be extinct. Of these 123, 101 still live in the British Seas, 12 are Arctic and North American, 8 Mediterranean, and 2 Asiatic. The southern species were probably derived from the Coralline Crag. The two Asiatic species were the *Corbicula fluminalis* and *Paludina unicolor*. Twenty species in the Norwich Crag have not been found in the Red or Coralline Crag, and he therefore thought there was some difference in their geological age, the Norwich Crag being both more recent than the Red Crag, and its shells of an Arctic or more northern kind. *Tellina balthica* he regarded as significant of brackish water conditions. *Actæon Noæ*, a characteristic shell of the Red and Norwich Crag, had been found fossil by Prof. Steenstrup in Iceland. Sir Charles Lyell had been struck with the similarity of the beds at Chillesford and at Aldeby, in which also the shells, though 40 in one case and 70 in the other, were very similar in character; but in neither was *Tellina balthica* found, though common in the glacial beds. He called attention to the condition of the shells as they occurred at Aldeby, and suggested that where the two shells of a bivalve were found in contact, they would probably afford some evidence whether they were derivative or no. Mr. Searles V. Wood, jun., was inclined to differ to a large extent from the author, especially with regard to the beds above the Chillesford clay. The sands containing *Tellina solidula* he placed as the lowest member of the glacial series; the fauna they contain is different from that of the Chillesford bed. He regarded the sand-beds at Kessingland as above the lower boulder-clay and contorted drift of Cromer, and considered that it might be traced as occupying this position along a great part of the coast of Norfolk. He had, in company with Mr. Harmer, surveyed a great part of the Norfolk and Suffolk district, and they intended to place their maps and sections at the disposal of the Geological Society and the Survey. He recommended that any examination of the country should commence from the east rather than from the west. Mr. Boyd Dawkins, speaking of the fossil mammalia of the crag, mentioned that, at the base of the crag at Horstead, immediately on the chalk, was a bed exhibiting an old land-surface, and in this were found the principal perfect mammalian remains, whereas in the crag above they were water-worn. But though these bones occurred in the marine deposit, the animals had lived on the land, and there was no evidence but that they belonged to a much earlier period than that at which it was submerged. He thought that the facies of the Cervidæ found at Horstead was that of an early Pliocene age. The mammals of the London Clay had in some cases become confounded with those of the Suffolk Crag, but these he regarded also as belonging to an old Pliocene land-surface. He differed from the author in not regarding the Forest-bed as Quaternary, as the remains of *Rhinoceros etruscus*, *Ursus arvernensis*, and *Elephas meridionalis*, &c., had occurred in it, in many cases in fine condition. He could see no reason for splitting up the Cainozoic series into four divisions, as there was no break in the life between the Tertiary and Quarternary periods. Though there might be a break in England, the forms of life were continuous from the Miocene of Pikermi on the Continent. The President suggested that if we were to admit a Quaternary period we must go back to the Miocene, as the mammalian fauna of that period was the direct ancestor of that of the present day. Mr. Prestwich, in reply, remarked that he did not quite agree with Mr. Jeffreys as to the number of derivative species in the different members of the Crag. The fauna, however, required further investigation. With regard to the objections of Mr. Wood, he had not on this occasion intended going into details as to the beds above the Chillesford clays; his object had rather been to show that these latter extended over a large area, and contained in other places than Chillesford the same shells as those occurring there. He did not attach the same value to the presence of *Tellina balthica* as did Mr. Wood, it being a shell now living and found on the coast. He had not overlooked the importance of the mammalian remains, but, like Mr. Dawkins, he had felt the uncertainty which, in the case of the Crag, so often attached to their origin, and therefore had not much insisted on them. He thought the divisions of Miocene and Pliocene were well known and generally accepted; and though the division was arbitrary, he thought the setting in of the Glacial period a good epoch at which to commence the Quaternary period. If we were to go back to some break in the forms of life, we might go back indefinitely.

Ethnological Society, January 25.—Professor Huxley, president, in the chair. The following new members were announced at this and the preceding meeting:—The Earl of Dunraven and Mount-earl, K.P., Lord Rosehill; Messrs. J. W. Barnes, T. H. Baylis, D. Duncan, M.A., J. E. Edwards, J. F. McLennan, W. Morrison, M.P., and R. L. Nash. Dr. Hooker, C.B., exhibited a collection of figures in unbaked clay, modelled by a native Zulu; and Colonel Lane Fox exhibited some stone mullers used for pounding grain.—Mr. Borwick, F.R.G.S., read a paper on the origin of the Tasmanians geologically considered. The Tasmanians have now become almost extinct, an old woman being the only survivor of the race. They were related in manners and in general *physique* to the neighbouring Australians, but were allied by black skin and woolly hair to the distant Africans, while they were assimilated by resemblance of language, customs, and habits of thought to many races scattered over vast areas. The author sought to explain this relation by constructing an ideal southern continent, whence all the dark-coloured races surrounding the Indian Ocean, and extending into the Pacific and Southern Oceans, may have radiated. He regards the Tasmanian as probably older than the Australian. Dr. Hooker, whose authority had frequently been quoted in the paper, pointed out the similarity and differences that obtain between the floras of Australia, Tasmania, New Zealand, South Africa, &c. It has recently been found that the flora of the Howe Islands is very unlike that of Australia, although so near to the coast. He protested, however, against the inference that the line of migration followed by plants is necessarily the same as that pursued by the higher animals. The President alluded to the great difference between the Australian and Tasmanian, especially in the character of the hair, and he regarded it as physically impossible that the Tasmanian could have come from Australia. He suggested that an interrupted communication, by a chain of islands, may have extended from New Caledonia to Tasmania, similar to that which now connects New Caledonia with New Guinea; and that by this means a low negrito type may have spread eastwards over this area.—Mr. Howorth's paper, "On a frontier-line of Ethnology and Geology," was then read. Siberia and North America form a well-defined province, botanically, zoologically, and ethnologically. North of the isothermal line forming the southern boundary of this province dwell the Ugrian races, whose conditions of existence were compared by the author with those of the prehistoric period. In Europe the isothermals have been gradually twisted to the north by the Gulf Stream; and the author believes that the gradual advent of the stream may be traced from no earlier period than about the twelfth century B.C.; Remarks on this paper were made by the President, Dr. Hyde Clarke, Dr. Richard King, and Colonel Lane Fox.—Mr. Atkinson read a "Note on the Nicobar Islands," and exhibited some grotesque figures carved in wood, taken from the Nicobars by Capt. Edge in 1867, and recently brought to this country by Capt. Mackenzie. These figures are to be placed in the Christy collection, and similar objects have been forwarded to the Museum in Edinburgh.

London Mathematical Society, January 13.—Prof. Cayley, president, in the chair. Mr. Walker gave an account of a paper "On the Equations of Centres and Foci of, and Conditions for, certain Involutions." In this communication it is shown that the three points corresponding to one having an assigned distance (x') from the origin, in one of three involutions determined by a quartic, and found from the equation—

$(abcd \between x', 1)^3$, $(bcde \between x', 1)^3$, $(cdef \between x', 1)^3$, $(defg \between x', 1)^3$, $(x, 1)^3 = 0$,

the sextic covariant of the quartic being written $(a\,b\,c\,d\,e\,f\,g \between x\,y)^6$, This form has been arrived at in carrying out a suggestion of the president, Prof. Cayley. It contains the equations giving the three centres of the involutions determined by the quartic, as well as that giving the six double points (the geometrical significance of which latter equation has been already pointed out by Dr. Salmon), by making x' infinitely great, and equal to x, successively. The case of the quartic breaking up into two quadratics is next discussed, when the roots of one correspond respectively to those of the other. The condition for two cubics ($u\,v$) determining an involution, of such a kind that the three roots of one correspond each to a root of the other, is investigated. This has (since the meeting) been identified by the author with $\Delta\,\Theta'^2 - \Delta'\Theta^2 = 0$, Δ, Δ', being discriminants of u and v, while $\Theta\,\Theta'$ are the co-efficients of λ and λ^3 respectively in the discriminant of $u + \lambda\,v$. The equations for determining the centre and double points—or, more generally, that determining the point corresponding to an assigned one—in the involution determined by two cubics, satisfying the above condition, are also investigated. Dr. Henrici, Prof. Hirst, Mr. Clifford, and the President took part in a discussion on the paper. The President then made a statement of some results he had arrived at with reference to quartic surfaces. Mr. Roberts exhibited and explained diagrams of the pedals of conic sections which he had constructed by the methods described in his paper read before the society, January 14th, 1869.

Quekett Microscopical Club, January 28.—P. Le Neve Foster, Esq., president, in the chair.—A paper was read by Dr. Robert Braithwaite on the geographical distribution of mosses. The paper gave an abstract of the arrangement proposed by Prof. Schimper, who divides the whole of Europe into three areas in latitude—viz. (1), a northern zone, comprising N. Russia, Scandinavia, and N. Scotland; (2), a middle zone, extending south of this to the foot of the Alps, and including all central Europe; (3), a southern zone, reaching from the last to the Mediterranean. More important than these is their distribution in altitude, or height above the sea level, and for this five regions are indicated, each characterised by certain predominant species, and marked out by lines gradually falling in altitude as we pass northward to the pole, where the extreme limits, or that of the sea level and the line of perpetual snow, become coincident. Commencing at the sea level, the dimensions in altitude are—(1), the Campestral region, or that of the cultivated field and fruit trees, embracing the greatest varieties of soil and conditions of surface; (2), the Montane, or lower mountain region, marked at its upper limit by the disappearance of the beech; (3), the Sub-Alpine region, extending from the upper limit of the beech to the upper limit of the spruce fir; (4), the Alpine region, embraced between the commencement and termination of growth of the dwarf pine, and marked by the presence of dwarf birch; (5), the Supra-Alpine region, reaching above the limit of the trees named to the line of perpetual snow. A brief sketch was then given of the various *habitats* affected by mosses, and lists of the characteristic species given; these embraced the dwellers on walls, roofs, trees, heaths, bogs, and rocks. They were illustrated by a fine series of specimens of mosses and their associated flowering plants, prepared by the late Mr. N. B. Ward, who thus ingeniously attempted to work out the idea of representing the whole flora of a locality at one glance. Conspicuous among these were the sheets from Ben Lawers, Ben Voirlich, Heidelberg, Killarney, and Eridge Rocks.

Anthropological Society, January 18.—Annual General Meeting.—John Beddoe, Esq., M.D., president, in the chair. The report of the auditors showed the income of the society in 1869 to have been 1,091*l.* 9*s.* 5*d.*, the expenditure 964*l.* 9*s.* 8*d.*, and the balance in hand on the 31st December 126*l.* 19*s.* 9*d.* The report of the council was read and adopted. The president then delivered the annual address, including a full obituary notice of Dr. James Hunt, founder of the society. The ballot for the election of officers and council to serve in 1870 was taken with the following result:—President, John Beddoe, M.D.; vice-presidents, H. Beigel, M.D., Captain R. F. Burton, Dr. Charnock, J. Barnard Davis, M.D., F.R.S., Captain Bedford Pim, R.N., Dr. Berthold Seemann; director, Thos. Bendyshe, M.A.; treasurer, Rev. Dunbar I. Heath, M.A.; council, J. Gould Avery, J. Burford Carlill, M.D., S. E. Collingwood, Walter C. Dendy, George Harris, Jonathan Hutchinson, W. B. Kesteven, Kelburne King, M.D., Richard King, M.D., A. L. Lewis, St. George J. Mivart, F.R.S., Major S. R. I. Owen, Edward Peacock, F.S.A., J. Spence Ramskill, M.D., C. Robert Des Ruffières, John Thurnam, M.D., W. S. W. Vaux, F.R.S., C. Staniland Wake, Alfred Wiltshire, M.D., E. Villin.

Entomological Society, January 24.—Annual General Meeting, Mr. Frederick Smith, vice-president, in the chair. The Report of the Council for 1869, and an address by Mr. H. W. Bates, the retiring president, were read. The following thirteen members were chosen to form the council for 1870, viz: Messrs. Bates, Dallas, Dunning, Fry, Grut, M'Lachlan, Parry, Pascoe, Saunders, Stevens, Wallace, and Wormald. Mr. Alfred Russell Wallace was elected president for 1870; and the following officers were re-elected:—Mr. Stevens, treasurer; Messrs. Dunning and M'Lachlan, secretaries; Mr. Janson, librarian. The thanks of the society were voted to the officers and members of the council for their services during the previous year.

Glasgow

Philosophical Society of Glasgow, January 12.—Dr. Francis H. Thomson, vice-president, in the chair. The president, Dr. James Bryce, F.G.S., gave an account of the "Geological Structure of Skye and the West Highlands." The difficulty and danger of thoroughly studying the peculiar geological structure of Skye were so great that no geologist, in the author's opinion, should undertake it without the company of an associate; and as he considered that no such person should ascend the mountains for the first time unaccompanied, the author specially recommended Angus Nicholson as a reliable guide. Dr. Bryce dwelt at some length upon the wonderful peculiarities in the structure of the Cuchullin mountains, which form such a characteristic feature of the island in the vicinity of Glen Sligachan. They rise to a height of about 3,300 feet, the last 400 feet being absolutely inaccessible, owing to the peaked, spiry, or pinnacled structure. Thoroughly skilled Alpine climbers had been quite baffled by the Cuchullin mountains, unless they had gone to the ignominious extremity of using ladders to aid them in making the ascent. That structure was entirely due to the great abundance of one single mineral, a variety of augite known as *hypersthene*, the intense hardness of which was owing to the presence of large quantities of oxide of iron and oxide of manganese (*query*, silicate of iron and silicate of *magnesia?*). While referring to the rock-features of Skye, Dr. Bryce remarked that of late geologists have been too much led away by the attractiveness of palæontology as a means of geological research, overlooking the superior claims of mineralogy. He considered that in Skye there were two chains of mountains—one black, in which the hypersthene prevails, and the other red, owing to the presence of syenite—and that they had come up in two, if not even in four eruptions, through a liassic basin, the thickness of which is probably not less than 1,500 feet. Besides the lias, he found gneiss, sandstone, quartzite, marble, numerous whin dykes, and crystalline slates from 10,000 to 20,000 feet in depth. When the country was examined closely two syenites were found, one intrusive, the other disruptive. The granites and syenites of Skye were very closely approximated to each other, each rock shading off into the other. On the coasts there were beds of öolite and traps, but they were difficult of examination, and indeed there were many points in the geology of the island yet to be explored. Dr. Bryce referred to the separate examinations of Skye made by Sir Roderick Murchison and the late Prof. Edward Forbes, but he differed in opinion from some of the conclusions of those geologists on the geology of the West Coast, and he expressed himself inclined to support the crystalline schist view of Prof. Nicol, of Aberdeen, rather than the Silurian theory which Sir Roderick Murchison and Mr. Geikie had promulgated, although the latter was the popular theory. Dr. Young said he could not agree with Dr. Bryce in his remarks regarding the relative claims of mineralogy and palæontology in geological inquiries. He dissented from some of the conclusions arrived at by Dr. Bryce, and on other points he confessed and regretted his inability to understand him. Dr. Bryce briefly replied.

Chemical Section, January 17.—Alexander Whitelaw, Esq., vice-president, in the chair. Two papers were read,—the first by Mr. J. Wallace Young, on "Artificial Alizarine," recently obtained from anthracene, one of the coal-tar products. In reference to the question of price, a member having much experience, said that manufacturers felt quite satisfied that they could supply artificial alizarine in large quantities, in half tons if it was wanted, and at a price much under that of natural alizarine as extracted from madder.—The other paper read was, "On the estimation of iodine and bromine in the mother liquors from saltpetre and in kelp." By Dr. John Clark.

Berlin

German Chemical Society, January 24.—F. Rüdorff showed a simple experiment to prove the expansion of water when freezing. Cylindrical bombs cast in iron, of half an inch in thickness, and measuring three inches in length, and one in diameter, were entirely filled with water, previously freed from air by boiling, and then closed by a tightly fitting screw. They were then covered by a mixture of pounded ice and common salt. In from ten to twenty minutes' time they exploded with a loud report like that of a pistol, breaking in different directions.—Mr. Holbein exhibited animals, from mussels up to small mammalia, which had been preserved in a solution of creosote in water (one of creosote to twenty parts of water). This process appeared particularly suited to the preservation of fishes.—A. Baeyer spoke on a third isomeric form of hydromellithic acid, adding interesting considerations on the transformation of isomeric bodies one into the other, which will not bear abbreviation.—A. Horstmann reported on the vapour density of acetic acid, which he found to be normal at low temperatures, when the acid vapour was diluted with air.—Prof. Lieben (of Turin) sent in a paper published conjointly with Rossi on normal butylic alcohol produced by the reduction of butyric acid.—Prof. Rose reported on the first diamond found in Europe. A small diamond, recognised as such by Schafarik in Prague, has lately been discovered in an alluvial formation in Bohemia, in which garnets, hyacinths, and sapphires have been found for years.

Prague

National Museum of Bohemia, December 18, 1869.—Prof. Krejci continued his account of the Permian formation of the N.E. of Bohemia, and discussed the section of Stepanitz, near Paka, at Bélohrad. Three deposits are there distinguished. The lowest is schistose and rich in fossil fish; the next is composed of glauconitic grit, and contains trunks of auracaria *in situ*; the upper is calcareous, finely laminated, full of beautiful concretions of polished stones, of chalcedony and agate, often arranged in rows parallel to the stratification. This is the original deposit of the celebrated Psaronites (silicified trunks of *Marattiaceæ arborescentes*. M. Krejci calls this stratum the Kalva beds. This simple arrangement is disturbed by numerous faults and discolorations, united apparently by melaphyr. M. Krejci believes that all the numerous portions of melaphyr in this neighbourhood exhibited originally only a single level; he insists on the fact that in the sections frequently exposed of late in the course of railway operations; the melaphyr is intercalated conformably between the sedimentary deposits; thus leading to the supposition of a metamorphic change of schist or phyllite into melaphyr. He allows, moreover, that the mountain, Grand Levin, near Horka (Falgendorf) arose apparently through a cleft only one to two metres wide. As regards the band of melaphyr and red porphyry, which, at the southern foot of the superb basaltic mass of Mount Kozakov, rests against the very sloping beds of the cretaceous series, and extends towards Mount Jeschken for a distance of at least ten kilometres, M. Krejci prefers to the idea of an irruption, that of a fault into which the beds of porphyry and melaphyr have slid on the one side to reappear on the other.

January 17.—M. Schafarik announced the discovery of the diamond in Bohemia. A note on the subject will be found in another page. We may add here that the Dlaschkowitz diamond has been presented by Count Schönborn to the National Museum of Prague.—The Royal Society of Bohemia held no public meetings during the month of December.

Boston

Society of Natural History, November 17.—The president in the chair. Prof. N. S. Shaler read a note on the occurrence of the remains of *Tarandus rangifer* Gray, at Big Bone Lick, in Kentucky. At a previous meeting was presented the evidence in support of the conclusion that one of the large mammals of North America, the buffalo, had recently changed its limits, and had only ranged in the Ohio valley within the past few centuries. The same locality supplies us with evidence that the caribou existed in abundance in this river basin at a time anterior to the coming of the buffalo, and probably not very long after the disappearance of the *Elephas primigenius*. Since the coming of civilised man into America, the caribou has been confined to a narrow area in the north-east part of the continent; it is questionable whether it has ever ranged during this time south of the southern limit of the State of Maine. The position in which these remains were found leaves the precise relationship in time of this species to the mammoths and mastodons a little questionable. There is, however, little doubt in my mind that, if not in existence during the later part of the time of these pachyderms, it came immediately after them. Its bones are always found below the line of the buffalo and the Virginia deer. The remains of this latter species are found only among the most recent deposits of the swamp. The disappearance from this region of this eminently boreal animal immediately after the passing away of the ancient elephants from the Mississippi valley, goes to confirm the conclusion that the climatic change which closed the period of the mammoths was from cold to warmth, and not an alteration of the opposite character.

Section of Entomology, November 24.—Mr. Edward Burgess in the chair. The following paper was presented:—"American Lepidoptera. II. *Phalænidæ* Latr." by Charles S. Minot. At the June meeting of the section, I presented a paper entitled "American Lepidoptera, No. I." which contained descriptions of four new Geometridæ (*Phalænidæ* Latr.), and was published without further introduction. I should now like to say a few words on the intended purport of the series. I propose that it shall contain any papers of a miscellaneous nature which may aid in completing our knowledge of the natural history of the Lepidoptera; such as descriptions of new species, or of the metamorphoses and lists of insects found in particular localities or States, with their times of appearance, and perhaps ultimately anatomical communications. The descriptions of new species will, for the present, be principally, if not entirely, confined to the Phalænidæ. Mr. W. H. Dall remarked that while passing over the Portage to the Yukon River, in Alaska, when the temperature was below zero of Fahrenheit, he shot a Canada jay, which had in its mouth the caterpillar of an Arctian; afterwards, when the thermometer was sixteen degrees below zero, he found one of the same caterpillars crawling upon the snow. On the middle of the frozen river, whenever the sun shone for a short time upon the crust, he saw upon the snow a species of *Lepisma* or *Podura* in great abundance, although the cold was intense. The caterpillar of *Vanessa Antiopa* was twice noticed alive during the winter, and the perfect insect was seen at Nulato, May 20th, when the nightly temperature was below freezing.

December 3.—The president in the chair. Dr. C. T. Jackson presented, in the name of Mr. Daniel McCain, specimens of native carbonate of magnesia from Greece, California, Maryland, and Kansas. These minerals are used by the Union Stone Company in making calcined magnesia, which is one of the ingredients of their artificial stone, serving, when combined with chloride of magnesium, as the binding material. Dr. Jackson gave a detailed account of the method of making the artificial stones, and of casting bas-reliefs, busts, and ornamental mouldings. He said the processes had been so improved that now artificial grindstones made of quartz-sand and of emery had been constructed, which were as solid and durable as any natural stone. The emery wheels made of these materials are vastly better than those made with a paste of vulcanised indiarubber, since they do not glaze, but wear away in such a manner as to always expose fresh particles of emery. He regarded this new manufacture as of great value for architecture and the mechanic arts, and as showing the importance of the mineral native carbonate of magnesia, which had been before used only for the manufacture of Epsom salts, of which a limited supply only is wanted. Professor N. S. Shaler offered some remarks on the relation of the rocks in the vicinity of Boston.

PHILADELPHIA

American Philosophical Society, January 7.—Mr. Pliny E. Chase made some observations on the comparison of different mechanical equivalents. He stated that recent determinations, by the different methods of Thomson and Farmer, fix the mechanical equivalent of light, in a wax candle burning $126\frac{1}{2}$ grains per hour, at 13·1 foot-pounds per minute, the equivalent of one grain being 6·213 foot-pounds. According to Dubourg, the heat evolved during the combustion of one grain of olive oil in oxygen is sufficient to heat 9682 grains of water 1° C. According to Favre and Silbermann, one grain of oil of turpentine, burnt in oxygen, would heat 10,852 grains of water 1° C. It may therefore be presumed that the total heat given out by the combustion of one grain of wax is about sufficient to raise 10,000 grains of water 1° C., or 18,000 grains 1° F. This represents a mechanical equivalence of $(18{,}000 \times 772 \div 7{,}000 =)1985{\cdot}143$ foot-pounds, which is 319·5 times as great as the corresponding equivalent of the light given out during the combustion. Tyndall, in his lecture on Radiation, states that the visible rays of the electric light contain about one-tenth of the total radiated heat. The relative luminous intensity of an electric lamp would, therefore, appear to be about 31·95 times as great as that of a wax candle. This ratio resembles that of solar to terrestrial superficial attraction, and the connection of electric and magnetic currents with solar radiation is so evident, that additional experiments, to furnish materials for a great variety of similar comparisons, seem desirable. While it is possible that the resemblance in the present instance may be accidental, the numerous harmonies which exist between the manifestations of cosmical and molecular forces render it at least equally possible that it may have a weighty significance.

Academy of Natural Sciences, August 3, 1869.—Professor Cope called attention to a thin slab of shale containing foot impressions of vertebrate animals found some time ago by Professor Gabb, from the subcarboniferous slate in Schuylkill County. The position of the slab was about 300 feet above the conglomerate. The impressions found by Dr. Isaac Lea some years back were from a position about 700 feet below the conglomerate, and, therefore, more ancient. Professor Cope thought that the impressions found by Dr. Lea were neither reptiles nor fishes, but air-breathing vertebrates—*Batrachians.* But these tracks were different from most *Batrachia*, showing slender digits and long tarsus. The fore-feet are smaller than the hind. They are probably referable to a Salamandroid animal.

DIARY

THURSDAY, FEBRUARY 3.

ROYAL SOCIETY, at 8.30.—On the Fossil Mammals of Australia. Part III. Diprotodon Australis Ow.: Prof. Owen, F.R.S.—Note on an Extension of the Comparison of Magnetic Disturbances with Magnetic Effects, inferred from Observed Terrestrial Galvanic Currents, and Discussion of the Magnetic Effects Inferred from Galvanic Currents on Days of Tranquil Magnetism: The Astronomer Royal, F.R.S.

LINNEAN SOCIETY, at 8.—Revision of the genera and species of capsular gamophyllous *Liliaceæ*: J. G. Baker, F.L.S.—On a new form of Cephalopodous Ova: Dr. Collingwood, F.L.S.

ANTIQUARIES, at 8.30.—On some Ancient Oaken Coffins discovered in Northumberland: T. W. Snagge, Esq.

CHEMICAL SOCIETY, at 8.

FRIDAY, FEBRUARY 4.

PHILOLOGICAL SOCIETY, at 8.15.

ROYAL INSTITUTION, at 8.—Verona and its Rivers: Prof. Ruskin.

ARCHÆOLOGICAL INSTITUTE, at 8.

GEOLOGISTS' ASSOCIATION, at 8.

MONDAY, FEBRUARY 7

ROYAL INSTITUTION, at 2.—General Monthly Meeting.

ENTOMOLOGICAL SOCIETY, at 7.

MEDICAL SOCIETY, at 8.

LONDON INSTITUTION, at 4.

TUESDAY, FEBRUARY 8.

ROYAL INSTITUTION, at 3.—On the Architecture of the Human Body: Prof. Humphry.

ROYAL MEDICAL AND CHIRURGICAL SOCIETY, at 8.30.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Discussion upon Mr. Harrison's Paper "On Railway Statistics and Expenditure."

PHOTOGRAPHICAL SOCIETY, at 8.—Anniversary Meeting.

ETHNOLOGICAL SOCIETY, at 8.—On the discovery of Flint Flakes under a Submerged Forest in West Somerset: W. Boyd Dawkins, F.R.S.—On Remains of Pre-historic man in the neighbourhood of the Crinan Canal, Argyleshire: Rev. R. J. Mapleton.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Anniversary Meeting.

ARCHÆOLOGICAL ASSOCIATION, at 8.

WEDNESDAY, FEBRUARY 9.

GEOLOGICAL SOCIETY, at 8.—The Fossil Corals of the South-Australian Tertiaries. Prof. P. Martin Duncan, F.R.S., Sec. G.S.—Note on a very large undescribed Wealden Vertebra: J. W. Hulke, F.R.S.—Additional Observations on the Neocomian Strata of Yorkshire and Lincolnshire, with Notes on their Relations to the Beds of the same Age throughout Northern Europe: J. W. Judd.

SOCIETY OF ARTS, at 8.—On Loss of Life at Sea: Mr. J. W. Wood.

THURSDAY, FEBRUARY 10.

MATHEMATICAL SOCIETY, at 8.—Quartic Surfaces: Prof. Cayley.

ZOOLOGICAL SOCIETY, at 8.30.—On a new Cervine Animal from the Yang-tze-Kiang: R. Swinhoe.—On the Size of the Red Corpuscles of the Blood of *Moschus, Tragulus, Orycteropus, Ailurus*, and some other mammalia, with historical notices: G. Gulliver.

BOOKS RECEIVED

ENGLISH.—The Body and its Health: E. D. Mapother (Falconer, Dublin).—Our Domestic Fireplaces: F. Edwards (Longmans).—Handbook of Ferns: K. M. Lyell (Murray).—Transactions of the New Zealand Institute, 1868 (Trübner).

FOREIGN.—29 Monographie du Genre Ostrea Terrain Cretage Atlas: Coquand (Williams and Norgate).—Fortschritte der Physik im Jahre, 1866: Quincke Schwalbe and Wangern (Williams and Norgate).—Anthropolgie der Natur volker T. Waik (Williams and Norgate).—Physiologie des Menschen: E. Larisch (Williams and Norgate).—Einleitung in die Physik: Karsten, Harms, and Weyer (Williams and Norgate).—Histoire Generale de Paris. Planches: E. Belegrand.—Gebirgsschichten aus mikroskop. Bacillarien unter und bei der Stadt Mexiko: C. G. Ehrenberg.—Ueber die Macula Lutea des Menschen, &c: Fr. Mukel.—Anatomisch. System. Beschreibung der Alcyonarien: A. Kölliker.—Recherches sur la Faune de Madagascar: P. L. Polle, D. C. Van Dan.—Des Mollusques fossiles de la craie de Lemberg: E. Favre.—Recherches sur les Animaux Vertebr. vivant et fossiles: P. Gervais.

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JANUARY 1870] [PART III.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

"To the solid ground
Of Nature trusts the mind that builds for aye."—WORDSWORTH

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No. 10

No. 11

No. 12

No. 13

Publishing Office—16, BEDFORD STREET, STRAND

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & CO., at the Office, 63, Bleecker Street, New York.—THURSDAY, February 3, 1870.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

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No. 15] THURSDAY, FEBRUARY 10, 1870

Registered for Transmission Abroad]

ROYAL SCHOOL OF MINES,

JERMYN STREET.—Professor RAMSEY, LL.D., F.R.S., will commence a Course of Thirty-six Lectures on GEOLOGY, on Tuesday next, the 15th February, at Two o'clock, to be continued on each succeeding Wednesday, Thursday, Monday and Tuesday, at the same hour. Fee for the Course, £3.

Professor GOODEVE, M.A., will commence a Course of Thirty-six Lectures on APPLIED MECHANICS, on Tuesday next, the 15th of February, at Twelve o'Clock, to be continued on each succeeding Wednesday, Thursday, and Tuesday, at the same hour. Fee for the Course, £3.

TRENHAM REEKS, *Registrar.*

THE SARS FUND.

	£	s.	d.		£	s.	d.
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Dr.W.B.Carpenter, F.R.S.	2	2	0	Dr. Frazer Thomson	1	0	0
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W. P. Beale, F.G.S........	0	10	6	Dr. Edward Charlton......	2	2	0
Dr. Holl, F.G.S...........	1	1	0	R. B. Bowman...............	2	2	0
Prof. P. Wright, F.L.S...	2	2	0	Dr. Dennis Embleton......	1	1	0
C. B. Rose, F.G.S.......	1	1	0	J. Blacklock..................	1	1	0
Prof. Dickie, F.L.S.......	0	10	0	Rev. W. Greenwell	1	1	0
T. F. Jamieson, F.G.S....	1	0	0	Dr. J. E. Gray, F.R.S. ...	5	5	0
Prof. Bell, F.R.S...........	2	2	0	Alfred Higgins, Esq........	0	10	0

Further Subscriptions will be thankfully received by the undersigned,
J. GWYN JEFFREYS.

25, Devonshire Place, Portland Place, London,
February 1, 1870.

R. A. PROCTOR, Esq., F.R.A.S., on

Sunday next, February 13, at 7, on "The Physical Condition of other Worlds," at South Place Chapel, Finsbury, followed by Selections from "SAMSON" and other Oratorios, by Miss ARABELLA SMYTH, Mr. AYNSLEY COOKE, &c. Chorus of 80. Tickets, 3*d.*, 6*d.*, and 1*s.*, at the doors. Professor HUXLEY'S lecture on "The Races of Great Britain," verbatim, 1*d.*

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SHARPEY MEMORIAL.

Subscriptions towards the Fund for establishing a "SHARPEY PHYSIOLOGICAL SCHOLARSHIP," in connection with a "SHARPEY PHYSIOLOGICAL LIBRARY and LABORATORY," in University College, and for procuring a Portrait or Bust of Dr. Sharpey, to be placed in that Institution, continue to be received, on behalf of the Committee, by the undersigned.

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London, 1st Jan., 1870.

THURSDAY, FEBRUARY 10, 1870

THE ROYAL COMMISSION ON SCIENCE

THE Council of the British Association for the Advancement of Science was received on Friday last by Earl de Grey, Lord President of the Council, as a deputation to urge on the Government the issuing of a Royal Commission to inquire into the state of Science in England.

That such a body, representing as it does, not only the science but the intellect of the nation, more fully than, perhaps, any other association in the kingdom, should take so decided a step is sufficient proof that in the judgment of those best qualified to guide public opinion on the subject, our scientific system needs reform.

The truth is that we have no scientific system, properly so called. Nothing can be more distinct than Prof. Stokes's statement to Earl de Grey as to the incompleteness of our arrangements. We have it on his authority that a certain class of Astronomical observations is carried on at the Royal Observatory and that natural objects are displayed at the British Museum; but that experimental research receives "little or no support" from the State. It is not easy to frame a plausible distinction between these branches of science, which shall justify support in one case and neglect in the other. The existing anomaly may be explained by the facts that astronomy and natural history have engaged the attention of man from the earliest ages and that they appeal palpably to his senses; whilst chemistry and physics are comparatively recent studies, whose aims and processes and even many of their results are understood and appreciated only by the few, though ministering to the welfare of all. Chemistry, in the modern sense of the word, is not a century old; electricity and electro-magnetism are younger still. Mainly by private means, these and cognate branches of science have been advanced in England to their present stage; "but," says Prof. Stokes, "it was perfectly obvious that there were many investigations which it was desirable to carry out and which would require the main part of a man's time; but which involved appliances on so large a scale as to be beyond the power and scope of a private establishment." The plain inference from this pregnant statement is that these desirable investigations cannot be carried on for want of means. It is notorious, indeed, that progress is stayed in many important directions for want of those "appliances and establishments" and that "time" which it is hopeless to expect from private sources.

Still, it may be urged that there is not so much need for these investigations as to demand that the State should undertake them; or, that the help of the State has something noxious about it which tends to paralyse the spirit of philosophical inquiry. Let us examine these two very different objections. The simple answer to the first is given by the very proposal of the deputation. They do not, on their sole representation, weighty though that must be admitted to be, demand that Government physical laboratories shall be established. They say, "We think such things are wanted; but do not take our word for it. Inquire; constitute a commission composed of persons of station, independence and statescraft, to receive our statements and to sift from them our interested enthusiasm, reducing what may be our too soaring aspirations to practical and business-like proportions. Inquire first and then act, if you see fit; but do not persist in neglecting, without inquiry, things that ought to be done."

With regard to the second objection, namely the paralysing effect of State aid, we can only treat it as a purely sentimental notion. Does Mr. Airy's salary paralyse astronomy? Does Sir Henry James's salary paralyse Geodesy? Does the money spent on art at South Kensington, on pictures for the National Gallery and on collections at the British Museum, paralyse those establishments? Is there something so peculiar in experimental labours as to place them in a category by themselves, subjecting them to malign influences from which the whole of the rest of the business of life is exempt? Are such labours so exceptional in their nature that whilst a public body like the Royal Institution shall purchase apparatus and pay salaries and thus stimulate the genius of Davy, Faraday and Tyndall, the same apparatus and stipends given to them by the State must have reduced these men to torpor?

But to return to practical matters. The main points for a Royal Commission to throw light upon are these. First, is it right that science should be aided at all by the State? Secondly, is the aid now given exactly what is needed—neither too much nor too little? Thirdly, the degree and direction in which science should become a State business having been settled, what will be the best organisation for the purpose? Not one of these points has ever yet been thoroughly considered in England. At present all is arbitrary, inconsistent and incomplete: or, to use Prof. Huxley's comprehensive word, "chaotic." The British Association wishes naturally to reduce chaos to order and they wisely begin—not by definite requisitions for things which few out of their charmed circle know the value of; but by a moderate demand for inquiry. This cannot possibly be refused to them. The nation is thoroughly awakened to a sense of its shortcomings as to education and it will be quite prepared to further those ends to which education is merely a means. The outlay which it will be called upon to provide need not be great; indeed, at first we shall have to deal more with the utilisation of what we already possess, than with the creation of new means. The great point is first to establish a sound principle of working and then to apply it by degrees, with caution and economy.

The word education reminds us of its occurrence in the course of the proceedings before Lord de Grey. Education and Science so naturally associate themselves in the mind that it is hardly possible to discuss the latter as independent of the former. Almost all the great continental scientific endowments include instruction in some form or other. And in this country the greater number of our most distinguished men of science are professors and teachers. The question of scientific instruction must, therefore, necessarily be considered by those who inquire into the question of scientific research. This will be by no means the easiest part of their labour. The complaint now is that men eminently qualified for research have too much of their time occupied in teaching. It will be difficult so to apportion the two functions that they shall reinforce and not obstruct each other. And again, there are some departments of science which experience has shown may be safely dissociated from instruction. Astronomy furnishes an example. Mr. Airy would probably not consider that the teaching of a class would aid him much in his peculiar duties.

We have said that this part of the inquiry will be difficult. The whole inquiry is indeed fraught with difficulty. It means nothing less than the constituting of a department of the State of which even the nucleus cannot be said, as yet, to exist. To do this liberally and efficiently and yet, with such regard to economy as shall make the result visibly beneficial to the community on whom the cost will fall, will be an achievement worthy of any statesman's ambition; but beyond no real statesman's reach.

We do not doubt that the Commission will be granted. Lord de Grey and Mr. Forster are too experienced to attach undue importance to the apparent want of harmony between some of the opinions expressed, or to suppose that all the grounds on which the Commission was asked for could be given in an hour's conversation. They will rather be swayed by the representative character of those who asked for it.

PETROLEUM AND ITS ALLIES

CONSIDERABLE anxiety has for some time past prevailed as to the existence of danger attending the use, storage and transport of the mineral oil now used for illuminating purposes and, as the questions involved are not only of great importance in many respects; but likely to be soon brought prominently before the public, some account of the sources of mineral oil and of its characteristics will probably be acceptable to our readers.

Thirty years ago, or less, the materials which form the subject of this article were almost unknown to either commerce or manufacturing industry. With some few exceptions, such as the use of the petroleum of Miano, in Italy, for lighting the streets of Parma and Genoa in 1800, natural mineral oil was only in scanty demand, under the name of Persian naphtha, for some few minor purposes and it was generally rare, even as a curiosity, in mineralogical collections. The analogous oils obtained artificially, by the distillation of coal and other bituminous materials, were even less familiar; for no material was then known that would yield them in sufficiently abundant proportion to admit of their being manufactured on a commercial scale. For this reason mainly, the various attempts to produce such oil were a succession of failures commercially and it was not until about the year 1840 that Mr. James Young, of Glasgow, had the good fortune to meet with a peculiar bituminous mineral—the precise character of which has been the occasion of much controversy—capable of yielding a very much larger proportion of oil by distillation than any other material of a similar kind. The discovery of this material and the recognition of its oil-yielding capability, were speedily turned to account by Mr. Young and his colleagues, forming the basis of a manufacture that has now assumed gigantic proportions and furnishing a commodity which is, for many thousands of people, a daily necessary.

But scarcely had this paraffin oil, now so well known, begun to come into general use as an illuminating material, than a formidable competitor appeared in the market in the shape of natural mineral oil, derived, at first and for a brief period, from Burmah and subsequently, in overwhelming abundance, from certain districts of North America, chiefly Pennsylvania and Canada. Since the first working of the petroleum deposits of America—about the year 1860, the exportation of this material, or of products manufactured from it, has increased rapidly and it now amounts to little less than one hundred million gallons a year.

The character of the refined petroleum imported from America has had much influence in extending its use; for, its pleasing appearance and comparative freedom from disagreeable smell, have gained for it a popular preference that so far is not unfounded.

American petroleum, however, contains a large proportion of a very volatile oil or spirit and, consequently, since the introduction of American refined petroleum into the market, the greater part of the oil derived from that source has been characterised by a greater degree of inflammability than the oil manufactured from Rangoon petroleum and from coal or shale; this difference being due to the fact that the volatile spirit, so abundant in American petroleum, is not completely separated in the process of refining. By leaving this spirit in the refined oil, a larger produce is obtained by the manufacturer and there is a further advantage gained in this way, owing to the fact that the volatile spirit, when separated, generally sells for only half the price of lamp oil.

The practical question in regard to the safety of mineral oil and its fitness for domestic use, is as to the extent to which the more volatile portions of the crude materials should be separated in the refining operation. Although in reference to this question, the possibility of careless and improper usage of the oil cannot reasonably be regarded as justifying any considerable restrictions in the application of a material so useful; still some allowance requires to be made even for that possibility, taking into account the conditions under which mineral oil is carried, stored and used in a general way. The point to be ascertained is not merely what oil may be used without necessary danger; but what description of oil will best answer the purposes for which it is intended, without requiring a greater degree of caution in its use than can fairly be expected, or any unreasonable restriction on the trade. Hence it would seem to be desirable for the convenience of those engaged in the mineral oil trade, as well as for ensuring public safety, that every branch of this trade should be subject to appropriate regulation: that the degree of inflammability of mineral oil should be limited; a definite standard established and, a mode of testing the oil adopted, which would not admit of discrepant results being obtained, either by accident or otherwise.

With this general object an Act of Parliament "for the Safe Keeping of Petroleum" was passed in 1862, prohibiting the storage of more than forty gallons of petroleum within fifty yards of a dwelling-house or building in which goods were stored, except in virtue of a license granted by local authorities who had the power to annex to their licenses any conditions thought necessary for diminishing risk of damage by fire or explosion. The application of the term "petroleum" in this Act was specially limited to crude petroleum, or any product of it giving off inflammable vapour at a temperature less than 100° Fahr. This Act may be said to have been entirely without effect on the refined petroleum sold for use in lamps and, another Act, passed in 1868 to amend it, has been but little more effective in this respect; so that the facts as to the storage and sale of mineral oil, of all degrees of inflammability, remain much the same as they were before.

The abortive character of this Act is probably to be ascribed, in great measure, to a conflict of interests, supposed to be opposite, when the bill was before Parliament and a further reason for its inoperative character, consists in the absence of any sufficient or fitting organisation for carrying out its provisions and regulating the trade in mineral oil. Strange to say, the licensing bodies have, generally speaking, no power under the Act to inspect and test mineral oil, except as a condition of licenses granted by them and the persons who are specially authorised by the Act to inspect and test, are not in most cases under the control of the licensing bodies. Of still greater influence in nullifying the provisions of the Petroleum Acts, is the want of any properly-constituted authority for instituting proceedings in cases where those provisions have been infringed. Any person may prosecute; but, as is generally the case with a duty so general, everyone leaves it for some one else to do so.

But perhaps one of the chief reasons why the Petroleum Act of 1868, has proved inoperative, is to be found in the unsatisfactory nature of the test by which the fitness of mineral oil for domestic use is directed to be ascertained and in the vague terms by which the operation of testing is described in the schedule appended to the Act. The point to be ascertained is the temperature at which mineral oil gives off inflammable vapour and, since any danger that may arise in this way, would exist chiefly in the ordinary use of the oil in lamps, it would seem to be an obvious necessity that the test, applied to ascertain that point, should be conducted under conditions as nearly resembling those obtaining in the actual use of the oil as could possibly be devised. The Act, however, prescribes a test under conditions which are the direct opposite of these. In using a mineral oil lamp, the oil is heated in a closed vessel partly filled with air; in testing the oil it is directed to be heated in an open vessel with the surface of the oil freely exposed to the atmosphere. In the test, any vapour that is given off from the oil is liable to be blown away by draughts and by diffusing into the surrounding air, to become so much diluted as to lose its inflammable character; while, in the lamp, any vapour given off is confined and forms an explosive mixture with the limited quantity of air contained in the oil reservoir. There is indeed, generally speaking, little real danger attending such a result as this, for the quantity of inflammable vapour produced in the reservoir of a lamp would rarely be sufficient to cause any dangerous explosion; but the flash resulting from the ignition of this vapour, would certainly be enough to startle almost any persons and cause them to drop the lamp. It is probably in this way that many of the accidents with mineral oil have taken place, since the lamps are very generally made of glass and since the oil readily takes fire when spilt upon linen, paper, or any such material.

Besides this cardinal defect in the prescribed test of mineral oil, the various directions given for conducting it are so vague and general, that they leave much to the fancy and option of the operator. Moreover, it is to be doubted whether inspectors of weights and measures, who are the persons authorised under the Act to test mineral oil, are generally competent to conduct these tests in a satisfactory manner.

Although the Act has been in operation only a few months, it has already given rise to much difficulty and inconvenience, without being productive of any benefit. Within the last few weeks, a series of trials of mineral oil, purchased indiscriminately at shops in various parts of the metropolis, has brought to light the fact that, out of 75 samples thus obtained, 39 of them were below the legal standard in regard to inflammability, when tested in strict accord with the directions of the Act.

These facts are sufficient to show that there is great need of further legislative action in this matter; this need has long been felt by those engaged in the mineral oil trade and there is every reason to believe that a well-digested enactment, providing for the safe transport, storage and use of mineral oil, would be of great benefit, not only to the public at large; but also to those engaged in all branches of the trade connected with this useful commodity.

HOSPITAL CONSTRUCTION

An Address on the General Principles which should be Observed in the Construction of Hospitals. Delivered to the British Medical Association at Leeds, by Douglas Galton, C.B., F.R.S. (London: Macmillan and Co., 1869.)

THIS able address with the discussion which followed it, brings fully before us the question of hospital construction. The Address itself is exclusively practical: it goes direct to its object and, by appealing to the results of every day's experience of the benefit of cleanliness, space and fresh air; it points out how these essential elements in the management of the sick, have been embodied in recent hospitals and it indicates by implication, what errors should be avoided.

After stating briefly the work done in this matter by different Sanitary commissions in this country, Mr. Galton gives the following enumeration of objects which must be attained in hospital buildings:—

"1. Pure air, that is to say, there should be no appreciable difference between the air inside the ward and that outside the building.

"2. The air supplied to the ward should be capable of being warmed to any required extent.

"3. Pure water, so supplied as to ensure the removal of all impurities to a distance from the hospital.

"4. The most perfect cleanliness within and around the building."

To realise these conditions the first step in hospital improvement is to select healthy sites, away from irremovable sources of air impurity and, having by this means obtained a pure moving atmosphere, the author proceeds to show how the site is to be used so that the pure atmosphere may not become a disease generator in the wards. The building must be so arranged as to interfere as little as possible with the free, natural movement of the outer air and this free outside movement should be kept up, as far as practicable, within the wards. "Stagnant air is foul air," especially in a hospital.

It has been experimentally shown that ward-air moves most readily when care is taken to combine as far as possible the following requirements:—1st, To let the prevailing outer air currents strike the *sides* of the wards; 2nd, To provide that the sun shall shine on the opposite sides of the wards every day he shines: 3rd, To have windows on opposite sides of the wards, with the beds arranged between them. A proper use of these opposite windows is the *sine qua non* of ward ventilation and of ward healthiness. But, in cold variable climates, provision has to be made for graduating the ventilation and for warming a portion of the air.

The subsidiary means which have been found to answer in practice are foul air shafts, fresh air inlets close to the ceiling, and warm air stoves—of a peculiar construction described in detail—so contrived that, while the ward is heated by radiant heat, the air warmed is not ward air but fresh air.

The cubic space per patient is determined primarily by the superficial area per bed, which, in its turn, is determined by the area required for efficient nursing. From 90 to 100 square feet per bed is sufficient, except in hospitals where there are medical schools. The cubic space per bed hence depends on the height of the ward.

There is but one test of ventilation and that is freshness of the ward air. No quantity test is of any avail, hence ventilation, that is, the proper use of the means of ventilation, is an essential part of ward administration. No man or woman who has not a sensitive nose and who has not also a perfect horror of bad smells or closeness, should ever take office in a hospital.

The central point in hospital construction is the ward itself and the following figure shows the usual arrangement of the ward and its offices, in the new class of hospitals.

FIG. 1.

On one side of the entrance is placed a nurses' room; on the other side of the entrance is placed a small scullery. In the ward itself the beds are arranged two and two along the wall spaces between the windows, with a bed at each corner. At the further end of the ward is a large end window. On one side of this window there is a building, thrown out from the corner, in which are placed the water-closets. The other building, at the opposite corner, contains the lavatory and bath-room.

The next figure shows the simplest arrangement of these ward units in a regimental hospital. Such a building can be constructed on one or two floors. The administrative portion, together with two or four small wards for special cases, occupies the centre of the block and the kitchen is detached. The larger wards project at either end. (A, fig. 2.)

A very important question, raised by Mr. Galton, is the manner in which hospital accommodation should be provided for recurring epidemics, fevers, cholera and the like. He shows that the cheapest and most effectual provision consists of temporary huts, a result which we commend to those who consider that large, costly, permanent fever hospitals are necessary for London.

With this general statement of the principles we must refer our readers to the address itself for the numerous points of detail which require to be attended to for securing due care and prompt attendance on the sick. They are all in strict accordance with scientific requirements and, if intelligently applied, will save many valuable lives.

We wish we could say as much of some portions of the discussion which followed the address. We allude to the obtrusion of the "germ" disease hypothesis into the hospital question. This theory, it is true, met with little countenance from the meeting; but there it was. In one sense its introduction was useful as showing what the final results of such a doctrine are. Of disease itself we know little scientifically as yet; nevertheless, it has become a fashion of late to supplement lack of knowledge by assuming that certain diseases are separate specific existences like animal or vegetable species, each springing from a "germ" or seed introduced from without; hence in the discussion it was averred that the supposed destructive influence of carbolic acid on these "germs" can be made to supply the place of fresh air in hospital wards, and, as a consequence, that the danger has to be encountered, not in foul air but in disease "germs."

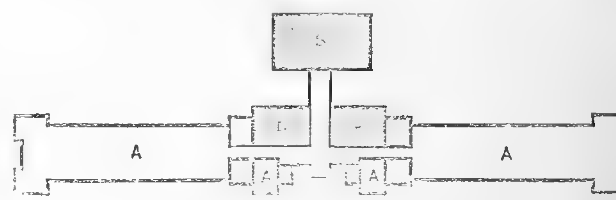


FIG. 2.

There may be disease "germs" for anything we know; but, until their existence is proved physically and until it is shown that there are germs with different distinctive specific characters, each of which germs can be shown to produce always the same group of symptoms in the human body, which symptoms can arise from no other cause; we can in no sense recognise the existence of disease germs. In scientific questions of this kind, "*de non apparentibus et de non existentibus eadem est ratio.*"

To neglect the ventilation and other sanitary arrangements of hospitals for a mere theory, would be to undo all that has been done in hospital improvements in Europe, with the inevitable result of destroying life.

Mr. Galton concludes his paper with some pertinent remarks on the cost of useless ornament in hospitals, which we commend to the consideration of hospital architects. Hospital resources are limited, patients are many—too many we should say.

Miss Nightingale begins her admirable "Notes on Hospitals"—a book which has done great good—with this startling passage:—"The very first requirement of a hospital is that it should do the sick no harm." Have hospitals, then, done harm to the sick? We are sorry to say that there are few of the older, badly constructed, ill-ventilated hospitals in any country which have not their calamitous records of immense death rates at all times and, especially, during epidemic seasons.

No one can read Mr. Galton's address without recognising that, from first to last, it is a protest against hospitals. Why are all these precautions and costly appliances necessary, unless it be to enable the sick poor to be grouped together in hospitals without destroying their lives?

Are not all these precautions a tacit admission that in breaking the family tie, in sickness, we are acting against Nature? She has bestowed the "family" with its common joys, sorrows and duties, on the human race. If, in order to aid the poor in sickness, it is necessary to break up the family tie and to expose the sufferers to risks in hospitals which they might escape at home, we would suggest whether there be not a prior question—namely, whether we cannot improve the dwellings of the people, make them better adapted for sickness as well as for health and thus look forward to the abolition of hospitals altogether.

We are, as yet, far from this consummation and, if we must have hospitals, we are bound to make them not only harmless, but useful. Mr. Galton has added a valuable contribution to the literature of hospitals in showing how this may be done.

ENTOMOLOGY IN AMERICA

A Guide to the Study of Insects and a Treatise on those Injurious and Beneficial to Crops: for the Use of Colleges, Farm-Schools and Agriculturists. By A. J. Packard, Jun., M.D. With upwards of 500 Engravings. Parts I.-VIII. (Salem: published by the Essex Institute, 1868-69. London: Trübner and Co.)

IT must be confessed that our American brethren are inclined in the present day to advance in the study of natural history, as in everything else. We can call to mind a dozen or more thriving institutions for the advancement of Science, especially natural history, in various towns in the United States, some of the names of which are hardly known to us, except by their scientific publications.

The Governments, both of the whole Confederation and of the different States, show a liberality in patronising scientific researches and in diffusing the results of those carried on under their auspices, which we should be glad to see imitated nearer home. A great number of American naturalists enter boldly upon investigations which but few of their distant relations on this side of the Atlantic, seem inclined to take up: their papers are generally of interest, and, not unfrequently, of great value.

In no department of zoology are the zeal and energy of the American naturalists more clearly shown than in the study of entomology. Doubtless, in the United States, as elsewhere, there are a great many amateurs, who rush into print with crude notions and write perhaps too hastily; but amongst the American entomologists there are several who are doing excellent work in the elucidation of this branch of the natural history of their country and even attacking groups, such as the *Ichneumonidæ*, in face of which German or Scandinavian pertinacity recoils baffled, or makes but little way.

Dr. Packard, the author of the "Guide to Entomology," of which eight parts (out of ten) are now before us, is well known as a writer on American insects, chiefly Hymenoptera and Lepidoptera,—he has also made some original investigations upon the anatomy and physiology of insects. The first portion of his book, occupying nearly two parts, is devoted to general entomology and furnishes an admirable, though necessarily brief, account of their organisation, of their reproduction and development in the egg and of their metamorphoses. The most recent memoirs connected with these subjects, have been made use of by the author and this part of his work is certainly the best manual of entomology which the English reader can at present obtain. The author concludes the general section of his work with directions for collecting and preserving insects, followed by a short bibliography and then proceeds to discuss the classification of insects.

In his classification, Dr. Packard departs somewhat from the generally received views, especially in regarding the class of insects as including, along with the true six-footed and generally winged forms, the Spiders and Myriapods, which have either eight or many feet. It is true that the Myriapods approach the true insects very closely; but the passage indicated by Dr. Packard from the Diptera to the Spiders appears to be founded solely on superficial resemblances and it by no means warrants the union of the *Arachnida* with the Insecta, although that of the *Myriapoda* may perhaps be accepted. Of course, as the boundaries of the class of insects are thus enlarged, the true insects of other authors have to occupy a lower rank in the system and Dr. Packard treats them as forming a single order of his class insects. He then adops the usual seven ordinal divisions as "sub-orders" and indicates their arrangement in two slightly divergent series as follows:—The Neuroptera, or lace-winged flies, form a common starting point, from which issue, on the one hand, the Orthoptera, Hemiptera and Coleoptera; on the other, the Diptera, Lepidoptera, and Hymenoptera, the latter series being the highest. The author does not state that he regards this as a genealogical tree, or as expressing the course of evolution of the groups; in any case the relationship of the Hemiptera to the Coleoptera does not seem very clear.

These slight objections to some of our author's theoretical views of classification do not, however, apply in the least to his exposition of the classification itself, which is admirably clear and complete. Under each order he gives a general account of the structure and habits of its members, followed and illustrated by a more detailed description of the characters and mode of life of particular species, arranged under their respective families. The examples selected by the author consist, for the most part, of the commonest species inhabiting the United States, a circumstance which will necessarily form a little drawback to its usefulness in this country; although, from the fact that great numbers of the North American insects have their allies, if not representatives, in Britain, the descriptions of habits, at any rate, will be generally applicable.

The study of economic entomology, especially with reference to insects injurious or beneficial to agriculture, has long been zealously followed in the United States, and the writings of Harris and Fitch are well known on this side the Atlantic.

OUR BOOK SHELF

The Sun. By Amédée Guillemin. Translated by T. L. Phipson, Ph. D. Pp. 296. 58 illustrations. (Bentley.)

MONSIEUR GUILLEMIN is favourably known among us by his beautiful book "The Heavens" and the present volume may be regarded as a considerable expansion of his chapters on the sun in that work, with additional matter, giving an account of the recent solar discoveries. The expansion has been very judiciously done; but the new matter introduced has been added, in too much haste and consequently the recent conquests of Science do not come out so satisfactorily as they might otherwise have done. In "The Heavens," M. Guillemin did what Frenchmen very rarely do—he took the trouble to inform himself on what was done in England, America and Germany. In the present instance he has taken his information from French sources exclusively and the result is poor.

Still, for those whose purpose it is to inform themselves on the sun generally, the book fills a gap and may be safely recommended. Mr. Phipson has done his part well—except where he has added notes and the book in its English dress is pleasant to the eye.

Handbook of Physical Geography. By Keith Johnston, Jun., F.R.G.S. Pp. 220. (W. and A. K. Johnston, Edinburgh and London. 1870.)

THIS is the text to accompany the altogether satisfactory half-a-crown atlas we noticed some time ago and in saying that the text is as good as the maps, we intend to convey high praise. Within the limits of somewhere about 200 pages, Mr. Johnston has contrived to give a very admirable account of the various natural phenomena with which physical geography has to deal; the facts are well and widely chosen. The style is clear and the arrangement a very model.

Of the four divisions of the book—Topography, Hydrography, Meteorology and Natural History, the two central ones possibly present evidences of the greatest care; for instance in Map 18 (the Mediterranean basin), the contour lines both of height and depth have been investigated by Mr. Johnston expressly for this work and in Map 13 (Physical Geography of Palestine) the isotherms have been worked out from observations at Alexandria, Cairo, Jerusalem, Beirut, Damascus, Aleppo and other places.

We heartily commend this book both to teachers and students.

The Advanced Atlas: consisting of Thirty-two Maps, containing all the Latest Discoveries and Changes in Boundaries; *The Progressive Atlas:* consisting of Thirty-two Maps—and *The Primary Atlas:* consisting of Sixteen Maps. All constructed and engraved by J. Bartholomew, F.R.G.S. (William Collins, Sons, & Co. Glasgow, Edinburgh and London.)

ALL these maps, even including the sixteen in the "Primary Atlas" which sells for sixpence, are printed in colours; their engraving is of a high order, the maps being rendered clear by a judicious omission of names. It would have been better for the young student if the boundaries between States, *e.g.*, Turkey and Greece, had been made more decided in the "Advanced Atlas." Great care has been taken in many cases, Africa for instance, to introduce the most recent discoveries.

Echoes in Plant and Flower Life. By Leo H. Grindon, Lecturer on Botany at the Royal School of Medicine, Manchester. (London: Pitman, 1869.)

WE opened this little book in the hope of finding some new light thrown on the fascinating subject of Mimetism. The writings of Mr. Darwin, Mr. Wallace, and Mr. Bates have made even the non-scientific reading public familiar with the existence of wonderful external resemblances between animals belonging often to widely different natural orders; resemblances which those writers have sought to explain on the theory of Natural Selection. Though the most remarkable instances of Mimetism to which attention has been drawn, are chiefly to be found in the tropics, scarcely less interesting examples are furnished by certain families of our own native Hymenoptera and Diptera: even in the vegetable kingdom we need not seek far for superficial resemblances which are not underlain by any corresponding similarity of organic structure. To trace these "echoes" in plant life (why "Plant *and* Flower Life" we do not know), is Mr. Grindon's hobby and to say that he rides his hobby too hard is only what might perhaps be expected. There is only a very limited number of ways in which anthers can open to discharge the pollen and to call the dehiscence by recurved valves of the bay tree, an "echo" of the same method in the barberry, seems to us an instance of decidedly hard riding. Nevertheless the writer has collected together a large number of very interesting facts which will be of service to anyone who hereafter attempts a scientific explanation of these phenomena. The writer does not; we hope some one else will and he will then find this little book of some value. The style in which it is written, is not such as to commend it to the man of science. In his preface the writer says, "to be a philosophical treatise, the treatment must be æsthetic." When we find the flowers of plants described as "those sweet harp-strings which, vibrating for ever, preserve to us the melodies of ancient Eden and by which they will be floated down the ages yet to come," the treatment of the subject may be æsthetic; we can hardly admit it to be philosophical. Would Prof. Huxley or Dr. Hooker recognise the following description? "Every true naturalist enjoys a renewed puberty of the soul. While other people are young but once, he, like the cicada, in age recovers his spring-time. In this respect he is abreast of the man of genius, whose privilege, like that of the sunshine, is to weave as lovely a sky for the evening as for the morning."

A. W. B.

British Lichens—Lichenes Britannici; scripsit Rev. Jacobus M. Crombie, M.A. (London: L. Reeve and Co 1870.)

MR. CROMBIE is well-known as an indefatigable hunter after lichens and one who has added a considerable number of new species to the British flora. This little book contains a record of the habitat and distribution of the 658 species of lichens at present known as inhabitants of Great Britain and Ireland, together with references to the authorities where descriptions are to be found and the synonymy. The classification followed is that of the veteran lichenologist Nylander, to whom the work is dedicated and the whole is written in Latin. It ought to be in the hands of everyone interested in this branch of our cryptogamic flora. A. W. B.

Chimie Organique en 1868.—*Rapport méthodique sur les progrès de la Chimie organique pure en* 1868. Par L. Micé. Large 8vo. pp. 446. (Paris: Baillière. 1869.)

WHEN we opened this work and found that the author had attempted, for the first time, what he truly designates as "neither an easy nor a glorious task" and that he intends his book to be a sufficiently concise and yet detailed annual report, a suitable "vade-mecum for a professor of high-class instruction," we formed expectations which were not quite realised on further perusal. M. Micé wrote this report at the request of the *Société des Sciences Physiques et Naturelles*, who purpose publishing similar reports annually. The title, it will be perceived, is perfectly general and it might have attracted any student of organic chemistry. But the author informs us (p. 1) that his book "can only be useful on condition of being methodical and *containing no more than a Faculty professor can deliver, from memory, in his lectures*." We should strongly recommend M. Micé, especially as he proposes to extend this plan to the entire domain of chemistry, to alter his title-page before again proceeding to publication. "Lecture Notes for Professors of Chemistry" would be a much more appropriate designation; less pretentious, certainly, but having the great advantage of accuracy. Undoubtedly, the author has succeeded in producing a *rapport méthodique*; but it is decidedly not a *rapport sur les progrès de la Chimie organique pure*, nor has it that nice adjustment between details and conciseness which is the essential requirement of such a treatise. The only work which fulfils and ably fulfils these conditions, is the German "Jahresbericht der Chemie," a model of patient and deliberate composition. M. Micé will find prefixed to it a list of some sixty or seventy periodicals, containing the various original papers to which it refers. We may fairly ask him whether many French professors (*du haut enseignement*) will be satisfied with the basis he has selected, viz., five French journals and the 3rd edition of MM. Pelouze and Frémy's "Traité de Chimie." Considering that the author has had recourse to such a method of shortening his labours, it is not surprising that the performance should exhibit a generally hasty character. At p. 117, for example, we find the following passage:—"Théine gives up a quarter of its nitrogen, creatine a third, the other natural and artificial alkaloids one-half." It so happens that the experiments in this particular case, instead of being carried out with *all* nitrogenous organic bodies, were pardonably limited to nineteen instances. We regret we cannot commend this work, as fulfilling either the promise held out on its title-page, or the more limited intention expressed in its opening paragraphs.

History of Creation.—*La Création d'après la Géologie et la Philosophie Naturelle.* Par J. B. Rames. (Paris: Hachette.)

THIS is an odd book. Even in these days of sensational works on science we are not sure that, in his own style, M. Rames has been surpassed. His purpose is to describe in a kind of prose epic, the history of our planet and its inhabitants, from the nebulous condition of the solar system down to the present day. Apostrophising sun, moon and stars by turns, he tells them how they have been fashioned and of what uses they are. Tyrants and philosophers come in for appropriate addresses and then the writer plunges into the depths of the primeval ocean in which the Laurentian rocks were formed. He finds its waters hot, charged with silica and in the act of depositing crystalline rocks in the form of gneiss and schist. One day—whether in the depths of the thermal ocean, or in the lakes that dotted the lonely islets, he cannot tell—"Life, one of the special forms of solar heat pervading the universe like all the other natural forces, finds, for the first time upon our globe in little aggregations of inert matter, the conditions which allow of its manifestation, and thus rises dimly the dawn of an organic kingdom." The subsequent development of these primal germs into the complex genera and species of the animal and vegetable world, through its succeeding geological formations, forms the subject of the remaining portions of the book, of which, however, only the first part, reaching into the Permian period, is published. M. Rames seeks no adventitious aid from sensational pictures: not a single illustration occurs in his book. He trusts wholly to the powers of his pen and has certainly produced a lively, if not very trustworthy, narrative.—A.G.

THE WORK OF THE SEA

THE work done by the Sea is infinitely various, immeasurable in quantity and of inexpressible value to the inhabitants of the earth. It is the one ceaseless worker, never resting and ever accomplishing the tasks it has to perform. The land and the sea may appear to some to be for ever fixed and unalterable, and the map of the world represents to them the geography of the globe of 6,000, or 60,000 years ago, the geography of to-day, and the geography of 60,000 years hence. Still not only does Geology show by the testimony of the far-distant past the impossibility of this being so; but it has been given to man to see and record the constant rising and falling of the land, within the periods of history and even to measure the movement with sufficient accuracy and such certainty as to enable him to venture predicting, to some extent, on the probable geography of the future.

The Earth is born of the Ocean. Continents and islands rise out of the sea, new, luxuriant and vigorous; and like ourselves they grow, mature and do their appointed work; then wane and seem to die, though they do *not* die. They sink beneath the waves, apparently for ever; but only to be regenerated, renewed, quickened into life and born again remodelled. And the sea—the invigorating and ever-toiling Mother—works this wonder.

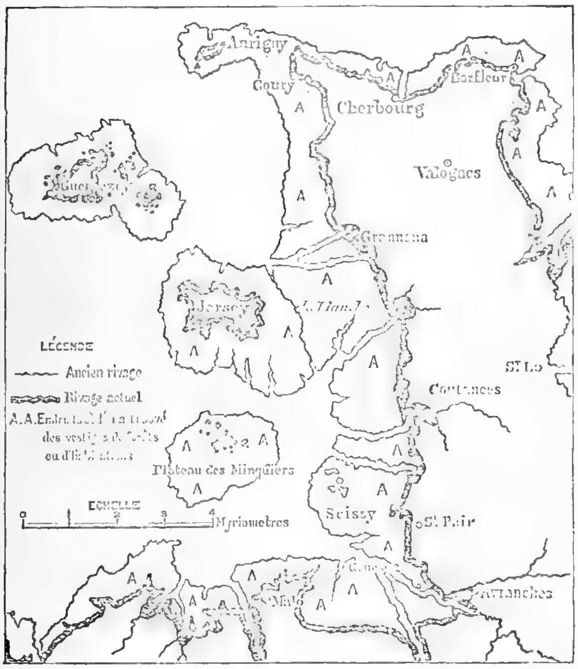
Mons. Quenault, Sous-Préfet de Coutances, in a little book called "Les Mouvements de la Mer," has lately given us some exceedingly interesting facts, which he has gathered from old records, as well as from his own observation and other sources, respecting the sinking of the land and the encroachments of the sea on the coasts of Brittany, Normandy and other places on the western borders of France. Thus, in the Gulf of Cordouan at the mouth of the Gironde, the sea has advanced 730 metres, within twenty-eight years; the buildings on the Pointe de Grave have often been destroyed and rebuilt and the lighthouse is now removed, for the third time, more inland. The sea flows more than ten metres deep over what a short time since was a sandy beach. Twenty-five more years and the Atlantic will flow over the marshes of Soulac and Verdun; the Gironde will enter the sea by a second embouchure and the Isle of Cordouan, detached from the continent, will gradually become a mere rock.

The legends which are recounted among the population of Brittany lead one to think that many places in the neighbourhood of the coast—to-day immersed—were formerly above the level of the sea. In their native poetry and with their passion for the marvellous, the country people refer these facts to supernatural agency, where the Devil plays a prominent part. The bay of Douarnenez, where at high water the depth is considerable, is the site of a once flourishing city, the town of Ys, the capital of Cornouaille. At the south side, when the tide is low, are distinguished clearly, five or six metres under water, Druidical remains, altars, portions of walls and ruins of various monuments. Again, on the opposite side, near Cape Chèvre, they are to be found, though not so easily seen and not so numerous; but that they can be seen under favourable circumstances there is no doubt whatever. The fishermen there believe all the reefs and rocks in the bay to be portions of the ruins. In the 16th century, when the water in the bay was not so deep as now, the Canon Moreau was able then to follow the lines of a vast enclosure (enceinte) of masonry, and above the sand, in the shallower places, he discovered funeral urns, stone sarcophagi, &c. The traveller Comby also adds, that after a storm which excavated and scooped out portions of the sands, one could perceive traces of elm trees, disposed with a regularity which shows that a plantation existed at this spot.

Submerged forests have been found on the coasts of Brittany and particularly in Finisterre, in the neighbourhood of Morlaix. There are historical documents to prove that at the bay of Mont Saint-Michel the coast has been submerged within a period subsequent to the Roman domination. Rouault, Curé de Saint-Pair, says:—"About the year 400 there was in the Basse Normandie towards the west a large forest named Sciey, extending from the rocks of Chausey to the Mont de Tomba"—now Mont Saint-Michel. In the twelfth century the troubadour Guillaume de Saint-Pari referred to this submerged forest in a quaint bit of old French, which may be freely translated thus:—

"Not far from Avranches, on Brittany's shore,
Quokelonde forest spread out of yore;
But that famous stretch of fertile land
Is hidden now by the sea and the sand,
No more will its venison grace the dish—
The ancient forest yields nought but fish."

This forest of Sciey, or Scissiacum, was said to have been full of wild beasts—"præbens altissima latibula ferarum"—and peopled by half-savage natives, to whom succeeded, in Christian times, a number of Anchorites who sought retirement there, far from the tumult of the



world. The parishes of St. Louis, Mauny and La Feuillette have disappeared beneath the waves since the 13th century. A story is told of a priest of the diocese of Dol, that, having in 1685, learned by tradition that there was formerly, in the place then (and now) occupied by the sea, a parish named St. Louis, informed the Court of Rome that this living was vacant "*per obitum.*" Upon this they consulted the registers and found actually that there had been presentations to this living by former Popes. A priest of Basse-Bretagne was therefore appointed and he departed at once to take possession. But on arriving in sight of Mont Saint-Michel, what was his surprise when he was shown on the sands and in the sea, the place where was formerly situated his pretended parish.

There is every reason to believe that the whole of the Channel Islands were, at one time, part of the mainland of France and there is positive proof of the island of Jersey having been so. There are certain existing manuscripts belonging to the monastery of Mont Saint-Michel, which tell us that, in the sixth century, the district of Jersey was separated from the mainland of Coutances by only a narrow rivulet, bridged by a single plank which the inhabitants were bound to keep in repair for the Archdeacon of the mother church to pass over on his periodical visitations. In the register of the taxes of the island, there is an entry referring to rents received from various persons for the privilege of allowing pigs to feed on the acorns in the forest of St. Ouen—now the bay of that name—but, M. Quenault's informant adds rather unnecessarily, "elles ne sont plus payées aujourd'hui!" There are also many other manuscripts quoted and instances given of the great alteration that has taken place in the outline of the Channel Islands and the coasts of France, of which there is given an exceedingly interesting map by M. Deschamps-Vadeville—a *fac-simile* of a chart copied in the year 1406 from one of a much older date. This map, which we reproduce in miniature, shows the coast line from Cape Finisterre down to St. Malo to have been, at that time, from six to twelve miles farther west than at present. The island of Jersey is part of a peninsula, ten or twelve miles wide, stretching out from the French coast to a point some three or four miles west of that island as it at present exists. Guernsey also is shown to have then been considerably larger than the Isle of Man now is. Throughout the whole area of this departed coast, are depicted the positions of some score of places where evidences of the existence of submerged forests have been discovered.

The sinking of the land which has taken place within the periods of history, has occurred only between the parallels of 10° S. and 55° N. lat. North of this, it is gradually becoming more and more elevated. Of this phenomenon M. Quenault gives an equally interesting and detailed account, with numerous facts and voluminous evidence which cannot be recounted within the limits of the present article. M. Quenault concludes—with regard to the depression of the land—"One gathers from all these evidences, that the movement, since the eighth century, has been about two metres a century. If it continues at the same rate for ten centuries more, the peninsula of Cotentin will be an island and all the ports of La Manche will be destroyed. Some centuries later and Paris will be a seaport, waiting only to be submerged in a score of centuries. Thus in a period, less than half as long as that during which the pyramids of Egypt have braved the ravages of time, Paris itself—if it is not burned down during one of the revolutions of its inhabitants, as amiable and *spirituel* as they are inconsistent—Paris will probably be engulphed in the Atlantic, a master before whom the intractable Parisian must haul down his flag. Let him take warning!"

CHARLES W. WHITAKER

MICROSCOPICAL INVESTIGATION OF METEORITES

A PAPER on the above subject, forming part of an investigation commenced two-and-a-half years ago by its author, Prof. Maskelyne, of the British Museum, was read at a recent meeting of the Royal Society. We are indebted to the author for enabling us to lay before our readers the following full abstract of the paper:—

With a view to obtain some more satisfactory means of dealing with the aggregates of mixed and minute minerals, which constitute meteoric rock, the author sought the aid of the microscope, having in the first place sections of small fragments cut from the meteorites so as to be transparent. By studying and comparing such sections, one learns that a meteorite has passed through changes and that it has had a history of which some of the facts are written in legible characters on the meteorite itself and, one finds, that it is not difficult roughly to classify meteorites according to the varieties of their structure. One also recognises constantly recurring minerals; but the method affords no means of determining what these are. Even the employment of polarised light, so invaluable where a crystal of which the crystallographic orientation is at all known, is examined by it, fails, except in rare cases, to be a certain guide to even the system to which such minute crystals belong. It was found that the only satisfactory way of dealing with the problem, was by employing the microscope chiefly as a means of selecting and assorting out of the bruised débris of a part of the meteorite, the various minerals that compose it and then investigating each separately by means of the goniometer and by analysis—finally recurring to the microscopic sections to identify and recognise the minerals so investigated. The present memoir is concerned with the former part of this inquiry. Obviously the amount of each mineral that can be so obtained is necessarily small, as only very small amounts of a meteorite can be spared for the purpose. On this account one has to operate with the greatest caution in performing the analysis of such minerals and the desirableness of determining the silica with more precision than usually is the case in operations on such minute quantities of a silicate, suggested the process which, after several experiments in perfecting it, assumed the following form. After the separation, by alternate treatment with hydrogen chloride and potash, of all silicate that gelatinises with acid, the pounded and weighed mineral was placed in a small retort of platinum with a little ball of the same metal and digested with an excess of pure hydrogen fluoride, containing some 32 per cent. of absolute acid, for two hours, at 100° C. By little platinum delivery tubes with which the retort was provided, a current of hydrogen was allowed to traverse the apparatus and afterwards to bubble through some concentrated aqueous solution of ammonia. After the lapse of the two hours the retort was placed in a bath of paraffin and its temperatuie slowly raised till 132° C. was reached, at which point the silicium difluoride is evolved and is carried by the current of gas into the ammonia. In a few minutes the operation is complete and it must be repeated with fresh charges of acid and ammonia, till all silicium has been driven into the receiver. This done, a little hydrogen sulphate is introduced into the retort and the retort once again heated in paraffin. If 0·2 gramme of silicate be taken, twice charging of the retort with hydrogen fluoride will suffice; if half a gramme, the process may have to be repeated three or four times. The greater portion of silicium is removed by the first operation and the ammonia becomes semi-solid with deposited gelatinous silica. This is slowly evaporated together with the later ammoniacal charges and the washings of delivery tube and receiver in a platinum dish, and, as the excess of ammonia passes off, a point is reached where the last flock of suspended silica is taken up by the hot solution; the dish is now removed from the water-bath and to its contents, when cold, are added a slight excess of potassium chloride and the requisite volume of absolute alcohol. After 24 hours have elapsed, the precipitated potassium hydro-fluosilicate is filtered off and weighed in the usual manner. The metallic oxides present in the mineral, remain in the retort as sulphates.

The Busti Meteorite.—This meteorite fell on the 2nd of December, 1852, about six miles south of Busti, a station half-way between Goruckpoor and Fyzabad, in India. The fall was attended by an explosion louder than a thunder-clap and lasting from three to five minutes. The explosion that shattered the meteorite, must have occurred soon after its passing the longitude of Goruckpoor. There was no cloud in the sky at the time. The stone, which weighed about 3lb., was presented to the collection at the British Museum by the Secretary of State for India. The Busti aërolite bears a great resemblance to the stone that fell on the 25th of March, 1843, at Bishopsville, South Carolina, U.S.

The meteorite consists for the most part of the mineral enstatite; at one end, however, were embedded a number of small chesnut-brown spherules, in which again one detected minute octahedral crystals, having the lustre and colour of gold. These two minerals seem scarcely to have been affected by the heat that fused the silicates which surround and encrust them. The brown spherules are sulphide of calcium (named by the author Oldhamite) and they also occur sparsely in the Bishopsville aërolite. This mineral forms small, nearly round spherules, whose outer surface is generally coated with calcium sulphate. It cleaves with equal facility in three directions, which give normal angles averaging 89° 57′ and are no doubt really 90°. Its system, therefore, is cubic; indeed, in polarised light it is seen to be devoid of double refraction. Its specific gravity is 2·58 and its hardness 3·5 to 4. With boiling water it yields calcium polysulphides and in acids it easily dissolves with evolution of hydrogen sulphide. Chemical analysis indicated the following as the composition of the spherules:—

		I.	II.
Oldhamite	Calcium monosulphide	89·369	90·244
	Magnesium monosulphide	3·246	3·264
Gypsum		3·951	4·189
Calcium carbonate		3·434	——
Troilite		——	2·303
		100·000	100 000

The presence of such a sulphide in a meteorite, shows that the conditions under which the ingredients of the rock took their present form, aie unlike those met with in our globe. Water and oxygen must have alike been absent. The existence of iron in a state of minute division, as often found in meteorites, leads to a similar conclusion. But, if we bear in mind the conditions necessary for the formation of pure calcium sulphide, the evidence imported into this inquiry by the Busti aërolite seems further to point to the presence of a reducing agent during the formation of its constituent minerals; whilst the crystalline structure of the Oldhamite and of the Osbornite next described must certainly have been the result of fusion at an enormous temperature. The detection of hydrogen in meteoric iron by Professor Graham tends to confirm the probability of the presence of such a reducing agent. Osbornite is the name given by the author to the golden-yellow microscopic octahedra imbedded in the Oldhamite, in honour of Mr. Osborne and in commemoration of the important service that gentleman rendered to science in preserving and transmitting to London, in its entirety, the stone which his zeal saved at the time of its fall. These minute octahedra gave the angles of the regular octahedron; but the amount, about 0·002 gramme, was too small for anything but qualitative experiments. These showed the little metallic-looking crystals to contain calcium, sulphur and a metal which gives the reactions of titanium in some singularly stable state of combination. The next mineral described was an augite, of which the measurements and analyses were given in detail. Its formula was ($\frac{2}{3}$ Mg, $\frac{1}{3}$ Ca) Si O_3. The greater part of the meteorite, however, consisted of enstatite, which presents itself in three apparently different characters: in each, however, the mineral is nearly pure magnesium monosilicate. Of this mineral, the measurements and analyses were recorded. The iron contained in small amount in this remarkable meteorite, gave as the result of its analysis 79·069 per cent. iron, 3·205 nickel, and 1·00 per cent. schreibersite.

The Manegaum Meteorite of 1843 was next described and was shown to consist almost entirely of an enstatite, with the formula ($\frac{2}{3}$ Mg, $\frac{1}{3}$ Fe) Si O_3, associated with small quantities of Chromite and of meteoric iron. In publishing the results obtained in the attempt, so far as this memoir goes, to treat exhaustively of the mineralogy of two important meteorites, the author wished to record his obligations to Dr. Flight, assistant in his department at the British Museum, for his valuable aid in the chemical portion of the inquiry.

In March, last year, Prof. Maskelyne recorded in a preliminary note, read before the Society, his discovery in the Meteorite of Breitenbach, of silica in *the rhombic system* with the specific gravity of *fused* quartz. It was associated with enstatite with the formula ($\frac{4}{5}$ Mg, $\frac{1}{5}$ Fe) Si O_3. It is singular that the measurements of the crystals of this enstatite, made at the British Museum and published by Prof. Viktor von Lang (Sitzungsb. Akad. Wien, vol. lix., 1869, p. 848), accord closely with those recently published by Von Rath as the crystallographic constants of a kind of enstatite to which he has given the name Amblystegite.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Japanese Sea Shells

SINCE writing the notice of Dr. Lischke's work which appeared in No. 13 of NATURE, I have received from Dr. Lea of Philadelphia a typical specimen of his genus *Hippagus* and the volume of his "Contributions to Geology." For such a valuable communication I would publicly acknowledge my obligation to that veteran conchologist. I was misled by Philippi and Searles Wood, in considering *Hippagus* and *Verticordia* the same genus. *Hippagus* is closely allied to *Crenella*, as the latter is represented by *C. glandula* of Totten and, indeed, I cannot detect any character to distinguish them generically. These agree in shape, sculpture, hinge, muscular impressions and inflexion of the beaks. The genus *Verticordia* of S. Wood is very different and belongs to another family, viz. that of *Lyonsia*.

Mr. Arthur Adams informs me that he has several Japanese species, which he believes are also found in the Mediterranean, and I have identified many British species with those of North Japan. J. GWYN JEFFREYS

An Oversight by Faraday

IT is not often that Faraday committed an oversight; but such I think he must have done in his well-known paper concerning the existence of a limit to vaporisation. ("Experimental Researches in Chemistry and Physics," p. 119.*) Faraday showed experimentally, that mercury emitted no appreciable vapour below 20° F. and accounted for this on the ground that "the elastic force of any vapour which the mercury could have produced at that temperature, was less than the force of gravity upon it and that, consequently, the mercury was then perfectly fixed." He adds, "I think we can hardly doubt that such is the case, at common temperatures, with respect to silver and with all bodies which bear a high temperature without appreciable loss by volatilisation, as platina, gold, iron, nickel, silica, alumina, charcoal, &c., and that, consequently, at common temperatures, no portion of vapour rises from these bodies or surrounds them."

Has not Faraday overlooked the fact that though gravity might prevent the *rise* of vapour, it would assist the *fall* of vapour from the sides or under surface of a body suspended *in vacuo?* If Faraday's theory had any grounds in truth, it would be possible to distil a substance from above downwards by the sole force of gravity, but I know of no experiment to support the idea. Were all the other forces which could act upon the molecules, exactly balanced in unstable equilibrium, the force of gravity might undoubtedly upset this equilibrium, so that vapour would be produced from the under surface of a suspended solid when it could not be produced from the upper surface. But a very slight estimation of the forces which may enter into such a problem, shows how unlikely it is that the case could ever happen.

I do not mean to say that the force of tenacity of solid substance, is identical with that which is opposed to volatilisation; but it is possibly comparable with it in amount. Now a copper wire, having a section of one square millimetre, will bear a weight of 90 lbs. and this force of tenacity only acts between portions of metal in absolute contact and continuity. Compare now the weight of a film of copper, say $\frac{1}{100}$ part of a millimetre thick, with the force by which it adheres to the remainder of the mass of copper with which it is continuous. Taking the specific gravity at 8·9, the weight will be, per square millimetre, 0·000089 gramme; the force which would be required to tear it from the remainder of the mass would be, for the same surface, 40819· grammes. The force of tenacity, therefore, exceeds the weight rather more than 450,000,000 (450 million) times. This seems to show that the molecular forces which tend to maintain the integrity of a solid metal, are almost infinitely greater than the gravitation of the same molecules towards the earth. To cause these molecules to fly off in free vapours, we must call in the aid of forces of heat, electricity, or chemical affinity which can cope with the prodigious force of solid cohesion. It is practically impossible that we should ever meet with a case, where these forces were so exactly balanced that the exterior force of gravity, many million times less in amount, should produce a perceptible disturbance.

These considerations do not, however, appear to affect the validity of Wollaston's speculations concerning a definite limit to the earth's atmosphere as caused by the gravity of the aërial particles. J.

* Phil. Trans. 1826, p. 484.

Where are the Nebulæ?

I AM unaffectedly glad to find that one whose opinion has such weight as Mr. Spencer's must have, should have anticipated me in the matters to which he directs your attention in his interesting letter. There can be no question as to his priority; since in 1863 I had not only formed no views respecting the nebulæ; but had no further knowledge of astronomy than I derived from a very faint recollection of what I had learned in a hasty two hours' perusal of Goodwin's Astronomy (Course of Mathematics) the night before our examination on the subject in the "Three days" at Cambridge.

In considering the subject of the nebulæ recently, however, the points touched on by Mr. Spencer had not escaped me. In five papers in the *Intellectual Observer and Student* called "Notes on Nebulæ," "Notes on Star-streams," and "A New Theory of the Universe" (three parts), I touched on these and many other proofs that the nebulæ are not external galaxies; but part and parcel of the sidereal system.

I have since found that Dr. Whewell, in his "Plurality of Worlds," had adopted the same view. But as a matter of fact, we owe the enunciation of clearly convincing evidence respecting the true nature of the nebulæ to Sir John Herschel; while Sir W. Herschel, when as yet the available evidence was incomplete, indicated his belief that the Orion nebula (amongst others) is within the sidereal system.

Strangely enough, the point first dwelt on by Mr. Spencer was boldly quoted by the Rev. C. Pritchard (V.P.R.A.S.) as a proof that the nebulæ are external galaxies, immediately after I had read my communication on the distribution of the nebulæ to the Astronomical Society. I asked at once if we were to regard those vacant spaces as the spy-holes, so to speak, of the sidereal system, through which alone the nebulæ could be hopefully looked for and Mr. Pritchard said "*Yes.*" Mr. Stone, also, pointed out subsequently, that the glare from the stars might elsewhere obliterate the nebulæ (at least the fainter ones) from view. This would be a point to be attentively considered were it not that in the Nubeculæ we have evidence that the glare from many stars does not obliterate faint nebulæ.

The second point dwelt on by Mr. Spencer affords a remarkable instance of the way in which considerations that should be perfectly obvious, escape even practised astronomers. Strangely enough, I dwelt on this point, only three days ago, in a letter I addressed (not for publication) to the editor of the *Spectator*. It is commonly understood and stated that telescopes which are only just able to show stars of the tenth, twelfth, or fourteenth magnitude as the case may be, are able to exhibit the component stars of certain external galaxies, which must (according to the theory) be thousands of times farther from us than the fourteenth magnitude stars. Not a thought has been given to the obvious conclusion that these component stars, to be thus visible, must be millions of times larger than the members of our galaxy.

In a letter addressed last August to Sir John Herschel (a portion of the answer to which was quoted in my article in NATURE for January 27), I pointed out half-a-century of reasons for believing that the sidereal system is differently constituted than has been supposed and that the nebulæ are not external to it. (This would have involved an egregiously long letter had I been writing to an ordinary correspondent, but in the actual case a few words served sufficiently to indicate each reason.) These reasons were not interdependent—each afforded good and most afforded perfectly sufficient ground for rejecting the accepted theory. In his reply, Sir John (always kind, courteous and encouraging) was good enough to speak of the "number and variety of the striking facts brought together and the evident bearing of a large proportion of them on the great problem offered by the sidereal system to man's contemplation." Amongst the facts which afford the strongest evidence of all, are two I left unnoticed in my late paper, viz., (1) the relatively large proper motion of the fainter stars and (2) the drift of whole groups of stars in a definite direction. These facts apply to the structure of the sidereal system, rather than to the position of the nebulæ; but, as a matter of fact, the two matters are so closely related, that evidence bearing on one carries with it conclusions affecting the other also. RICHD. A. PROCTOR

February 4

Analogy of Colour and Music

I FIND in your number of January 13 an interesting paper by Mr. Barrett on the Correlation of Colour and Sound. It seems to me that Mr. Barrett depreciates the phenomenon of Newton's rings by saying that the "connection between the relative spaces occupied by each colour and the relative vibrations of the notes of the scale" .... "cannot be more than a coincidence." The diameters of the rings are functions of the wave-lengths and, therefore, expressions of a physical condition. Mr. Barrett's own process is, to say the least, very rough and, after taking "the mean of two limits," rather wide apart for the length of the waves of each colour, he obtains a series of numbers which differ not inconsiderably from those which belong to the musical scale and he is obliged, after all, to place blue and indigo together, taking their "mean rates" as corresponding with G. I do not know how far Newton's measurements are correct; but I find that Professor Zannotti, of Naples, gives for the diameters of the rings from red to red the cube-roots of the numbers 1, $\frac{8}{9}$, $\frac{5}{6}$, $\frac{3}{4}$, $\frac{2}{3}$, $\frac{3}{5}$, $\frac{9}{16}$, $\frac{1}{2}$. The intervals between these, taken successively, are $\frac{9}{8}$, $\frac{16}{15}$, $\frac{10}{9}$, $\frac{9}{8}$, $\frac{10}{9}$, $\frac{16}{15}$, $\frac{9}{8}$; that is—major-tone, semi-tone, minor-tone, major-tone, minor-tone, $\frac{1}{2}$-tone, major-tone. Calling the major-tone *M*, the minor tone *m*, and the semi-tone ×, for the sake of brevity. I will give the five different forms of which the musical scale is capable—expressed by the succession of intervals—and show that the above series of intervals is one of them:—

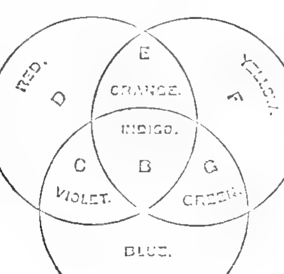
	D,		E,		F,		G,		A,		B,		C,		D	
(1)		m		×		M		m		M		×		M,		or Sintono.
(2)		M		×		m		M		m		×		M,		or Newton's scale of colours.
(3)		M		×		M		m		M		×		m		
(4)		m		×		M		M		m		×		M		
(5)		M		×		m		M		M		×		m		

Varieties depending upon the permutation of the quantities M, m, and ×. The 1st contains the imperfect fifth, DA; the 2nd two such fifths, EB and FC; the 3rd GD; the 4th A_2E_2; and the 5th the imperfect fifth, C_2G,—all of course with their corresponding augmented fourths.

Thus, Newton's scale of colour is one of a series of five scales of sound, all requiring modification by a *comma* of one, or at the most two-fifths; but all are found of perfect major and minor tones and major semitones. If the correlation between colour and sound exists, I think it will be found here. If this be admitted, the colours and notes corresponding are as follows:—

D, E, F, G, A, B, C, D

Red, Orange, Yellow, Green, Blue, Indigo, Violet, Red; or better according to the figure—



Thus the series of colours corresponds with the Gregorian Scale of the *first mode* and not with the modern scale of C. I may remark, by the way, that the ancient Greek *plain chant* is said sometimes to have a notation in which the notes are distinguished by different colours. It would be interesting to know whether such a notation has any scientific foundation.

In conclusion, I would say, that Newton's rings give a far more clear division of the colours that we get in the spectrum and the distinction between blue and indigo is too well defined to warrant them to be treated as Mr. Barrett has done. No doubt the neighbourhood of indigo is a difficult one and to make the correlation with sound complete, this colour itself ought to be divided into two; indigo-blue and indigo-violet corresponding to the notes B♭ and B♮, both of which are required to obtain the fourths and fifths all perfect. Allow me to inquire if there be any marked line in the red, dividing it into two reds separated by the interval $\frac{81}{80}$? I ask this question because the Sintono Scale (1) requires two D's differing by this interval, to complete its intervals of fourths and fifths. Also, would the correction of the fifths, &c., in the other four scales given above, by the introduction of one or two new notes, be such that these notes can be made to correspond to marked divisions in the spectrum or to like divisions in the series of colours determined by Newton's method?

W. S. OKELY

THE supposed analogy between the spectrum and the musical scale is not strictly accurate, because in the former the colours blend into one another imperceptibly, while the notes of the latter are separated by distinct intervals.

Yet it is precisely on this blending of the colours that the pleasing effect of the spectrum depends. If we place red, orange, yellow, &c., in their order, in immediate juxtaposition, as distinctly defined bands, we obtain precisely that arrangement which is admittedly distasteful.

The chromatic scale, as its name implies, approaches more nearly to the spectrum than does the diatonic; but the spectrum would be still better represented by the sliding tones produced by running the finger up the sounding string of a violin.

But leaving this objection, which may be thought too critical, I would remark, that the analogy which Mr. Barrett points to is rather one of melody than of harmony.

In the case of a musical concord, the two notes fall simultaneously on the ear and are perceived as one compound sound, the effect of which is very different from that produced by sounding the notes in succession, however rapid; yet this last is what rather seems to correspond to the sensation produced by two colours placed in juxtaposition, the eye passing rapidly from the one to the other. To obtain the optical analogue of a musical concord, the colours ought to be received simultaneously on the retina—in other words, should be blended. Could not this be accomplished by producing two distinct spectra by means of two prisms and causing the so-called harmonious colours in either to overlap one another on the screen? Blending thus, for example, those rays of the two spectra whose vibrations are to one another in the ratio of 100 to 75, their resultant (a purple of some sort, I suppose) would give us the true analogue of the fifth in music.

Similar experiments, I am aware, have been made by causing patches of colours to rotate upon a disc so rapidly that they are in effect blended upon the retina; but some modification of the method above suggested would seem to have the immense advantage of enabling the experimenter to combine colours whose wave-lengths would be in any desired ratio.

I should be curious to know whether the result of such an experiment would be that the compound tint produced by the two rays would be more or less agreeable, the more or less nearly its component parts were in the exact musical ratio; also whether, when the two colours were slightly "out of tune," we should have the phenomena of "interference" presenting themselves analogous to the "beats" in music.

A curious speculation here suggests itself. It is well known that what are called complementary colours—red and green, for instance—produce, if combined in due proportions, white.

Proceeding by the above method, then, should we find that the particular tints of red and green necessary to produce white, are those whose ratio is exactly that of the musical fourth? If so, white is as much entitled to a place in our catalogue of colours as purple or any other harmonised compound.

If white is not the optical representative of the musical fourth, where shall we look for its analogue in the latter science? Can any of your readers suggest a method of producing a *white sound?* "White," we know, is the resultant of the blending of the whole rays of the spectrum—*i. e.*, of the same part of the retina simultaneously receiving rays whose wave-lengths pass imperceptibly through every conceivable shade of difference.

If it were possible for a violinist to slide his finger up the string of his instrument in such a way that, instead of producing a sound varying in pitch, every part of the string passed over should continue to sound simultaneously with every other part; or, if we can suppose some millions of violinists each sounding a note inappreciably higher than his neighbour, but comprehending among them every conceivable shade of pitch within the octave, we might possibly obtain the purest and most ætherial of tones, a "White Sound!"

Edinburgh, Jan. 24 FRANCIS DEAS

Government Aid to Science

WILL you allow me, with the utmost respect, to remind your able correspondent, that *every individual* in the state pays taxes for ignorance and inefficiency; while so interwoven are the interests of man with man—so often does inquiry after the most abstract principles lead to valuable practical results, that it is impossible to predict in which department of Science discoveries may be made that shall materially lighten these unsatisfactory imposts. Hence the field of research should be open to all and every facility afforded. If this be not the duty of the State it is difficult to explain its *raison d'être*.

The question from the economical point of view is—Shall we pay heavy rates for prisons and workhouses, or shall we try to lighten them by the spread of education? It is well to remember that the law of supply and demand will not avail here, for they who most want it are the least likely to ask for instruction. Perhaps, Mr. Wallace's chief objection is to the unsatisfactory way the money raised by rating, is expended. And here is room for large reforms, if not retrenchment. His proposal regarding the British Museum seems admirable. It is painful to see what excellent opportunities for teaching those who really require it, are lost in that magnificent collection, for want of a little, a *very little*, more expense and trouble.

These remarks are made from the very lowest stand-point, the principle of self-interest—a principle, I believe, your correspondant would heartily despise; for the man of science is essentially liberal, essentially averse to huckstering calculations of profit and loss, essentially unqualified for scrambling after loaves and fishes. E. G. A.

Kant's View of Space

I AM quite willing to leave the readers of NATURE and the students of Kant to decide on the propriety, in English philosophical discourse, of calling Space and Time "forms of Thought," the more so as Sir W. Hamilton—a great stickler for philosophic precision—uses the term in that sense and would have been surprised to hear that he had misrepresented Kant in so doing. My opponents persist in limiting the term Thought to the restricted meaning given to it in Kant's terminology, which, in English, is restricting it to Conception or Judgment: on this ground they might deny that Imagination or Recollection could be properly spoken of as Thought. Throughout I have accepted Thought as equivalent to mental activity in general and the "forms of Thought" as the conditions of such activity. The "forms of Thought" are the forms which the thinking principle (Kant's *pure* Reason) brings with it, antecedent to all experience. The thinking principle acts through three distinct faculties: Sensibility (Intuition), Understanding (Conception), and Reason (Ratiocination): to suppose Thought absent from Intuition, is to reduce Intuition to mere sensuous impression. Therefore, whatever is a form of Intuition must be a form of Thought.

The following passage from Mr. Mahaffy's valuable translation of Kuno Fischer's work on Kant, may here be useful: "Sensibility and understanding are cognitive faculties differing not in degree but in kind, and form the *two original faculties of the human mind*" . . . . The general problem of a Critick of the Reason "is subdivided into two particular objects, as human Reason is into two particular faculties of knowledge. The first object is the investigation of the sensibility; the second, that of the understanding. The first question is, How is rational knowledge possible through sensibility? The second question, How is the same knowledge possible through the understanding?" (pp. 4, 5.)

Those who maintain that it is improper to speak of Space and Time as forms of Thought, must either maintain that Kant held Sensibility *not* to be a faculty of the Mind (thinking principle); or that the term Thought is *not*, in English discourse, a correct expression for the activity of the thinking principle. I believe that the student will agree with me in saying that, although Kant restricted the term Thought to what we call Conception or Judgment, he understood by the activity of the mental faculties (Pure Reason) what we understand by Thought.

It is not, however, to continue this discussion that I again trespass on your space; but to reply to the personal part of Mr. Sylvester's letter. He charges me with misquoting myself and with misquoting him. I said that, in my exposition, Space and Time were uniformly spoken of as forms of Intuition and I say so still. Mr. Sylvester has taken the trouble of reading that exposition without taking the trouble of understanding it; he declares that he "has marked the word intuition as occurring once and forms of sensibility several times; but forms of intuition never." His *carefulness* may be estimated by the fact that the word intuition occurs *four* times on the two pages: his *comprehension* by the fact that it is perfectly indifferent whether Sensibility or Intuition be the term employed, since sensibility is the faculty and Intuition the action of that faculty. Mr. Sylvester, not understanding this, says "If form of sensibility is as good to use as form of intuition, form of understanding ought to be as good as form of thought; but Mr. Lewes owns that the former is indefensible, whilst he avers that the latter is correct." Considering that this passage occurs in a letter which charges me with unfair misquotation, it is curious. So far from owning that the former is "indefensible," it is what I declare to be true; and, with regard to the latter, though I do think a form of Understanding is a form of Thought, my statement was altogether *away* from it, namely, that Space and Time as forms of Sensibility, would be incorrectly spoken of as forms of the Understanding.

With regard to the alleged misquotation of his own words, which he characterises as unfair and as "too much like fighting with poisoned weapons," it was a charge which both astonished and pained me. There are few things for which I have a bitterer contempt than taking such unfair advantages of an adversary. I beg to apologise to Professor Sylvester for any misrepresentation which, unintentionally, I may have been guilty of. But, in accepting his denial of the construction I placed upon his language, I must still say that, after re-reading his letter, I am at a loss to see what other construction it admits of, that has any bearing on the dispute, and that he has not expressed his meaning with sufficient clearness. Intuition and Thought are there compared with Force and Energy as terms "not convertible"; Force is detached from Energy as potential from actual and Intuition without Thought, is made to hold an analogous position. Here is the passage; let the reader judge:—

"Can Mr. Lewes point to any passage in Kant where Space and Time are designated *forms of Thought?* I shall indeed be surprised if he can do so—as much surprised as if Mr. Todhunter or Mr. Routh in their Mechanical Treatises were to treat *energy* and *force* as convertible terms. To such a misuse of the word energy it would be little to the point to urge that *force without energy is a mere potential tendency*. It is just as little to the point, in the matter at issue, for Mr. Lewes to inform the readers of NATURE that *intuition without thought is mere sensuous impression*."

Is it to use "poisoned weapons" to interpret this as assuming that Intuition and Thought differ as potential and actual? I repeat that, since Mr. Sylvester disclaims the interpretation, my only course is to apologise for it; but, after his own misinterpretations of me, he will not, I hope, persist in attributing mine to a desire to take an unfair advantage. If I make no reply to the other points roused in the various letters it is in order not to prolong the discussion.

GEORGE HENRY LEWES

I DO not know whether Mr. Sylvester and Dr. Ingleby will be satisfied with Mr. Lewes' letter in yours of the 27th. I am not and I think, in defending his former mistake, Mr. Lewes has fallen into additional errors.

It is undoubtedly fair to translate an author into your own language before criticising him, provided you found no criticism on the language that you have put into his mouth. But this I think Mr. Lewes has done. He accuses Kant of inconsistency in speaking of pure *à priori* cognitions, when, on his own system, pure thought only supplies one element to these cognitions, the other being derived from sense or intuition. Now (not to insist here that Kant constantly uses the term cognition in a wider sense than that which Mr. Lewes insists on fastening upon him), this criticism is evidently invalidated by the simple remark that Kant admits pure intuitions, as well as pure concepts and explains the nature of mathematics, as a system of *à priori* cognitions, by the fact that its object-matter consists of nothing but pure intuitions.

Mr. Lewes now informs us that Kant's Intuition and Thought "differ as species and genus." According to Kant they differ in kind; and Liebnitz was as wrong in making sensibility a species of thought as Locke was in making Thought a species of sensibility. Space and Time, Mr. Lewes adds, are forms of "mental activity" and, therefore, are properly termed "forms of Thought," in the meaning of the latter term which is usually current in this country. If they were forms of mental activity they would be forms of Thought, according to Kant, likewise; for the criterion by which Kant distinguishes between Intuition and Thought (under which term he includes both the understanding proper and the reason proper) is that, in the former, the mind is passive (receptive) while, in the latter, it is spontaneously active; and it is precisely on this ground—the passive reception of them by the mind—that he refers Space and Time to Sensibility rather than Thought. This is repeatedly brought out in the Transcendental Deduction of the Categories. See in particular Sections 11 (Meiklejohn, p. 80) and 18 (Meiklejohn, p. 90).

I think if Mr. Lewes will turn to the preface to the first edition of the "Critick," he will see that the transcendental logic only (and perhaps I might limit it to the transcendental dialectic) grapples *directly* with the problem indicated by the title of the book. The Æsthetic is a preliminary inquiry, which proves afterwards of great use; but is not to be considered as a Critick of Pure Reason in this particular department. His using the term "concept" of space, is certainly confusing; but its explanation, I think, is to be found in a passage in the "Transcendental Exposition" of this "concept" (Meiklejohn, p. 25), where he says, "It must be *originally* intuition, for from a *mere* conception no propositions can be deducted which go out beyond the conception and this happens in geometry." In the preceding page he similarly qualifies his statement that Space is an intuition. "No conception *as such*," he says, "can be so conceived as if it contained, within itself, an infinite multitude of representations." We may *now* have a concept as well as an intuition of Space and Time; but the intuition was the original form of the idea and it is to the intuition that we must always have recourse in mathematics when we wish to discover a new truth.

I think, if Mr. Lewes will again read over the Transcendental Æsthetic and the parts of the Transcendental Analytic which are closely related to it, he will see that Kant never designates the *original* representations of space and time "concepts," or refers their origin to "pure reason." W. H. STANLEY MONCK

Trinity College, Dublin, Jan. 29

[This correspondence must now cease.—ED.]

NOTES

THE Gold Medal of the Royal Astronomical Society will be presented to M. Delaunay, the president of the Paris Academy of Sciences, to-morrow. It is to be regretted that the stay of the distinguished French savant in England is but short.

WE referred last week to the "situation" at the Paris Observatory. The action of the French Government has been of the promptest and M. Le Verrier is no longer Director. This step indicates very clearly—too clearly we fear—the strength of the case put before the Minister of Public Instruction, in the memorial, of which a copy has been sent to us. This document, which is signed by all the *chefs de service*—Villarceau, Marié-Davy, Wolf, and Loewy—and the *astronomes adjoints* without exception, discusses all points connected with the administration of the Observatory, scientific and otherwise. It is to be sincerely hoped that M. Le Verrier may be able yet to do service to astronomy, in some other capacity, some position where his great talents alone will be called into play. His is a name that will never die, let us hope it is but momentarily eclipsed.

THE Trustees of the Johnson Memorial Prize for the encouragement of the study of astronomy and meteorology propose "the laws of wind" as the subject for the next essay:—1. With regard to storms; 2. With regard to average periodical phenomena at given places on the earth's surface. The prize is open to all members of the University of Oxford and consists of a gold medal of the value of ten guineas, together with so much of the dividends, for four years, on 338*l.* Reduced Annuities as shall remain after the cost of the medal and other expenses have been defrayed. Candidates are to send their essays to the registrar of the university under a sealed cover, marked "Johnson Memorial Prize Essay," on or before the 31st day of March, 1871, each candidate concealing his name, distinguishing his essay by a motto and sending at the same time his name, sealed up under another cover, with the same motto written upon it. No essay will be received after the 31st day of March, 1871.

A NEW office has been constituted under the Public Works Department and Mr. Douglas Galton, C.B., F.R.S., has been appointed to it with the title of Director of Works and Buildings. We may congratulate ourselves that our public building will be looked after by one so eminently qualified by his high scientific attainments and great experience in such matters.

AT the meeting of the French Academy on January 31, the two candidates recommended for the vacancy in the Bureau des Longitudes were M. de la Roche-Poncié and M. Gaussin. The former received 40 votes out of 43. At the same meeting the mineralogical section presented a list of candidates for the vacancy in the list of correspondents to replace Sir Roderick Murchison, who has recently been nominated a foreign associate. The candidates were, in the first rank, Prof. C. F. Naumann; in the second, in alphabetical order, MM. Abich, Gustav Bischoff, Ami Boué, Dana, von Dechen, Domeyko, James Hall, von Hauer, von Helmersen, C. T. Jackson, Kjerulf, von Kokscharow, W. E. Logan, W. H. Miller, Ferdinand Römer, Scacchi, A. Sismonda, and Studer.

THE *Goloss*, of St. Petersburg, says that a special commission will shortly be appointed by the Academy of Sciences there, for the purpose of observing the transit of Venus on the 26th of November, 1874 (old style). The members of the commission are to be Messrs. Struve, Savitch and Wild, of the Russian Academy; Messrs. Döllen and Wagner, superintendents of the Observatory at Pulkova; Vice-Admiral S. J. Seleny and Major-General Forsch. The *Goloss* adds that the reason the commission will be appointed so early, is that much time will be required for making the necessary preparations and that similar commissions have been already appointed in England, France and Germany.

PROF. W. H. FLOWER, who has recently been appointed Hunterian Professor of Comparative Anatomy and Physiology, will commence a course of eighteen lectures introductory to the study of the anatomy of the class Mammalia, on Monday, February 14, 1870, in the Theatre of the Royal College of Surgeons. The lectures are to be delivered on succeeding Mondays, Wednesdays and Fridays, at four o'clock and will treat of methods and aims in the study of morphology: classification of the mammalia; osseous system of the mammalia: Axial skeleton—vertebral column; modifications of the characters of the vertebræ in the cervical, thoracic, lumbar, sacral and caudal regions in different mammals; sternum, cranium, hyoid arch. Appendicular skeleton—essential structure and modifications of the bones composing the shoulder-girdle and anterior extremity; structure and modifications of the pelvic girdle and posterior extremity; comparison between the structure and the functions of the anterior and the posterior extremities. Tegumentary system and its appendages: the dermis; modifications of the integument mainly due to peculiar conditions of the dermis; ossifications in the integument; the epidermis and its modifications; callosities, scales, nails, claws, hoofs, horns, hairs, spines, antlers, glandular organs connected with the integument, or opening on the external surface of the body; scent glands; mammary glands. Dental system: structure and essential characters of teeth; classification and nomenclature of teeth; development and succession of teeth; modifications of the characters of the teeth in the different groups of the Mammalia; horny structures taking the place of teeth in certain mammals. Baleen, &c. These lectures are open to Fellows and Members of the College of Surgeons and of learned and scientific bodies in the United Kingdom.

THE death is announced of E. W. Brayley, many years connected with the London Institution, and a frequent lecturer on scientific subjects. Mr. Brayley was well known for his scientific attainments and has contributed to scientific literature, some valuable papers on geology, astronomy and other subjects.

THE second course of Cantor Lectures for the present Session will be given by Dr. Benjamin Paul, F.C.S. The course will consist of four lectures, "On the Phenomena of Combustion and the Chemical and Physical Principles involved in the Use of Fuel and in the Production of Artificial Light," to be delivered on Monday evenings, the 7th, 14th, 21st, and 28th of March, at 8 o'clock.

THE third part of the nineteenth volume of the *Jahrbuch der kais.-kön. geologischen Reichsanstalt*, including the more important papers communicated to the Austrian Geological Institute during the months of July, August, and September, 1869, has just reached us. It contains some valuable memoirs for the students of general geology. M. D. Stur describes the characters and mode of occurrence of the brown-coal in the district of Budafa, in Hungary. He has ascertained the existence of two layers of useful coal, the upper one varying from two to three feet in thickness, the second being usually from four to six feet and sometimes as much as eleven feet thick. Borings indicate a third horizon having coal from eight-and-a-half to ten feet thick; but the quality of this coal has not been ascertained. Dr. M. Neumayr's contributions to the knowledge of the fossil fauna of the Austrian dominions consist of lists and numerous descriptions of fossil shells, from the late Tertiary freshwater marl of Dalmatia and from the Congerian beds of Croatia and West Sclavonia. This paper is illustrated with four plates. M. D. Stur reports upon the geological survey of the environs of Schmöllnitz and Göllnitz, in Hungary, including especially the mountain-mosses of the Volovec and Branisko. It includes an "Eozoonal" rock and deposits belonging to the Carboniferous, Permian, Triassic and Liassic formations. The other papers are: A description of the Amphibole-Trachyte of the Mátra in Central Hungary, by Dr. Joseph Szabó; an account of mineralogical investigations in the chemical laboratory of the Institute, communicated by Karl Ritter von Hauer and a translation, by Dr. E. Bunzel, of the account given by Drs. Carpenter and Wyville Thomson of their dredging operations on board the *Lightning*, in 1868.

THE *Canadian Entomologist* for January announces that the Council of the Agricultural and Arts Association of Ontario has appropriated the sum of four hundred dollars to aid the Entomological Society during the present year in forming a cabinet of insects useful or prejudicial to agriculture and horticulture, for continuing the journal and making an annual report. It contains also notes on some of the common species of *Carabidæ* found in temperate North America, by P. S. Sprague; on the currant worm, by W. Saunders; remarks on the history and architecture of wood paper-making wasps, by W. Cowper; a list of *Coleoptera* taken at Grimsby, Ont., by J. Pettit and miscellaneous notes.

THE Nederlandsche Maatschappij ter bevordering van Nijverheid—that is, The Netherlands Society for the Promotion of Industry—offer, for the year 1871, a prize of a gold medal worth 150 florins and three hundred florins in money, for the best method of illuminating floating buoys so that they can be seen at night. The contrivance, whatever its form, is to be self-lighting, for obvious reasons. Here, then, is another task for those who are skilful in sending sparks through long wires. We remember that Mr. Siemens had some project of the sort a year or two ago. Is this a fitting opportunity for trying to work it out? If Dutch mariners feel it desirable that their buoys should be lighted at night, so do those of all other nations. Competitors for the prize are to send their documents and models to the general secretary of the society, M. F. W. Van Eeden, at Haarlem, before September 30, 1871.

WE learn from the *Athenæum* that Dr. Andrews, Vice Principal of Queen's College, Belfast, has been elected an Honorary Fellow of the Royal Society of Edinburgh, in the room of the late Master of the Mint.

A CONTROVERSY is going on in the *Medical Times and Gazette* as to the sufficiency of a test for Morphia, involving serious considerations as regards toxicological inquiries. The point is, whether the production of a blueish purple tint on mixing a substance with a molybdate and sulphuric acid, is sufficient proof of the presence of morphia, or whether the same colours may not be produced by other substances which are quite innocuous.

NEWS has this week been received from Mr. C. F. Tyrwhitt Drake of Trinity College, to whom, last autumn, the University of Cambridge granted a sum of money out of the Worts Travelling Bachelors' Fund, to enable him to collect zoological specimens while accompanying Mr. E. W. Palmer of St. John's College, the distinguished orientalist, in exploring the Tîh country—the "Wilderness of the Wanderings." The Arabs were by no means prepared to find Englishmen travelling without the luxuries to which they are accustomed and, in consequence, were suspicious of their object in visiting the country. It is to be hoped, however, that nothing will hinder our adventurous explorers from accomplishing their wish of reaching the Jordan by the route traditionally followed by the Israelites. Mr. Drake's journal and collections can scarcely fail to be of much interest.

WE understand that one of the two zenith sectors, constructed by Messrs. Troughton and Simms from the designs of Lieut.-Col. Strange, for the Great Trigonometrical Survey of India, has reached its destination—Bangalore, in the Madras Presidency. This instrument differs entirely from all of its class. Ramsden's and Graham's cumbrous though most ingenious structures of timber were superseded by the far more efficient sector designed some years ago for the Ordnance Survey by the Astronomer Royal. But even Airy's zenith sector was too heavy for transit over the rugged and pathless mountain chains of Hindustan. It weighed, without its packing-cases, upwards of 1,100 lbs. The instrument of which we now speak has been reduced to 600 lbs., without loss of power. The telescope has an aperture of 4 inches with a focal length of 4 feet and the sectors are portions of a circle 3 feet in diameter, read by means of 4 micrometer microscopes. This class of instrument is intended solely for the determination of latitude. Hitherto it has been used for this purpose, in measuring the zenith distances of known stars, as its name implies, which we may call the absolute method. But of late years another mode of determining latitude has come much into favour,—this we will call the differential method. It consists in measuring, with a micrometer attached to the eye-end of the telescope, the difference of zenith distance of two stars nearly equidistant from the zenith, one north, the other south. Its merit consists chiefly in the simplicity of the means necessary for the purpose, namely, a telescope firmly mounted with a good micrometer and a good level, no circle or sector being required. Colonel Strange has, we hear, adapted his instrument to both methods, which may therefore be thus submitted to a comparative trial under circumstances equally fair to each. The instrument is in the hands of Capt. J. Herschel, R.E., who is about to employ it for the twofold purpose of furnishing data for improving our knowledge of the figure of the Earth and of throwing light on the interesting physical problem of local attraction. It will be remembered that some years ago the operations of the Russian Survey indicated the presence, in a particular locality, of a huge subterranean cavity, the existence of which would never have been suspected, had not anomalies in observed latitudes established the fact. We may expect to hear of similar phenomena being discovered by the same means in India when observations are multiplied by a more portable instrument than any hitherto used of equal power. The facts that cavities may exist where least suspected and that hidden masses of higher specific gravity than the surrounding rocks are known to occur, render it imperative that in geodetic operations the latitude, which is affected by such irregularities, should be more frequently observed than was formerly thought necessary. It is satisfactory to find that such scientific desiderata are appreciated and so liberally provided for, by the Indian Administration.

THE purity of the metropolitan water supply has been seriously affected by the winter floods. Professor Frankland, in his last monthly report, states that the water supplied by the East London Company was very turbid and contained vibrios. This is the first occasion in which Dr. Frankland has detected these organisms, which are abundant in putrid sewage, in the London water.

A VERY interesting paper on the Pearl, Coral and Amber Fisheries, was read at the meeting of the Society of Arts held on the 19th inst. The chair was occupied by Professor Owen, who in proposing a vote of thanks to the lecturer, Mr. T. L. Simmonds, made some instructive remarks on the origin of pearl, coral and amber. Both the paper of Mr. Simmonds and the observations of Professor Owen, will be found at full length in the last number of the Society's Journal.

WE are glad to know that an "Athenæum" has been established in Belfast. It contains a large reading-room, provided with most of the daily and weekly papers and the monthly and quarterly reviews. There is also a commercial, literary and scientific reference library and all the usual accessories of a club. Such an undertaking deserves every support. A series of lectures on scientific and literary subjects has already been commenced in connection with this institution.

THE Lowndean Professor of Astronomy in the University of Cambridge intends to give a course of lectures on the Lunar Theory, with special reference to M. Delaunay's method of treating the subject.

Land and Water announces that the Prince Pless, who has large possessions in Siberia, has succeeded in crossing the common Red Deer with the Wapiti (*Cervus Canadensis*) and the perfect fecundity of the hybrids appears to be well established.

ACCORDING to *Les Mondes*, the Mont Cenis tunnel will certainly be finished during the present year. On the 1st ult., the galleries opened measured 10,598 metres and there only remained 1,621 metres to be excavated.

THE *Photographic News* announces that a Photographic Society has just been formed at Dresden. Among the members are the names of Krone, president, Hahn, Hanfstængl, &c. The society publishes a monthly journal entitled *Helios*, this being the sixth photographic journal published in Germany.

IS Sicily about to lose the monopoly of sulphur which she has so long enjoyed? By recent intelligence from America, we learn that a bed of pure sulphur, 135 feet in thickness and about 530 feet below the surface, has been discovered on an island in Bayou Choupique, in the delta of the Mississippi. The place is within ten miles of the sea, from which it may be anticipated that shipment of the mineral will be comparatively easy. The extent of the deposit has not yet been ascertained; but the local formations are such as to lead to the inference that it is "immense." Besides the sulphur, there is a deposit of gypsum, of perhaps equal extent; hence we may anticipate that the company formed to work the one, will also turn the other to profit. Sulphur is so much in demand for the manufacture of sulphuric acid and for many other purposes in the arts, that this discovery of a deposit in a country teeming with energy and enterprise, seems opportune. When in full work it will most likely occasion a fall in the price of sulphur and a corresponding falling off in the use of pyrites. This sulphur bed was discovered during the sinking of a well in search for petroleum. But instead of "oil" the boring discharges a copious stream of water, which is described as a saturated solution of sulphuretted hydrogen, combined with a small amount of gypsum and common salt. It is clear that the company which is about to explore the sulphur, will have to provide for an abundant drainage, as well as for ventilation. The locality may be found on a good map, near Lake Calcasieu, on the western border of the Mississippi delta.

SCIENTIFIC SERIALS

THE new number of Pflüger's Archiv. (III. i.) contains a paper by Prof. L. Hermann "On the absence of currents in uninjured inactive muscle." Munk's views are criticised and a new experiment described, in which the gastrocnemius of a frog is prepared for investigation, in such a way that no contact between the cutaneous secretion and the surface of the muscle (a source of currents in previous observations) takes place. With a galvanometer of 1,600 windings, giving a deviation of 300 sc. for an ordinary nerve current, the muscle so prepared gave only a deviation of 10 to 20 sc. "We are hereby justified," says the author, "in supposing that with a still more careful method of preparation, by the avoidance of yet other unknown causes of injury, we shall at last get a muscle *perfectly* free from currents."

In another paper "On the course of the development of currents in dying muscle," Prof. Hermann shows that when part of a muscle is killed and rendered rigid by exposure to a temperature of 40° C., the development of the current takes place just at the moment when *rigor mortis* makes its appearance.

The same author has also a paper "On the danger of drinking cold water when the body is heated," in which an attempt is made to submit the matter to an experimental inquiry. The only result obtained, however, was that in curarized animals, the injection of ice-cold water into the stomach caused a sudden and great rise in the arterial tension in the carotid and crural arteries, apparently from spasm of the visceral arteries in the neighbourhood of the stomach. Such a sudden increase of tension would prove dangerous in the case of unsound vessels. When the animals, however, were not curarized, very little rise of tension was observed, suggesting the idea that some compensating mechanism was at work, *e.g.* respiratory movements.

There are also papers "On acute phosphorous poisoning," "On convulsions due to disturbances of the cerebal circulation (venous obstruction)" and "On simultaneous contrasts" by Prof. Hermann and his pupils; "On the action of Hydrocyanic acid on the red blood corpuscles" by Geinitz; "On the interference of the bile with gastric indigestion" by Hammarsten; and, "On serum-albumin" by Zahn.

Revue des Cours Scientifiques, February 5.—This number contains an interesting paper read by M. P. I. Van Beneden, of Louvain, at the Belgian Academy of Sciences, on what he terms "commensalism" in the animal kingdom, or certain associations of animals for feeding purposes, which are not, in the ordinary sense, cases of parasitism. The author gives several illustrations of this fact, and he defines the parasite as an animal which lives upon another, while the commensal or messmate is merely a feeding companion. He distinguishes free and fixed commensals. Of the former there are numerous instances in the class Crustacea. The most interesting examples of the latter are the *Tubicinella diadema* or *coronula* covering the skin of whales; the *Remora*, found in the Mediterranean, and made use of, in fishing, by the inhabitants of Mozambique after the manner of a falcon on land. This number also contains a lecture by M. Ch. Robin, on Histology, delivered at the Faculté de Médicine in Paris.

In *Silliman's Journal* for January, Professor B. Silliman has a paper on the relation between the intensity of light produced by the combustion of coal gas and the volume of gas consumed, read at the Salem meeting of the American Association for the Advancement of Science last year, in which he gives as the result of many trials the theorem that, within ordinary limits of consumption, the intensity or illuminating power of gas flames increases as the square of the volume of gas consumed, according to which the method of computation hitherto adopted in photometry, would involve an error amounting to 40 per cent., in the case of rich gas, burning at the rate of $3\frac{1}{2}$ feet an hour with an observed effect of 20 candles—the illuminating power reduced to the standard consumption of 5 cubic feet an hour, being in this case equal to 40 candles instead of 28·57 candles. Hence it follows that all photometric determinations obtained by computation from volumes greater or less than the standard of 5 cubic feet an hour, in the simple ratio of the volumes consumed, must be considered as absolutely worthless. This applies also to the case of sperm candles burnt at a rate different from the standard of 120 grains per hour. As a consequence of these observations it would appear to be essential for photometric observers, in their determinations, to bring the rates of consumption both of gas and sperm to the agreed standards. For the consumer of gas it is evident, also, that where it is important to obtain the maximum economical effect from gas, this result is best attained with burners of ample flow. Prof. W. D. Alexander describes, in a letter to the editor, the results of a careful survey of the crater of Haleakala in the island of Maui. F. W. Clarke gives a new method of separating tin from arsenic, antimony and molybdenum, based on the solubility of the sulphides of tin in oxalic acid solution. E. Billings, paleontologist of the Canadian Geological Survey, continues his notes on the *Crinoidea*, *Cystidea* and *Blastoidea*. A paper on a new spectroscope, with contributions to the spectral analysis of the stars, by Dr. Zöllner, is translated from the Proceedings of the Royal Society of Saxony. H. J. Clark has a paper on Polarity and Polycephalism, extracted from a forthcoming memoir on the anatomy and physiology of *Lucernariæ*, in which he treats of the discussion that has of late years prevailed as to whether the lower compound denizens of water are individuals or organs forming only a part of an individual. Dr. Sterry Hunt contributes a paper on Laurentian rocks in Eastern Massachusetts, in which he announces the discovery of Eozoön in the limestone of that district, by Mr. Bicknell. In a paper on the chemistry of common salt, Dr. Goessmann treats of the origin, occurrence and manufacture of salt. J. Lawrence Smith gives an account of the fall of meteoric stones in Alabama, with analyses, and points out the importance of a thorough re-examination of the mineral nature of meteoric stones. A. E. Verrill continues his contributions to zoology, from the Museum of Yale College, by describing Echinoderms and Corals from the Gulf of California and gives also a note on the generic relations and synonymy of the Common Sea-Urchin of New England (*Euryechinus Drobachiensis*) in which he replies to a criticism by M. Agassiz upon the author's classification of the species here referred to. E. S. Morse has a paper on the early stages of Brachiapods, describing the development of *Terebratulina Septentrionalis*, abundant in the waters of Eastport (Maine) and Dr. Jeffries Wyman has a paper on the existence of a Crocodile in Florida, said to have been killed near the mouth of the Miami river and considered by the author, as belonging to the sharp-nosed species (*C. acutus*).

SOCIETIES AND ACADEMIES

LONDON

Royal Society, February 3.—The following papers were read:—"Note on an Extension of the Comparison of Magnetic Disturbances with Magnetic Effects inferred from observed Terrestrial Galvanic Currents—and Discussion of the Magnetic Effects inferred from Galvanic Currents on days of tranquil magnetism." By George Biddell Airy, Astronomer Royal. (Received December 22, 1869.) The author, referring to his paper in the Philosophical Transactions for 1868, stated that he had examined the whole of the galvanic currents recorded during the establishment of the Croydon and Dartford wires (from 1865 April 1, to 1867 October 24). The days of observation were divided into three groups: No. 1 comprising days of considerable magnetic disturbance; No. 2, days of moderate disturbance, of which no further use was made and No. 3, days of tranquil magnetism. The points most worthy of notice are, that the general agreement of the strong irregularities, galvanic and magnetic, is very close; that the galvanic irregularities usually precede the magnetic, in time and that the northerly magnetic force appears to be increased. The author remarks that no records appeared open to doubt as regards instrumental error, except those of western declination; and to remove this he had compared the Greenwich curves with the Kew curves and had found them absolutely identical. In the discussion of the galvanic current-curves, on days of tranquil magnetism, for independent examination of the galvanic laws, the author explained the method of measuring the ordinates and connecting the measures into expressions for magnetic action, at every hour, grouping the measures, at the same nominal hour, by months and taking their monthly means for each hour. As these exhibited sensible discordance, they were smoothed by taking the means of adjacent numbers, taking the means of the adjacent numbers of the new series and so on, repeating the operation six times. The author explained the theory of this process and the way in which it tends to degrade the periodical terms of higher orders. He then explained an easy method of resolving the numbers so smoothed, into periodical terms recurring once or twice, or thrice in the day, &c. and applies the method to the numbers for every month. When these quantities (which from month to month are perfectly independent) are brought together in tables, they present such an agreement, with gradual change accompanying the change of seasons, as to leave no doubt of their representing a real law of the diurnal changes of the galvanic currents. They also show the existence of a constant turn towards the north (explaining the apparent increase of force to the north observed in the results for days of great disturbance), and a still larger force towards the west (also well marked on the days of great disturbance). No light is obtained as to the origin of these turns; but they appear to be probably pure galvanic accidents, depending on the nature of the earth-connections. The author then exhibited, in curves, the diurnal inequalities of magnetism which the galvanic currents must produce. The form generally consists of two parallel lobes, making with the magnetic meridian an angle of nearly 60° from the north towards the west. The greatest east-and-west difference of ordinates, in the month of April, is 0·0004½ of total horizontal magnetic force; it corresponds in the hours to which those ordinates relate, nearly with the ordinary diurnal inequality. But it is much smaller than the ordinary diurnal inequality and the daily law of the galvano-magnetic inequality differs greatly from that of diurnal inequality. For the greater part, therefore, of diurnal inequality the cause is yet to be found.

"On the fossil mammals of Australia.—Part III. *Diprotodon australis*, Owen." By Prof. Owen, F.R.S., &c. Received December 10, 1869. In this paper the author communicated his descriptions of *Diprotodon australis*, with figures of the fossil remains at his command, which have been received from various localities in Australia, since the first announcement of this genus founded on a fragment of lower jaw and tusk described and figured in the "Appendix" to Sir Thos. Mitchell's "Three Expeditions into the Interior of Eastern Australia," 8vo, 1838. The fossils in question include the entire cranium and lower jaw, with most of the teeth, showing the dental formula of:—$i\,\frac{3-3}{1-1}$, $c\,\frac{0\cdot0}{0\cdot0}$, $m\,\frac{5-5}{5-5}=28$; portions of jaws and teeth exemplifying characteristics of age and sex; many bones of the trunk and extremities. The author described the skull and teeth and the result of the comparisons, establishing the marsupial characters of *Diprotodon* and its combination of characters of *Macropus* and *Phascolomys* with special modifications of its own, which are more fully and strongly manifested in the bones of the trunk and limbs, subsequently described. The pelvis and femora present resemblances to those in *Proboscidea*, not hitherto observed in any other remains of large extinct quadrupeds of Australia. But in all the bones described, essentially marsupial characteristics are more or less determinable. A summary of the characters of *Diprotodon* illustrated the conditions of its extinction, its analogies with the *Megatherium*, its affinities to existing forms of *Marsupialia* and the more generalised condition which it manifests of that mammalian type. A table of the localities, in Australia, from which remains of *Diprotodon* have been obtained and a table of the principal admeasurements of the skeleton, are appended to the text.

Royal Astronomical Society, January 16.—Third meeting of the Session.—Mr. De la Rue, vice-president, in the chair. The chairman announced that the president, though he was recovering his health, was not able to take the chair. Thirty-one presents were announced and the thanks of the society voted to their respective donors. The first paper read was a communication from Sir John Herschel, having reference to a supplementary list of eighty-four double stars observed at Slough since the year 1820. Amongst these were many observed by the elder Struve and an interesting portion of the communication referred to the relation between Sir John Herschel's estimate of the magnitudes of stars and Struve's. It appeared from the comparison that Herschel's magnitude 3·0 corresponded to Struve's 2·6 and the difference gradually widened from successive magnitudes until from the lowest orders the two lists were altogether discordant. A similar relation was observed (we believe by Mr. Knott) between the magnitudes in Admiral Smyth's Bedford catalogue and Argelander's estimates.—A communication from Mr. Joynson, having reference to observations made on occultations and on phenomena of Jupiter's satellites, was then read.—In a paper containing a list of occultations, Captain Noble referred to an estimate, by Mr. Penrose, of the latitude of the former's observatory as deduced from an occultation of ζ Ceti.—The next paper, by Commander Davison, on the November meteors as seen at Santa Barbara, California, contained several interesting diagrams.—The annual statement of the observations made on the sun at Kew was then read. It appeared from this that sun-spots have scarcely been so numerous as was to have been expected so near the epoch of maximum spot-frequency. The sun was observed on 96 days during the year 1869; there were no days when the sun was without spots and 224 new groups made their appearance.—Mr. Browning then read an account of a new method of measuring the position of lines in the spectrum. In this arrangement an illuminated cross is made to traverse the spectrum by turning a micrometer screw. Mr. Browning mentioned that he had found it perfectly impossible, by the ordinary mode of measurement, to deal with the faint spectrum of the planet Jupiter. The spectrum itself was nearly obliterated and the lines in it were rendered altogether invisible. He remarked that though Jupiter is so bright, its spectrum is fainter than that of a second magnitude star, even when the latter spectrum is made as wide as that of the planet (a peculiarity obviously depending on the fact that we use but a portion of a planet's light in observing its spectrum, while the linear image of a star includes the whole of the star's light). Mr. Bidder, referring to Mr. Browning's method of bringing the illuminated cross upon the spectrum, said that he had often thought Sir W. Herschel's plan of comparing double stars with movable lights placed at some distance from the observer might, with modifications, be applied to the micrometrical measurement of double stars. He described an arrangement he had tried for this purpose. Messrs. Huggins and Lockyer made some suggestions on the mode of measuring the plan of lines in the spectrum, the former pointing out the necessity of having the cross differently coloured for measuring lines in different parts of the spectrum and showing how this might be done by means of a small prism: the latter remarking that some arrangement was desirable by which the lantern might be so shifted, while the micrometer screw was turned, as not to alter the conditions under which the spectrum was observed. At the chairman's request, Mr. Lockyer then gave an account of Mr. Newall's great telescope, a Cooke refractor, 25 inches in clear aperture, remarking that it was a noteworthy circumstance, that a telescope of this size should have been mounted in the so-called German manner; that is, not on a long polar axis; but on the Fraünhofer stand, familiar to his hearers. He said that Mr. Newall proposed to devote the powers of this instrument in the most generous manner to the interests of science and that when it had been erected in a suitable climate, astronomical workers would be invited to avail themselves of its powers. The chairman then asked if any information could be given respecting Mr. Buckingham's 21-inch refractor, from whose performance so much had been expected. Mr. Buckingham, who was present, said that he had only that evening been observing Jupiter with it; and he had to remark, with reference to the ruddy colours of the equatorial belt which had recently been attracting so much attention, that in his powerful instrument he could clearly discern red masses resembling clouds in shape, on a white background. One band, in the red part of the spectrum, was at present invisible. The chairman invited Mr. Buckingham to make some frequent communications respecting the great telescope's performance. He also confirmed the statements made by Mr. Buckingham respecting the present aspect of the planet. Colonel Strange then gave a most interesting account of a transit instrument constructed by the late Mr. Cooke on the Russian plan (so called) and Mr. Carrington mentioned that the instrument should properly be called the Harris transit, after a countryman of our own who devised the method. The instrument, which is intended to be used by those engaged in the survey of India, was exhibited at the meeting. Instead of the ordinary arrangement, the optical axis of the instrument is divided into two halves at right angles to each other, one corresponding to the object half of an ordinary transit, the other being in the horizontal axis of the instrument; so that the eye-piece is placed at one end of the horizontal axis and the observer stands on one side of the instrument. The advantages of the arrangements are obvious: the eye is always at the same height and the vision always directed horizontally. On the other hand, Colonel Strange remarked that he could not altogether get rid of his dislike to the plan. He thought all who had been engaged in actual observation would agree with him that the less the cone of light forming the object-glass was tampered with the better. But passing over that and minor objections, there remained this important point to be considered. In the ordinary arrangement, any disturbance of the collimation, whether taking place at the object-end or at the eye-end of the instrument, produced effects varying inversely as the distance separating the object-glass from the eye-glass. In the new arrangement, if the prism by which the rays from the object-glass were reflected towards the eye-glass were disturbed, the effects would be increased in precisely the same proportion that the distance between the prism and the object-glass is less than that between the eye-piece and the object-glass in the ordinary arrangement. The answer to this was, that the prism in effect never does get disturbed; but, for his own part, he thought this could hardly be looked upon as established. There was this further objection (first pointed out by Captain Clarke) to be considered, that there was a variation in the collimation—errors according to the position of the instrument. An interesting discussion ensued, during the course of which the possible disturbances resulting from the heat, or from the weight of the observer, were discussed and the performance of the instrument compared with that of such an instrument as Mr. Carrington is about to employ, in which the whole of the telescope's axis is always horizontal. Mr. Stone was then invited to give an account of his researches into the heating powers of the stars, which he did in a most interesting and lucid manner. The substance of his remarks has already appeared in these columns under another heading.

Zoological Society, January 27.—Prof. Newton, V. P., in the chair.—A letter was read from Mr. R. B. White, concerning the hairy tapir (*Tapirus roulini*) of the Andes of New Granada, of which he was endeavouring to obtain specimens for the Society's menagerie.—Dr. Cobbold, F.R.S., exhibited specimens of, and made remarks upon, the new entozoön from the Aard-wolf, described at the last meeting of the society, and proposed to be called *Acanthocheilonema dracunculoides*.—Mr. G. D. Rowley, exhibited and made remarks upon a specimen of the Siberian lark (*Alauda sibirica*), recently taken at Brighton, and believed to be the first example of this species that had occurred in the British Islands. He also exhibited some other rare birds from the same locality.—Prof. Newton, in exhibiting a specimen of the North American *Zonotrichia albicollis*, shot near Aberdeen, and sent to him for that purpose by Mr. W. C. Angus, called attention to the injudicious practice of many ornithologists who are prone to give the name of "British Birds" to all such foreign species as occasional stray to this country.—A communication was read from Professor Owen, containing a letter received from Dr. Haast, F.R.S., on the discovery of cooking-pits and kitchen-middens containing remains of various species of *Dinornis*, in the province of Canterbury, New Zealand.—Mr. P. L. Sclater read a paper on some new or little-known birds from the Rio Paranà, collected during the second survey of the river by Captain Page, U.S.N. and submitted to him for examination by the Smithsonian Institution. — Dr. W. Baird communicated a description of a new genus and species of shells from Whydah, on the West Coast of Africa, proposed to be called *Pretoma*, together with some remarks on the genus *Proto* of Defrance.—Mr. R. B. Sharpe read a paper on the genus *Pelargopsis* of the family *Alcedinidæ* and pointed out the geographical distribution of the eight species of this genus in the Indian and Australian regions.—Mr. Sharpe also exhibited and pointed out the characters of a new species of *Campephaga* from Damara-land, which he proposed to call *Campephaga Anderssoni*, after the late Mr. C. J. Andersson, its discoverer.—Dr. J. E. Gray communicated some notes on the skulls of the whales of the genus *Orca* in the British Museum, and a notice of a specimen of the same genus from the Seychelles.—A communication was read from Dr. J. C. Cox, containing descriptions of seventeen new species of land shells from the South Sea Islands. The original specimens were stated to be in the cabinet of Mr. John Brazier, of Sydney.—A communication was read from Lieut.-Col. Playfair, containing an account of a fresh-water fish recently discovered in the vicinity of Aden, which appeared to referable to the widely-distributed Cyprinoid, *Discognathus lamta*.—Dr. J. Murie read a note upon a larval æstrus found in the orbit of the hippopotamus, to which was added a list of the species of mammals in which æstri-larvæ have hitherto been found.—Dr. Murie also read a note on a specimen of the so-called *Aquila Barthelemyi* recently living in the Society's Gardens, which appeared to be nothing more than a variety of the Golden eagle *Aquila fulva*.

Chemical Society, February 3.—Prof. Williamson, F.R.S., President, in the chair. Mr. Chapman read a note on the organic matters contained in the air. Some time ago the author in connection with Mr. Wanklyn and Mr. Smith, found that the smallest traces of nitrogenous organic matter in water could be detected by converting the nitrogen of the organic matter into ammonia and estimating the latter with the Nessler test. It occurred to the experimentors that the process might be extended to the investigation of the air by washing it with water. But Mr. Chapman found the operation of washing the air more difficult than he had expected. It seemed the most obvious method to draw air through water, or through some other medium which would have afterwards to be washed with water. The absorption by water alone proved insufficient. Filters of cotton wool and gun cotton acted very well; but neither of the two materials could be obtained free from traces of nitrogenous substances. Asbestos seemed to be sufficiently good; but the preparatory treatment it has to undergo before its use in the experiment, is too troublesome. Lastly, finely powdered pumice-stone was tried as a filtering medium and was found satisfactory in all respects. It has to be heated to redness before it is employed and is then moistened with some water spread over coarser pieces of pumice, which rest on wire gauze fitted into a funnel. The funnel is connected with one neck of a Wolfe's bottle, whilst the other neck is joined to an aspirator. When a sufficient quantity of air—say 100 litres—has been drawn through the apparatus, then a pumice is transferred to a retort which contains water freed from ammonia and organic matters and the operation is now proceeded with exactly as if it were an estimation of nitrogenous organic matter in a sample of water. By this method Mr. Chapman found that the air of crowded rooms contains suspended fixed organic particles, as well as volatile bases. The first can be removed by filtration through cotton wool, the latter pass through the filter and when conducted into water can be detected therein. Air collected from the neighbourhood of a sewer contained notable quantities of those volatile bases. The author thinks it would be of interest to investigate by the above-described method the air in hospitals, fever wards and the like places. With respect to the examination of the volatile bases occurring in the air, Dr. Mills suggested that the charcoal out of the "Stenhouse air filter" might furnish a good means for collecting those bases.—In another paper Mr. Chapman communicated some new reactions of alcohols. Amylic alcohol, as commonly obtained, consists of two liquids, one rotating the polarised ray, the other not. The two may be separated by distilling the mixture from soda, calcic chloride, &c. The non-rotating alcohol is retained, the rotating distills over. But by repeated distillations it was found that the rotating alcohol is converted into the non-rotating by the very treatment employed to separate the two. No difference in the physical properties of the two alcohols is perceptible. The compounds of the non-rotating liquid do not turn the ray of polarised light; those of the rotating do and that in an opposite direction to the original alcohol. These facts seem to indicate that the internal structure of organic compounds is not so permanent as the habit is of thinking them. Another observation Mr. Chapman made whilst pursuing these experiments was, that caustic soda is not merely unable to dry alcohol, as is well known, but that it actually moistens it. On proper investigation, it turned out that the sodium replaces the hydrogen of the alcohol, whilst the displaced hydrogen takes the place of the sodium in the caustic soda and thus produces water. Referring to this latter observation, the president remarked that it confirmed the idea of a double decomposition taking place when potassic hydrate is dissolved in alcohol, an idea derived from the well-known reaction of carbonic action on a solution of potassic hydrate in alcohol, whereby ethylo-potassic carbonate as well as potassic carbonate is formed.—Mr. Perkin exhibited a modification of Berthelot's method for the synthesis of hydric cyanide (prussic acid) by direct union of acetylene and nitrogen under the influence of the electric spark. Mr. Perkin takes advantage of the fact that nearly all the hydro-carbons, when submitted in the state of vapour to the action of the spark, yield more or less acetylene. Nitrogen was caused to bubble through benzole, then to pass through a globe in which the spark was discharged and thence into a solution of silver. Even after a few seconds, abundant evidence of the formation of hydric cyanide was obtained. Hydric cyanide is further produced when the spark is discharged in a mixture of ammonia-gas and ether vapour. If, however, nitrogen instead of ammonia is employed, no prussic acid is formed. Mr. Perkin's modification of Berthelot's method is well adapted for purposes of lecture demonstration.

Royal Geographical Society, January 24.—Sir R. Murchison, president, in the chair. A letter from Mr. Hayward detailing his plans of reaching the Pamir Steppe, by way of Ghilghit, was read. He expected to winter in Ghilghit and hoped to be at Lake Karakol next May; he proposed to thoroughly lay down the positions of the Pamir Steppe and the basin of the Jaxartes. An account of Easter Island, or Rapa Nui, by Mr. Palmer, R.N., was then read. The island lies in 27° 8′ 46″ S., long. 109° 24′ 36″ W., about 1,000 miles from Pitcairn. It is volcanic and contains several extinct craters, the highest point being 1,100 to 1,200 feet high. The principal craters are Te Rana Kau, the depth of which is 700 feet; Te Rano Hau, whence came the tufa of which the hats or crowns of the images are made; and Te Rana Otu Iti, where the images were sculptured of grey lava. There is no water, save in pools, which are 26 feet deep and one spring, mineral, but potable. The coast is ironbound, without harbours. The character of the natives has been much improved by the teaching of the Jesuit Fathers and they now are scrupulously honest. They are perfectly idle, content to starve rather than work; number about 900—600 women to 300 men and will probably, ere long, die out. They make and sell well-carved wooden figures, with eyeballs of obsidian, ornamented with double-headed "aronies," or birds—and other figures. They are described by all visitors as a tall, almost white, race; the women handsomer than those of the Marquesas. They are not idolatrous, but believe in a Great Spirit. The dead, swathed in grass, are laid on platforms, heads to seaward. They have a tradition that they came from Oparo. The platform for the images faced the sea, supported by a stone wall seven or eight yards high, built of dry stones six feet in length; the platform was 100 paces long and thirty feet deep, terminating landwards in a step three feet high. It was strewn with bones; all the images had been thrown down. Near that, on an area paved with large stones, stood a pillar of red tufa, six feet high, on which were two skulls, apparently twelve or fourteen years old. A place of cremation was near this. The images amount to several hundreds, some unfinished. In the crater of Otu Iti they vary in size from thirty feet (of which the head measures two-thirds) to five feet. They are marked by excessive shortness of the upper lip; the eyeballs, of obsidian, are lost; the ears display very long pendant lobes; each image has its own name; some have "hats" or crowns, some have the heads cut flat to receive them; the tools seem to have been long boulders ground down with obsidian—only one specimen was found. The paper was illustrated by numerous drawings made on the spot and enlarged pictures taken from them. Mr. Markham pointed out the resemblance between these remains and the Imarra works in the vicinity of Lake Titicaca, in Peru and advocated the theory that this island had been a stepping-stone for the successive arrivals of immigrants into Peru and perhaps revered as a holy isle whither the Incas sent ships. The Peruvian images were dispersed like those of Easter Island, as though walking through the country; the present islanders were simply Polynesians and probably not descendants of the sculptor-race. Mr. Franks pointed out the resemblance of some peculiarities in the wooden figures now made and the stone images; at the same time the wooden figures brought home by Cook and now in the Museum, differed materially from those brought in 1840—the change of style, therefore, would not imply a change of race. The want of forest timber might have occasioned the employment of the soft volcanic tufa and a long lapse of time would account for the numbers of images found. Sir G. Grey stated that all Polynesians were addicted to carving—if the wooden figures carved in New Zealand had not decayed there would be now thousands of them; there were in these islands traditions of stone figures brought from other islands. Mr. Palmer said, in reply, that he had not formed any theories on the subject; but only recorded what he saw; the people had all been withdrawn to the settlement in consequence of the Peruvians having kidnapped some hundreds to work the guano deposits.

Anthropological Society of London, February 1.—Captain Bedford Pim, R.N., V.P., in the chair, "On the negro slaves in Turkey," by Major Frederick Millengen, F.R.G.S. The author exposed first the particulars connected with the sale of negro slaves in Mussulman countries, then described the condition of negroes in Turkey and concluded by some general observations. The negroes imported into the Sultan's dominions come from the countries situated on the higher basin of the Nile; and though that valley is the route followed by the cargoes of slaves on their way to the markets, numbers of secondary channels exist, through which slave-dealers convey their merchandise. The causes of the supply are the feuds of the negro races, the causes of demand are that slavery is inherent in the religious system of Mussulman nations, inherent in their social system and congenial to their ideas and manners. The author considered that Sir Samuel Baker's expedition to put a stop to the slave trade must end in failure; and he quoted the speech of Lord Houghton plainly avowing the disappointment felt by his friend Sir Samuel Baker on seeing the Mussulmans hostile to his scheme. In conclusion, the author said that, if the Sultan and Khédive really intend doing away with slavery, they have nothing else to do but to open wide the gates of their harems.

DUBLIN

Natural History Society, February 2.—Mr. R. P. Williams in the chair. Dr. A. W. Foot exhibited a young bitch terrier suffering from goitre and made a few remarks on the subject of goitre in animals. The list of animals affected with this complaint includes the lion, hyæna, racoon, monkey, cat, dog, horse, mule, pig, cow, sheep and mouse. The geological conditions which appear to be connected with the occurrence of this disorder in animals were discussed and commented upon. —Prof. Macalister read a paper "On some points in the anatomy of the sartorius muscle." - Dr. A. W. Foot exhibited thirteen species of dragon flies, collected during the past summer in the county of Wicklow: *Agrion elegans, minium, pulla, cyathigerum; Lestes nympha, Calypteryx virgo, splendens, Æschna pratensis, juncea, grandis, Libellula quadrimaculata, striolata* and *cærulescens.*

MANCHESTER

Literary and Philosophical Society, January 25—J. P. Joule, LL.D., F.R.S., &c., president, in the chair.

"On organic matter in the air." By Dr. R. Angus Smith, F.R.S., &c. In referring to the new experiments by Prof. Tyndall on this subject, the author mentioned that he had long ago proved the existence not only of inorganic and organic material; but also of organised bodies in the atmosphere. He did not claim to have originated the idea that this is the case; but rather to have furnished proof and quantitative demonstration of the fact, as far back as 1846, when he brought a notice of the subject before the Chemical Society and, in 1848, in a report to the British Association; having also followed up the inquiry since then, in conjunction with Mr. Dancer and published his results at various times. In conclusion he says we must not be panic-stricken because of the presence of organised germs in the air. Some are hurtful; but it may be that others are required for the maintenance of healthy animal life exactly as in vegetable fermentation.

Prof. Williamson exhibited some specimens affording additional information as to the organisation of calamites. Through Mr. Butterworth he had succeeded in obtaining examples whose structure was intermediate between calamodendron and calamopitus. In the general arrangement of separate parts the new specimens corresponded closely with the type figured by Mr. Binney; but they differ in two important particulars. All the fibro-vascular tissues are of the reticulate type seen in calamopitus and dictyoxylon, with a few scalariform vessels here and there. The cellular laminæ separating the vascular wedges exhibit remarkable variations even in the same specimen; the cells being sometimes elongated into vertical forms of prodenchyma—sometimes extended transversely and still more frequently they consist of ordinary parenchyma. In some the fibro-vascular tissues of the wedges are separated by masses of cellular tissue, both at the nodes and internodes. These tissues, or modified medullary rays, are so numerous in one example, that more than two vertical vessels can scarcely be found in contact without the intervention of one of these vertical rows of mural cellular tissue. In other specimens these medullary rays are much more scanty, as if connecting the type under consideration with that figured by Mr. Binney. In these new examples, the verticillate medullary radii of calamopitus are wholly wanting. Additional proof is thus afforded that all three of the types may be only variations of the common calamodendron and it thus becomes more demonstrable that in the Lancashire coal-field, at least, we have no evidence of the existence of an equisetiform type of calamite distinct from the calamodendroid one. The author further announced the discovery by Mr. Butterworth of a young calamite in which the vertical layer is well preserved, presenting a parenchyma of somewhat remarkable structure and of a thickness equal to the ligneous zone which it invests. Its further description will be given after investigation.

"On the so-called molecular movements of microscopic particles." By Professor Stanley Jevons, M.A. In studying the phenomenon first pointed out by Robert Brown in 1827, the author found that silicates appeared to be generally the most active substances in this respect, pure quartz crystal in fine powder maintaining rapid oscillation: but charcoal, red phosphorus, antimony and sulphur were also very active. Metallic oxides and earthy salts, such as carbonate of lime, appeared to be less active; but it cannot be said any substance is free from such motion. On varying the liquid, however, by dissolving salts in it, the fact became apparent that pure distilled water gave rise to the greatest activity. The motion appeared to be closely connected with the suspension of fine powder in water, a fact already noticed by Dujardin.* All acids, alkalis, or salts which checked the motion were found to facilitate the subsidence of suspended material. Gum arabic, on the contrary, prevents subsidence and it has a remarkable power of exciting the molecular motion. The author was soon convinced that the motion was due to electrical action, by the close analogy with the circumstances under which electricity is produced by the hydro electric machine, pure water alone producing much electricity, while almost any salt, acid, or alkali prevented the action by rendering the water a conductor. Ammonia, however, is a remarkable exception in this respect and it does not stop the molecular motion or facilitate subsidence of suspended material. Boracic acid, likewise, is a non-conductor and does not cause subsidence.

However, acetic acid, which Faraday stated did not render water a conductor, does, in common with other vegetable acids, occasion subsidence. It is probable that silicic acid does not render water a conductor, since silicate of soda tends to increase the molecular motion rather than otherwise and this is another exception to the general influence of soluble substances in causing subsidence.

The author is of opinion that this motion of suspended particles is closely connected with the phenomena of osmose as a case of action and reaction; for, if a liquid be capable of impelling a particle in a given direction, the particle, if fixed, would be capable of impelling the liquid in an opposite direction with an equal force. The earthenware jars used by Graham were composed of a substance highly active under the microscope, and the fact that osmose is chiefly an affair of very dilute solutions, certainly accords with the electric origin of the molecular motion, which the author considered to be established experimentally, pointing to the experiments of Wiedemann on electric osmose as suggesting a speculative explanation. Solid particles of organic substances also exhibit the motion; albumen, distrin, sugar, starch-solution, alcohol, &c., have little power to arrest the motion. The author thinks it not unlikely that, when these phenomena are fully investigated, they will give strong support to the theory lately put forward by Becquerel, that the movements of liquids in animals and plants are really due to electric action. Mr. Dancer stated that particles approaching to a spherical form showed the greatest activity with some few exceptions, as in the case of sublimed mercury and sulphur. He did not regard electric action as a satisfactory explanation of the phenomenon, and thought the results of many experiments pointed to heat as a probable cause.—"On a general system of numerically definite reasoning," by Prof. W. Stanley Jevons, M.A. The substance of this paper was given in the report of the Royal Society's proceedings for January 20.

LIVERPOOL

Naturalists' Field Club, January 14.—The Rev. H. H. Higgins, president, in the chair. The President informed the members that Mr. H. S. Fisher was in communication with some botanists in the south of England, with the view of obtaining exchanges of specially local plants and that he had been successful in supplying a gentleman in Cornwall with fifty or sixty specimens of plants, placed in a list of desiderata forwarded by him—among them *Centaurea latifolia*—a plant peculiar to Crosby in this neighbourhood. He also mentioned that he had witnessed the phenomenon known as the Zodiacal Light at Rainhill on the 19th of December last, at 4.25 P.M. In substance, but not in form, it resembled the tail of a comet.—Mr. Gibson then read a

* Manuel Complet de l'Observateur au Microscope. Paris: 1843, p. 60.

short paper on the Parasitic character of *Pyrola rotundifolia*—Wintergreen—and stated his belief, founded on minute personal investigation, that it *is* Parasitic on the root of the dwarf willow, *Salix repens*. He never found Pyrola where the willow was absent and in some cases he detected the fibrous roots of the Pyrola apparently growing on those of the willow.

BRIGHTON

Brighton and Sussex Natural History Society, January 13.—The president, Mr. T. H. Hennah, in the chair. The receipt of a copy of a paper by Mr. C. Roper, on the Decapod Crustacea found at Eastbourne, was announced.—Mr. J. E. Mayall communicated a note on what he believed to be a new fact in connection with coal gas. While engaged in the spectrum analysis of organic bodies, he had found his results interfered with by the presence of copper. Examining the solutions and no trace of copper being found, it occurred to him that it might be present in the common coal gas used in the Bunsen lamp, in which the incandescence of the organic matter was produced. Having candles with wicks dipped in the chlorides of various metals always at hand as standard spectra, on comparing the flame of a copper candle with that of the gas under examination, their spectra were found to be identical. From this he inferred the copper was generated from pyrites contained in the coal. Mr. J. E. Mayall then read a paper on Volcanic Theories.

PARIS

Academy of Sciences, January 24.—M. Lecoq de Boisbandeau communicated a note on the continuity of luminous spectra, in which he developed his theory of the production of spectra by inequalities in the luminous molecules, and referred especially to the phenomena presented by rubidium, cæsium, and potassium.—At this meeting there were no other papers on subjects of any special importance.

January 31.—M. Vérard de Sainte-Anne read a Memoir on a project for establishing a communication between France and England. The author proposes the establishment of a railway bridge, either open or tubular, across the Straits of Dover. A continuation of M. J. Boussineq's memoir on the theory of the flow of a liquid through an orifice in a thin partition was presented by M. de Saint-Venant.—M. Gaiffe communicated a letter containing remarks on the process employed by Mr. Adams to produce deposits of nickel by electrolytric action, in which he maintained that the neutral chloride and sulphide of nickel and ammonia with no trace of free fixed alkali can alone furnish workable baths.—M M. Becquerel maintained that the presence of soda and potash does not hinder the deposition of the nickel.—M. A. Lallemand stated that when a solution of sulphur in sulphide of carbon is exposed to solar light concentrated by a lens, insoluble sulphur is produced: the spectrum of the emergent light is deficient in all the rays between G and H and the ultra-violet spectrum has entirely disappeared. A solution of phosphorus in sulphide of carbon is similarly acted upon.—M. Cahours presented a note by M. L. Daniel, giving an account of some interesting experiments with vacuum-tubes under the influence of magnetism. — A note on the heat of combination of boron with chlorine and with oxygen, by MM. L. Troost and P. Hauteville, was presented by Mr. H. Sainte-Claire Deville, who also communicated a paper by Mr. Landrin on the division of a limited quantity of acid between two bases employed in excess. From his experiments it appears that the oxides are dissolved in simple equivalent proportions, *i.e.*, 1 to 2, 3, 4, 5, &c.—A note by M. E. Bourgoin on the cause of the unequal loss of oxalic acid at the positive and negative poles and on the nature of oxalic acid when dissolved in water, was presented by M. Bussy. The loss by decomposition is three times as great at the positive as at the negative pole; the gas disengaged at the former is pure carbonic acid, at the latter hydrogen. The author concludes that the composition of oxalic acid in solution in water, is $C^4 H^2 O^8$, 2 H^2, O^2.—M. C. Dareste read a paper on the convolutions of the brain.—M. P. Gervais presented a reply to the observations of M. Balbiani on the ova of the *Sacculinæ*, by M. E. Van Beneden and M. A. L. Donnadieu noticed a case of monstrosity (hemiterism) in a carp.—M. A. Chatin communicated a note on the cause of the dehiscence of the anthers of plants, in which he denies that this phenomenon is due exclusively to the fibrous cells of the endothecium as supposed by Purkinje and shows that in some cases certainly and in many others probably, the exothecium or epidermic layer plays an important part in it.

DIARY

THURSDAY, FEBRUARY 10.

ROYAL SOCIETY, at 8.30.—On some remarkable Spectra of Compounds of Zirconia and the Oxides of Uranium: H. C. Sorby, F.R.S.—On the Mathematical Theory of Stream Lines, especially those with four foci and upwards: Professor Rankine.—On Linear Differential Equations: W. H. L. Russell, F.R.S.
MATHEMATICAL SOCIETY, at 8.—Quartic Surfaces: Prof. Cayley.
ZOOLOGICAL SOCIETY, at 8.30.—On a new Cervine Animal from the Yang-tze-Kiang: R. Swinhoe.—On the Size of the Red Corpuscles of the Blood of *Moschus, Tragulus, Orycteropus, Ailurus* and some other mammalia, with historical notices: G. Gulliver.
ANTIQUARIES, at 8.30.
LONDON INSTITUTION, at 7 30.

FRIDAY, FEBRUARY 11.

QUEKETT MICROSCOPICAL CLUB, at 8.—For exhibition of objects and microscopic gossip.
ROYAL INSTITUTION, at 9.—The Deep Sea: Dr. Carpenter.
ASTRONOMICAL SOCIETY, at 3.—Anniversary Meeting.

SATURDAY, FEBRUARY 12.

ROYAL BOTANIC, at 3.30.

MONDAY, FEBRUARY 14.

MEDICAL SOCIETY, at 8.
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.

TUESDAY, FEBRUARY 15.

ANTHROPOLOGICAL SOCIETY, at 8.—On the Aborigines of the Chatham Islands: Dr. Barnard Davis and A. Welch.—Polygamy: Dr. John Campbell.—Inscribed Stone from Venezuela: R. Tate.
PATHOLOGICAL SOCIETY, at 8.
STATISTICAL SOCIETY, at 8.—On International Coinage and the Variations of Foreign Exchanges during recent years: E. Seyd.
INSTITUTION OF CIVIL ENGINEERS, at 8.
ROYAL INSTITUTION, at 3.—On the Architecture of the Human Body: Prof. Humphry.

WEDNESDAY, FEBRUARY 16.

SOCIETY OF ARTS, at 8.—On Emigration: T. Plummer.
METEOROLOGICAL SOCIETY, at 7.

THURSDAY, FEBRUARY 17.

ROYAL INSTITUTION, at 3—Chemistry: Prof. Odling.
LINNEAN SOCIETY, at 8.—On the Tree Ferns of British Sikkim: Mr. Scott.
CHEMICAL SOCIETY, at 8.
ZOOLOGICAL SOCIETY, at 4.
ANTIQUARIES, at 8.30.
ROYAL SOCIETY, at 8.30.

BOOKS RECEIVED

ENGLISH.—Transactions and Proceedings of the New Zealand Institute, 1868: Edited by J. Hector, M.D. (Trübner).—The Year Book of Facts: J. Timbs (Lockwood and Co.).

FOREIGN.—Bericht über die Fortschritte der Eisenhütten-Technik im Jahre, 1867, nebst einem Anhange enthaltend die Fortschritte der anderen Metallurgischen Gewerbe: A. K. Kerpely.—Studien aus dem Institute für experimentelle Pathologie in Wien aus dem Jahre, 1869: S. Stricker.—Zeitschrift für Parasitenkunde: Dr. E. Hallier and Dr. F. Zürn.—Handbuch der theoretischen und clinischen Percussion und Auscultation vom historischer und critschen Standpuncte bearbeitet: Dr. P. Niemeyer.—Beitrage zur Naturkunde Preussens herausgegeben von der königlichen physikalisch-ökonomischen Gesellschaft zur Königsberg: miocene baltische Flora: O. Heer.—Landwirthschafliche Zoologie: Dr. C. E. Giebel (Williams and Norgate).

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JANUARY 1870] [PART III

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

"To the solid ground
Of Nature trusts the mind that builds for aye."—WORDSWORTH

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No. 10

No. 11

No. 12

No. 13

Publishing Office—16, BEDFORD STREET, STRAND

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH

No. 16] THURSDAY, FEBRUARY 17, 1870

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J. GWYN JEFFREYS.

25, Devonshire Place, Portland Place, London,
February 14, 1870.

THURSDAY, FEBRUARY 17, 1870

THE MEASUREMENT OF GEOLOGICAL TIME

I.

MODERN geological research has rendered it almost certain, that the same causes which produced the various formations with their imbedded fossils, have continued to act down to the present day. It has therefore become possible that, by means of changes which are known to have occurred in a given number of years, some measurement of the time represented by the whole series of geological formations might be obtained. It is true, that changes in the earth's surface, the records of which constitute the materials for geological research, occur very slowly, yet not so slowly as to be quite imperceptible in historical time. Land has risen or sunk beneath the sea, rivers have deepened their channels and have brought down sediment which has converted water into land, cliffs have been eaten away and the surface of the earth has been, in many ways, perceptibly and measurably altered during an ascertained number of centuries. But it is found that these changes are too minute, too limited and too uncertain, to afford the basis of even an approximate measurement of the time required for those grand mutations of sea and land, those contortions of rocky strata many thousands of feet thick, those upheavals of mountain-chains and that elaborate modelling of the surface into countless hills and valleys, with long inland escarpments and deep rock-bound gorges, which form the most prominent and most universal characteristics of the earth's superficial structure. Another deficiency in this mode of measurement arises from the fact, now universally admitted, that the record of past changes is excessively imperfect, so that even if we could estimate with tolerable accuracy the time required to deposit and upheave the series of strata of which we have any knowledge; still that estimate would only represent an unknown proportion, perhaps a minute fraction of the whole time which has elapsed since the strata began to be formed.

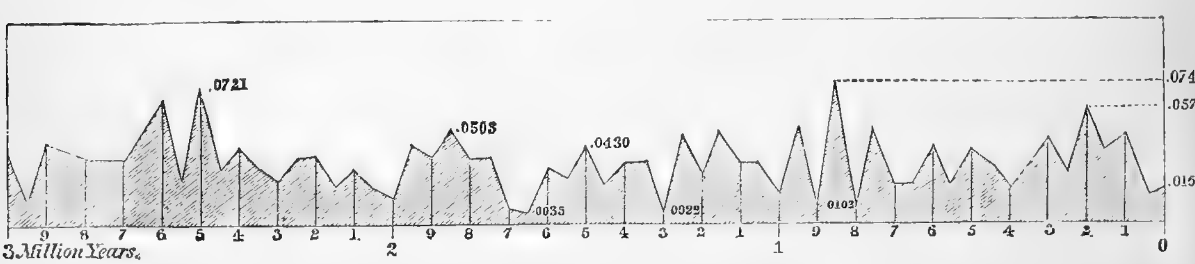
But there is another class of geological phenomena which enable us to measure those very gaps in the record of which we have just spoken, and it is now generally admitted that the continual change of the forms of animal and vegetable life which each succeeding formation presents to us, affords the best means of estimating the proportionate length of geological epochs. Though we have no reason to think that this change was at all times effected by a uniform and regular process; yet believing, as we now do, that it was due to the action of a vast number and variety of natural causes acting and reacting on each other, according to fixed general laws, it seems probable that, with much local and temporary irregularity, there has been on the whole a considerable degree of uniformity in the rate at which organic forms have become modified. It may indeed be the case that this rate of variation has continually increased or diminished from the first appearance of life upon the earth until the present day, or has been subject to temporary changes; but so long as we have no proof that such was the case, we shall be safer in considering that the change has been tolerably uniform.

To measure geological time, therefore, all we require is a trustworthy unit of measurement for the change of species: but this is exactly what we have not yet been able to get; for the whole length of the historical period has not produced the slightest perceptible change in any living thing in a state of nature. Moreover, though, the much longer time that has elapsed since the Neolithic or Newer Stone age, has been sufficient for some changes of physical geography and has, to some extent, altered the distribution of animals and plants, it has not effected any alteration in their form. It is only when we get back to the Palæolithic or Older Stone age, when men used chipped flints for weapons and Europe was, probably, either just emerging from the severity of the glacial epoch, or in some of the intercalated milder periods, that we meet with a decided change in the forms of life. Elephants and rhinoceroses, bears, lions and hyenas then inhabited Europe; but they were nearly all of species slightly different from any now existing, while the reindeer, the musk-sheep, the lemming and some other animals, were the same as those that still live in the Arctic regions: all the mollusca, however, were identical with living species. In the newer Pliocene Crag, on the other hand, which seems to have been deposited just as the glacial epoch was coming on, there are 11 per cent. of extinct species of shells and about 55 per cent. of extinct mammalia. What we want, therefore, is to be able to estimate, by means of the physical changes before alluded to, the time since the beginning or the end of the glacial epoch. Then we should have the unit we require for measuring geological time by the repeated changes in the forms of life as we go further and further back into the past; but before showing how this may perhaps be done, something must be said about physical and astronomical determinations of the age of our globe.

A few years ago, Sir W. Thomson startled geologists by placing a limit to the time at their disposal, which they had been in the habit of regarding as practically infinite. He showed, from the known laws of heat and the conservation of energy, that there are determinable limits to the age of the sun. Then, applying the same principles to the earth, he showed that, from the known increase of heat towards its interior and from experiments on the rate of cooling of various rocks, it cannot have existed in a habitable state for more than about one hundred million years. It is within that time, therefore, that the whole series of geological changes, the origin and development of all forms of life, must be comprised. But, geologists had been accustomed to demand a much vaster period than this for the production of the series of fossiliferous deposits in the crust of the earth; while the researches of Mr. Darwin render it almost certain that, however vast the time since the Silurian and Cambrian epochs, yet anterior to these, at least an equal, and probably a much longer, series of ages must have elapsed since life first appeared upon the earth, in order to allow for the slow development of the varied and highly organised forms which we find in existence at those early epochs. Sir Charles Lyell is not disposed to admit the accuracy of these calculations, and Professor Huxley has criticised them in detail, with a view of showing that they are, in many respects, unsound; while Mr. Croll as strenuously maintains that they are sound in principle and accurate within certain limits.

We have now to consider the bearing of Astronomy upon the problem. In a series of admirable papers in the *Philosophical Magazine*, Mr. Croll has fully discussed the question, how far variations in the excentricity of the earth's orbit, together with the precession of the equinoxes, have produced variations of climate in past ages. He has endeavoured to show that the date of the last glacial epoch and those preceding, may be determined by such considerations. With this view he has laboriously calculated tables showing the amount of excentricity for a period of three million years, at intervals of 10,000 years for a large portion of that time, and 50,000 for the remainder. These tables show that the amount of excentricity is alternately great and small at intervals of 50,000 or 100,000 years, as represented with sufficient accuracy in the diagram, which I have constructed by means of his figures. Owing to the precession of the equinoxes, combined with the revolution of the apsides, either pole will be presented towards the sun (constituting summer in that hemisphere and winter in the opposite one) at a different point in the earth's orbit on each succeeding year, the motion being such as to cause a complete revolution in 21,000 years. If, therefore, at any one period, winter in the northern hemisphere occurs when the earth is nearest the sun or in *perihelion* (as is the case now), in 10,500 years it will occur in *aphelion*; at the one period the winters will be shorter and warmer, at the other longer and colder. When the excentricity is great (say two, three, or four times what it is now), million years probably includes a large portion of the tertiary period, which therefore should have mainly consisted of alternations of warm and cold climates in each hemisphere, the latter generally forming true glacial epochs. This seems the legitimate deduction from Mr. Croll's reasoning and from the tables of excentricity with which he has furnished us; but, as he very justly argues, we cannot expect to find geological evidence of all these changes of climate. The warm and temperate periods will naturally leave the best records, while the cold epochs will generally be characterised only by an absence of organic remains. Besides, we must consider 10,500 years as a very small fragment of time in geology and we have good reason for thinking that several such periods might pass away without the occurrence of those exceptional conditions which Mr. Darwin and Sir C. Lyell have shown to be necessary for the preservation of any geological record. As to physical proofs of ice-action, very few could survive the repeated denudations, upheavals and subsidencies, which the surface must have undergone since any of the earlier glacial epochs; so that it may be fairly argued that these repeated changes of climate may have occurred and yet have left no distinct record by which the geologist could interpret their history.

Throughout the whole of his argument, Mr. Croll considers astronomical causes to be the most important



Mr. Croll shows that, from the known laws of heat in reference to air and water, winter in *aphelion* will lead to an accumulation of snow, in the polar regions, which the summer will not be able to melt. This will go on increasing for many thousand years, till winter occurs near the *perihelion*, when the snow will be melted and transferred to the opposite pole. When the excentricity was very great a glacial epoch would occur in each hemisphere for more or less than 10,500 years, the other portion of the period of 21,000 years being occupied by an almost perpetual spring, with two transition periods from that to the glacial epoch. By examining the diagram of excentricity, we see that during the last three million years there have been more than twelve periods of great excentricity, each long enough to admit two or three, and several of them eight or ten, complete revolutions of the equinoctial points, thus sufficing for the production of not less than fifty or sixty glacial epochs in each hemisphere, with intervening phases of perpetual spring or summer.

The diagram also shows us (and this is of very great importance) that the present amount of excentricity is exceptionally small. During the last three million years there have only been five occasions, always of very short duration, when it has been less than it is now, while periods of high excentricity have often lasted for two hundred thousand years at a time. This period of three and effective agents in modifying climate, while Sir Charles Lyell maintains that the distribution of land and water, with their action on each other by influencing marine and aerial currents, are of prepondering importance. He has certainly shown that these causes have an immense influence at the present time. The effects which, on Mr. Croll's theory, ought to be produced by the existing phase of precession combined with even the small amount of excentricity that now exists, is not only neutralised, but actually reversed by terrestrial causes. Dove has shown that the whole earth is really warmer when it is furthest from the sun in June, than when it is nearest in December, a fact which is to be explained by the northern hemisphere (turned toward the sun in June) having so much more land than the southern. So, the northern hemisphere being three millions of miles nearer the sun in winter than in summer, while the southern hemisphere is the reverse, the northern winter ought to be warmer and the northern summer cooler than the southern; but this, too, is the opposite of the fact, for the southern summer is more than 11° Fahr. cooler than ours, while its winter is nearly 5° Fahr. warmer. The immense differences of temperature of places in the same latitude, sometimes amounting to nearly 30° Fahr., can also be traced, in almost every instance, to the distribution of land and water and of winds and currents. Sir Charles Lyell further argues that the existing distribution of land is so extremely irregular—such an undue proportion being near the poles, while there is such a deficiency at the equator and in the south temperate zone—that whatever differences may have occurred in past time, they can hardly fail to have often been such as to cause a more uniform climate. Therefore he believes that if the poles were tolerably free from land, so as to admit of the uninterrupted circulation of the warmer equatorial waters and to afford no lodgment for great accumulations of snow and ice, a glacial epoch would be impossible even during the most extreme phases of excentricity.

We have now much evidence to show that three distinct modifications in physical geography occurred just before or during the Glacial epoch, which would each tend to lower the temperature. The first is the submergence of the Sahara, which would have caused the southerly winds to be charged with aqueous vapour, condensing on the Alps into snow instead of being, as now, dry and heated and acting powerfully to melt the glaciers. The second is the submergence of Lapland, which would have admitted the cold iceberg-laden waters of the Arctic Sea into the very heart of Europe. The third is the probable submergence of part of Central America, causing the Gulf Stream to be diverted into the Pacific. The only proof of this is the fact that one-third of the known species of marine fishes are absolutely identical on the two sides of the isthmus of Panama; but it is impossible to conceive any means by which such an amount of identity could have been brought about except by a recent, if only a temporary, communication. A subsidence and elevation no greater than what occurred in Wales about the same time—as proved by Arctic shells of existing species in drift 1,300 feet above the sea—would have effected the communication by a broad and deep channel. Now if any two of these changes of physical geography occurred together, we may be sure that a very small increase of excentricity would have led to a more severe glacial epoch than would be possible, under existing conditions, with a much larger excentricity. We must keep this in mind when attempting to fix the most probable date for the last glacial epoch. A. R. WALLACE

FARADAY

The Life and Letters of Faraday. By Dr. Bence Jones. Two vols. 8vo. (Longmans, 1869.)

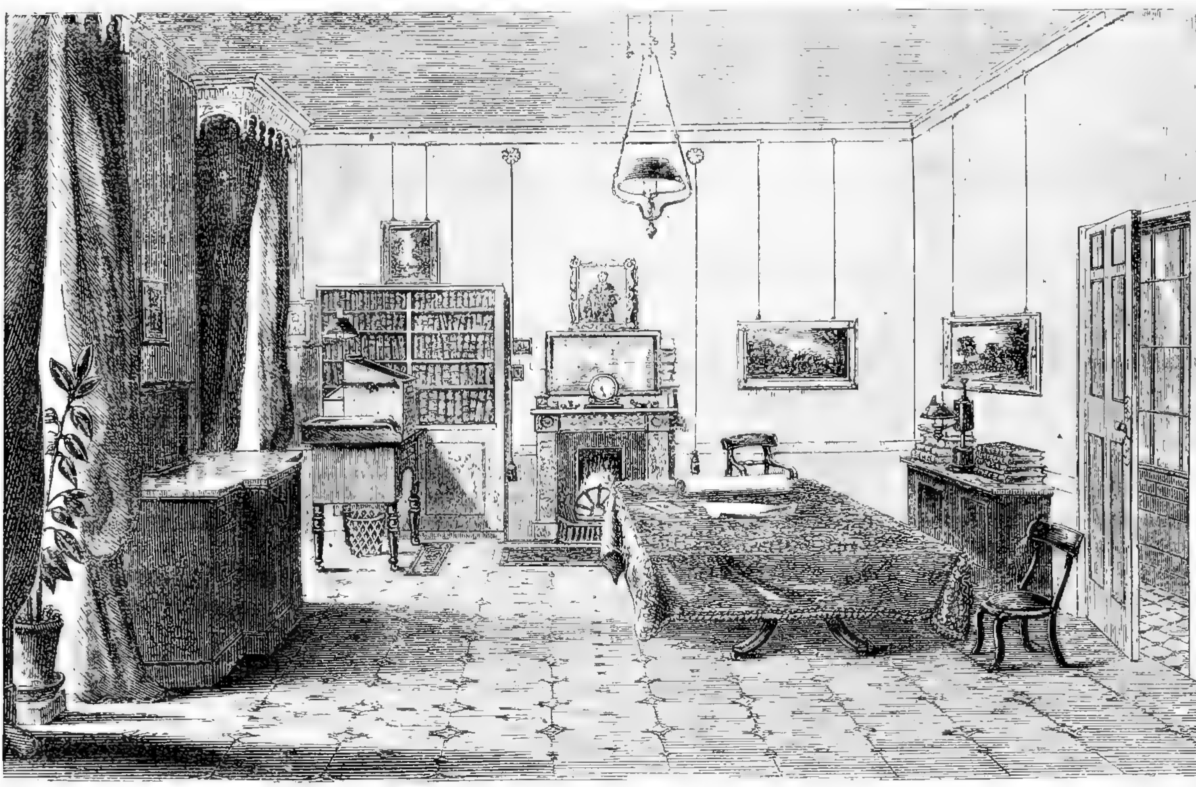
IF none but Apelles was fit to paint Alexander, where shall we find a biographer worthy of Faraday? Shortly after his death, many sketches of his character and work appeared, among which that of De la Rive may be specially mentioned. These were succeeded by Tyndall's two Friday evening discourses on "Faraday as a Discoverer," which were afterwards embodied in an admirable little book. But a more complete biography was wanted, and the question was frequently asked, "Who understood him sufficiently well to draw his portrait?" Eventually it was rumoured that the materials had been placed in the hands of Dr. Bence Jones. First there appeared an unusually long obituary notice in the Proceedings of the Royal Society, consisting of little else than a catalogue of the papers published, lectures delivered, reports written and honours won by the great philosopher in each year during half a century; showing that Dr. Jones had a rare collection of interesting documents, so as to whet our appetite for the coming work. Now it is before us—"The Life and Letters of Faraday"—in two goodly octavo volumes.

The preface tells us what we are to expect: not a complete likeness either of the man or of the philosopher; but a kind of "autobiography"—for, as the author truly says, "from his letters, his laboratory note-books, his lecture-books, his Trinity-house and other manuscripts, I have arranged the materials for a memorial of Faraday in the simplest order, with the least connecting matter." The very abundance of that material was a source of embarrassment, and the necessity for omissions seems to have been felt more strongly as the work advanced; so that while very nearly half the first volume is devoted to three years of Faraday's life—when he was between twenty and twenty-three years of age and before his "earlier scientific education at the Royal Institution" commenced—the latter years of his life are so rapidly passed over, that some of his latest scientific work—for instance, the adjustment of apparatus in lighthouses—is not even alluded to.

An autobiography has great advantages, especially when it is, as in this instance, an unconscious one; but it is not without its defects. It gives a picture only from one point of view, and Faraday was too modest always to do himself justice. We want to know what impressions other people formed of him, and those who have enjoyed his company would wish to find, in the book, some reflex of his own brightness, some of those characteristic anecdotes which are told in scientific circles. The best, almost the only sketch of this kind in the book, is by one of his nieces, Miss Reid, who gives charming details of her uncle's treatment of her when a little girl, and of his habits both at work and play. Tyndall's book, though professing to describe Faraday only as a discoverer, gives a far more vivid impression of the man. I propose at some time to write down my own reminiscences of him; but at present there is not room to deal with more than the way in which he is presented to the world in the "Life and Letters."

The career of Michael Faraday was marked by steady progress rather than by striking events; there were few changes in his life save such as rose naturally from his increasing knowledge and ever-growing fame. We find him born in London in 1791, of poor parents, taught little more than the rudiments of reading, writing, and arithmetic; beginning active life as an errand-boy at a bookseller's in Blandford Street, and shortly afterwards apprenticed to a bookbinder. Here, however, we see him taking every opportunity of gaining knowledge, making experiments in natural science, and presently, on introducing himself to the notice of Davy, obtaining the post of assistant in the laboratory of the Royal Institution. That was in March 1813. His travels with Sir Humphrey about the Continent, for a year and a half, are minutely described in copious extracts from his diary and his letters home: we see here how he came into contact with many other bright intellects, and learned what to copy and what to avoid. In 1816, at the City Philosophical Society, he gave his first lecture, and, in the *Quarterly Journal of Science*, he published his first paper—on native caustic lime—the beginning, in each case, of a series which for many years delighted and instructed his contemporaries. In 1821 commenced his happy domestic life, through his marriage with Miss Sarah

Barnard. Immediately afterwards he became a member of the Sandemanian Church, in which eventually he held the office of elder, and frequently preached. When he was appointed Director of the Laboratory at the Royal Institution, in 1825, his first act was to invite the members to evening meetings with experimental demonstrations, thus commencing the Friday evening discourses, while in the same year he started the juvenile lectures at Christmas. Eight years afterwards he was appointed Fullerian Professor of Chemistry. He continued to discharge these various duties at Albemarle Street till failing health rendered it impossible. During this time we see Faraday working often for the Government and regularly for the Trinity House, while the researches in his laboratory were never intermitted, except through illness. To enumerate his investigations here would be out of the question, but all students of science will remember something of what he accomplished in the liquefaction of gases, the preparation of steel and optical glass, the ventilation of lighthouses, and, especially, that magnificent series of researches in electricity which extended from 1831 to 1855, comprising the induction of electric currents, the evolution of electricity from magnetism, the explanation of the voltaic pile, with the definiteness of electro-chemical decomposition, the influence of magnetism on a ray of polarised light, diamagnetism, the polarity of bismuth and other crystalline bodies, the effect of heat on magnetic force, as well as the mutual relation of these various powers of nature.



FARADAY'S ROOM AT THE ROYAL INSTITUTION

These discoveries were made known principally in the "Philosophical Transactions," extending his reputation so much that, though living in great simplicity, his friendship was desired by the great as well as by the wise of the earth. He received unsought no fewer than ninety-five honorary titles and marks of merit, while both the Royal Society and the Royal Institution in vain requested him to become their president.

The book consists in a great measure of Faraday's own words; to a few intimate friends, as Mr. B. Abbott, Huxtable, his wife, Schönbein, and De la Rive, both father and son, he poured out his thoughts in a rich stream. From these various writings it is very tempting to make extracts. Here are two or three:—

"The philosopher should be a man willing to listen to every suggestion, but determined to judge for himself. He should not be biassed by appearances; have no favourite hypothesis; be of no school and, in doctrine, have no master. He should not be a respecter of persons, but of things. Truth should be his primary object. If to these qualities be added industry, he may indeed hope to walk within the veil of the Temple of Nature."

"When a mathematician engaged in investigating physical actions and results, has arrived at his own conclusions, may they not be expressed in common language as fully, clearly, and definitely as in mathematical formulæ? If so, would it not be a great boon to such as we to express them so—translating them out of their hieroglyphics that we also might work upon them by experiment? I think it must be so, because I have always found that you could convey to me a perfectly clear idea of your conclusions, which, though they may give me no full understanding of the steps of your process, gave me the results, neither above nor below the truth, and so clear in character that I can think and work for them."

"I do think that the study of natural science is so glorious a school for the mind, that with the laws impressed on all created things by the Creator and the wonderful unity and stability of matter and the forces of matter, there cannot be a better school for the education of the mind."

his imagination,—as a man, truthfulness, kindness, and energy. He speaks also of the great influence of religion on his character.

To form a complete conception of Faraday we must picture him calmly, patiently, and honestly asking questions of nature in his laboratory, and following up the intuitions of his genius; now chatting with his friends in a strain of kindly sympathy or genial playfulness, then giving forth the results of his own or others' discoveries to large and rivetted audiences with perfect simplicity of thought and language; experimenting before them with marvellous dexterity; writing learned papers and inventing useful applications; but ever enriching mankind both by the wealth of his discoveries and the beauty of his example.

BOOKSELLER'S SHOP IN BLANDFORD STREET WHERE FARADAY WAS APPRENTICED

For giving us this correspondence we owe no small debt of gratitude to Dr. Bence Jones, who has also enriched the biography by letters which Faraday received on various occasions from many eminent men. In conclusion he enumerates what he conceives to be the chief characteristics of the subject of his memoir: as a philosopher, the trust which he put in facts, and the power of

J. H. GLADSTONE

OUR BOOK SHELF

Sorghum and its Products.—*An Account of recent Investigations concerning the Value of Sorghum in Sugar Production, &c. &c.* By F. L. Stewart. (Lippencott: Philadelphia. 8vo. 1869. London: Trübner.)

Mr. STEWART informs us that sorghum was introduced in 1854 into the United States from France, whither it had been carried from China. It is now grown on a large scale and quite successfully, in North America. The little treatise now before us is intended as a manual for the manufacture of syrup and sugar from this plant: the author has divided his work into thirty chapters, treating consecutively of the history and cultivation of the sorghum, the extraction of sugar from it and the mode of utilising the various waste products obtained.

Mr. Stewart's manual may be read with interest, not only by manufacturers—who will find it most practically written—but by all who feel a pleasure in the success of economic chemistry. The author does not, however, carry his description so far as the final stage of a finished process. He seems to have contented himself with writing merely for farmers of about 75 acres, and instructing them how to prepare on their own land "a golden syrup, unexcelled either in colour or flavour by the best products of the refineries" (p. 153), or "a fair yellow sugar." This is not the proper condition of a great national industry. The successful manufacture of sugar, indeed, can hardly be attained without the concentrated effort of a large capital, aided, even then, by considerable special knowledge. The class of cultivators described by the author would consult their own advantage by contenting themselves with the humbler office of contributing the raw material.

Vegetable Essences.—*Die Pflanzenstoffe* in chemischer physiologischer, pharmakologischer, and toxicologischer Hinsicht. Bearbeitet von Dr. Aug. Husemann und Dr. Theod. Husemann. Erste Lieferung; Bogen 1—16. (Berlin: Springer, 1870. London: Williams and Norgate.)

THE first section of an important work on those products of the vegetable kingdom which are of importance to the chemist, the physiologist, and the physician. These substances the MM. Husemann classify as follows:—A, Simple combinations; (1) Bases or alkaloids; (2) Acids, both those of general distribution and those of special development; (3) Neutral substances, with the same distinction. B, Compound substances; (1) Volatile oils; (2) Resins; (3) Fats. In each section the substances are arranged under the natural orders to which the plants belong; and we have an account of their discovery, mode of preparation, properties, composition, products of decomposition, behaviour with various reagents, and physiological and toxological effects. The present part does not exhaust the alkaloids.

A. W. B.

ON THE DAILY LABOURING FORCE OF THE HUMAN HEART

II.

IT remains for me to explain the manner in which the two elements of the calculation of the daily labouring force of the heart (see p. 255) have been ascertained. These elements are, the capacity of the left ventricle of the heart, and the hydrostatical pressure of the blood inside the ventricle at each pulse.

The average capacity of the left ventricle is ascertained by filling it with melted wax, at a pressure equivalent to that of 9 ft. vertical, of blood; and afterwards weighing the solidified wax cast of the ventricle and comparing its weight with that of a known volume of the same wax. In this manner, it has been found that the average capacity of the left ventricle does not differ much from 3 ounces.

In the unavoidable absence of any direct experiment on the hydrostatical pressure of the blood in human arteries, we are obliged to have recourse to indirect methods of estimating its amount. The first attempt made by me was the following:—On the 22nd of March, 1863, I had an opportunity of witnessing the removal of a large fibro-cellular tumour from the left groin of a middle-aged, large sized man, in the operating theatre of the Meath Hospital. In the course of the operation, the external epigastric artery (which appeared enlarged to feed the tumour) was divided, and before it could be ligatured, strong jets of blood were thrown from it in various directions about the floor of the theatre. I noticed, as the poor fellow struggled on the operating table, that the jets of blood fell short, or enjoyed a longer range, according to the angle of elevation of the orifice of the bleeding artery, and that there was a certain maximum range on the floor of the theatre, which was not exceeded. Having afterwards measured the vertical height of the bleeding artery, and the horizontal distance of the squirts of blood corresponding to the maximum range, I found them to be 3 ft. 6 in. and 8 ft. respectively. From these *data*, I readily calculated (by the parabolic theory of maximum range of projectiles on a descending inclined plane) the velocity of the blood issuing from the orifice of the artery, and found it to be 12·905 ft., corresponding to an hydrostatical pressure of 2·586 ft.

This result, although of great value, leaves us still in ignorance of the hydrostatical pressure of the blood inside the arteries when they are intact; for, owing to the wonderful perfection of the mechanism of the heart, its force of contraction is exactly regulated by the resistance it is compelled to overcome, and as soon as a large artery is opened, the heart instinctively feels that the resistance is lessened, and spontaneously reduces its force of contraction, to correspond with the diminished resistance of the circulation. The beneficial effects of this remarkable property of the heart, in the case of wounded arteries, are evident, for its reduced force of contraction greatly diminishes the loss of blood.

Dr. Hales, in the course of his Hæmastatics, remarks that the blood did not spout much higher than 2 feet from the wounded artery of the horse, although the pressure inside the arteries, when the circulation is complete, exceeded 9 feet of blood. The difference in the force of the heart in the two cases arises from the resistance offered by the capillary circulation.

We find ourselves, therefore, obliged to estimate the force of the hæmastatical pressure in the human arteries, not by direct experiment, but by the following indirect reasoning.

The experiments of Poiseuille on the discharge of liquids through capillary tubes, prove that the resistance offered by such tubes is directly proportional to the length of the tubes and inversely proportional to the squares of their cross sections.

The quantity of liquid discharged by a capillary tube in a given time is inversely proportional to this resistance, and may be expressed by the following formula:—

$$Q = A \times \frac{h d^4}{l}$$

In this expression Q denotes the quantity of liquid discharged in a given time, A is a constant, h denotes the charge or hydrostatical pressure, and d and l are the diameter and length of the capillary tube.

Now, there is reason to believe that in animals, similar in bulk, the arrangement and structure of the capillaries are such that the ratio of the squares of their cross sections to the total lengths of the capillaries is practically constant, as may be proved from the following comparison of the sheep and dog. The left ventricle of a sheep's heart, according to Hales, contains 1·85 cubic inches, and its pulse beats 65 times in a minute; the quantity of blood passing through its capillaries in a given time being obviously proportional to the product of these two quantities. The hæmastatical pressure in the arteries of the sheep (Hales) is 6·46 feet of blood.

If we bring to the left hand side of equation (1) the quantities depending on capillary resistance, we find

$$A \times \frac{d^4}{l} = \frac{Q}{h} = \frac{1{\cdot}85 \times 65}{6{\cdot}46} = 18{\cdot}6.$$

The number thus found is to be regarded as the *capillary coefficient* of the sheep. The average of the capacities of the left ventricles of six dogs measured by Dr. Hales, was 0·954 cubic inches; and the average hæmastatical pressure in the arteries of sixteen dogs, was 4·75 ft. of blood; while the pulse of the dog beats ninety-seven times in the minute, on an average. Hence we can obtain the *capillary coefficient* of the dog,

$$A \times \frac{d^4}{l} = \frac{Q}{h} = \frac{0{\cdot}954 \times 97}{4{\cdot}75} = 19{\cdot}6.$$

The sheep and dog differ from each other, as much as man and the horse do, in size of heart and rate of pulse; they also differ in hæmastatical pressure; yet, notwithstanding these differences, the *capillary coefficient* depending on them all, comes out to be nearly the same in both animals.

The *capillary coefficient* of the horse is double that of the sheep and dog, showing that the resistance to circulation in the horse is only half that of the smaller animals. The left ventricle of the horse contains 10 cubic inches, the rate of pulse is 36 beats in a minute, and the average hæmastatical pressure is 9·14 ft. of blood. Hence we find for the *capillary coefficient* in the horse

$$A \times \frac{d^4}{l} = \frac{Q}{h} = \frac{10 \times 36}{9{\cdot}14} = 39{\cdot}3.$$

I now assume that the *capillary coefficient* in man is the same as in the horse; or, in other words, that man bears to the horse, in regard to blood circulation, the same relation as the dog bears to the sheep.

On this assumption, the hæmastatical pressure in the human arteries may be thus found. The human heart has a capacity, in its left ventricle, when in action, of 3 ounces, or 5·2 cubic inches, and beats 75 times in a minute. Solving equation (1) for h, we find

$$h = \frac{Q}{A \times \frac{d^4}{l}}$$

Substituting for Q, the product of the capacity of the ventricle and rate of pulse; and for the *capillary coefficient*, its value in the horse, we obtain

$$h = \frac{5{\cdot}2 \times 75}{39{\cdot}3} = 9{\cdot}923 \text{ ft. of blood.}$$

This is the hæmastatical pressure used in the preceding paper on the force of the heart.

SAMUEL HAUGHTON

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Scientific Queries

MAY I venture to ask you, or one of your readers, for information on the following points :—

1. What is Le Verrier's Law of Storms?

2. What the latest state of our knowledge regarding the peculiar changes undergone by the Mexican Axolotls during their metamorphoses? Have changes, similar to those observed in 1866 by Duméril been noticed in the Zoological Gardens or elsewhere? Have any observations regarding generation in the so-called Pereniobranchiates been made on any other animals besides the Axolotl and the Siredon?

3. Where can I find any account of the earliest observations on the peculiar nesting arrangements of the Hornbills, as described by Wallace? I see that Captain Layard has sent a note on this subject to the Zoological Society, but I have no means of ascertaining what he states.

4. In a lecture published by Blanchard in the *Revue des Cours Scientifiques* a few months ago, on the Progress of Natural History in the Departments of France (excluding Paris), I see that a medal has been lately awarded to M. Lespes for his entomological researches. Are these recent researches, or are they those described several years ago by Mr. (now Sir John) Lubbock in the *Natural History Review?*

5. Is it not the general opinion of your readers that Sir John Lubbock would confer a great favour on those who possess the first edition of his *Prehistoric Times*, by publishing in the form of a pamphlet the chief additions which are introduced into his second edition?

F. R. S.

Haze and Dust

DR. TYNDALL, in his lecture upon Haze and Dust, says "that if a physician wishes to hold back from the lungs of his patient, or from his own, the germs by which contagious disease is said to be propagated, he will employ a cotton-wool respirator;" and, further on, "time will decide whether in lung diseases also the woollen respirators cannot abate irritation, if not arrest decay."

May I ask if there is any necessity for the unsightly respirators one sees over the mouths of people during the winter months and cold evenings? Has not Nature already provided us with an efficient one—one which, on experiment, will doubtless prove to be quite as trustworthy as the artificial one, without any of its inconveniences? I refer to the hair-sieve with which the sinuosities of the nasal passages are supplied; the hairs besetting its path freeing the indrawn air from contaminating particles of dust, whilst it is effectually warmed in its inward passage.

That the air is thus filtered might, I think, be ocularly demonstrated by inhaling exclusively through the nostrils, and then expiring through the glass tube, when the floating matter will be found absent, having been arrested in the nose; I suggest this experiment, because, from the eminent professor applying a handful of wool to his *mouth* and *nose*, I infer that he did not give his natural respirator a fair chance of showing its capabilities.

Apart from the use of respirators, *en passant*, I may perhaps be allowed to echo the opinion of our best medical men in saying that the mouth is not *the* organ for respiration; if it were, should we not find the olfactory nerves developed there also? By respiring through the mouth you do not properly exercise your sense of smell, you allow the hairs lining the nasal cavities to dwindle away and become suppressed through non-use, and finally, you clog up the minute tubercles of the lungs with all kinds of rotten matter.

It is a well-known fact, that people who habitually breathe through the nose are less liable to infectious diseases and pulmonary complaints, one very common benefit derived by such who sleep with the mouth closed, is that they never awake with the painful and disagreeable sensation produced by a parched throat and cracked lips. This may be a small matter, but I think it is deserving of attention. When we break Nature's laws we must pay the penalty.

A. L.

The Solution of the Nile Problem

I HAVE read with much pleasure Mr. Keith Johnston's remarks in your impression of the 27th ult. on the subject of Dr. Livingstone's explorations, not only because they manifest an intimate acquaintance with the general physical features of the field of inquiry and a proper estimate of the merits of the question; but because they help to establish the correctness of my opinion, that the Chambeze and its lakes belong to the Nile system, and not to that of the Congo. I have only to explain that, in my letter of December 1st (NATURE, No. 9), I did not "give the opinion that the river which forms the main part of the great traveller's latest discoveries is *the head stream* of the Nile," but merely said that it "joins" it.

On the question of levels your correspondent is substantially correct, and if he will look to the *Illustrated Travels* of the 1st inst., he will see how far I agree with him. From Dr. Livingstone's statements it appears that the general drainage level of the basin of the Chambeze does not exceed 3,000 feet; and it is not improbable that in the passage of the waters northwards on the west side of Tanganyika, they fall two or even three hundred feet lower, so as to descend nearly if not entirely to the level of the Albert Nyanza. But even if this be the case, I fail to see how the difference in height, however small, "could not give a sufficient lowness to the latter lake (Albert Nyanza) to allow this river (Chambeze) to flow down to it through the five degrees of latitude which separate them." The levels of the Lakes Liemba, Tanganyika, and Albert Nyanza—of which the first is in about 10° S. lat. and the last has its northern end in about 3° N. lat.—are respectively *circa* 2,800, 2,844, and 2,720 feet; and as the continuity of these three bodies of water is assumed by Mr. Keith Johnston, it follows that there is here a virtual dead level extending over not five, but *thirteen* degrees of latitude, or 780 geographical miles! If then it is possible for the waters of Lake Liemba, the head of Livingstone's "eastern line of drainage," to flow into the Albert Nyanza, it is equally possible for those of the Chambeze and its lakes, forming that traveller's central line of drainage, to do so.

In his last letter from Ujiji, Dr. Livingstone says that "the western and central lines of drainage converge into an unvisited lake west or south-west of this"—that is to say, situated in the unexplored regions west of Tanganyika, in the north-north-west direction in which he saw the Lualaba (as he calls the lower course of the Chambeze) flowing, after it had emerged from the crack in the mountains of Rua, north of Lake Moero. This "unvisited lake" is evidently the Lake Chowambe of the traveller's former communications, which by his now calling Baker's Albert Nyanza by the name of "Nyigi Chowambe," he would seem to identify with it. But this is quite consistent with Baker's own statement, that, to the south of about 1° 30′ S. lat., the Albert Nyanza "turns suddenly to the west, in which direction its extent is unknown."

"Albert Nyanza," "Nyigi Chowambe," and this "unvisited lake west or south-west of Ujiji," are, therefore, one continuous body of water, which, being on the lowest level of all, must form not merely the "western line of drainage," but the *main* drainage of the upper Nile Basin; and as, on its eastern side, it is the recipient of the waters of the lakes Victoria Nyanza and Tanganyika, so, on its western side, it receives those of the great lake discovered by Signor Piaggia, with an elevation (as I believe) of four or five thousand feet.

This is entirely in accordance with the opinion I have always entertained that the water-parting between the basin of the Nile and those of the rivers flowing into the Atlantic—the Ogowai the Kuango (Congo), the Kwanza, and the Kunene—is on about the twentieth meridian of east longitude, as it is, in fact, marked on my maps of "The Basin of the Nile" of 1849, 1859, and 1864. The Mossamba range of mountains, situate to the east of the Portuguese colony of Benguela, on the west coast of Africa, forms the southern extremity of this water-parting, and it is in these mountains that I find the head of the great river, which with the Lufira forms Livingstone's "western line of drainage," or, as it should be more correctly designated, the main stream of the Nile. This river is the Kasái, Kassávi, or Loke, whose sources are in the forests of Quibokoe or Kibokoe, on these Mossamba Mountains, within 300 miles of the Atlantic Ocean; which river was crossed by Dr. Livingstone within 160 or 170 miles of its head, on February 27th, 1854, in his adventurous journey across the African continent, and is described by him in page 332 of his "Missionary Travels," and the lower course of which river was followed down by the Hungarian traveller, Ladislaus Magyar, in 1850, as far as about 6° 30′ S. lat., *where he heard that it flowed eastward into Lake "Nhanja"*—a statement strikingly in accordance with Mr. Cooley's assertion, adverted to in my former communication, that "the drainage of the Cazembe's country is all into the Nyanza on the east."

The Nile of Egypt, in thus having its source at the opposite side of the continent of Africa, within a short distance of that ocean into which it does *not* flow, only follows an almost general law of Nature. In the *Athenæum* of July 22nd, 1865, when commenting on Sir Samuel Baker's announcement of his discovery of the Albert Nyanza, I compared the Nile and its Lakes with the Po and its Lakes, pointing out how the two rivers have some of their sources in *snowy* mountains, not at the extremity but at the side of their respective basins. Dr. Livingstone's present discoveries seem to establish the fitness of this comparison, and to extend it. For as the Po, whose exit is in the Adriatic, has its head sources in the Cottian and Maritime Alps, within a few miles of the Gulf of Genoa; so, in like manner, the Nile, which flows into the Mediterranean, has its head on the Mossamba Mountains, within 300 miles of the Atlantic Ocean.

The spot which I have thus discovered to contain the hitherto hidden Source of the Nile, and so to reveal

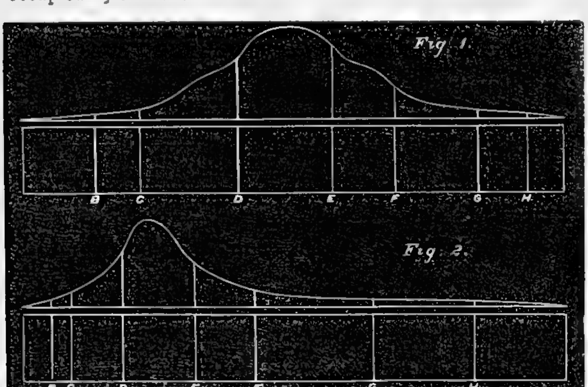
—fluori causas per sæcula tanta latentes,
Ignotumque caput,

is the most remarkable culminating point and water-parting of the African Continent, if not of the whole world; for, within the space of a degree east and west (between 18° and 19° E. long.) and half as much north and south (between 11° 30′ and 12° S. lat.) it includes not only the head of the mighty Nile, which runs northwards over one-eighth of the entire circumference of the globe, but likewise those of the Kuango, (Congo), the Kuanza and the Kunene flowing westwards; those of the Kuivi and the Kubango running to the south; and that of the Lungebungo having its course eastward and forming the head stream of the Zambesi. It is, in fact, what I have been endeavouring to determine since 1846, "the great *hydrophylacium* of the continent of Africa, the central point of division between the waters flowing to the Mediterranean, to the Atlantic, and to the Indian Ocean" (*Journal of the Royal Geographical Society*, vol. xvii. p. 82), as likewise to Lake Nyami, or some other depression in the interior of the continent.

Bekesbourne, Feb. 2 CHARLES BEKE

Analogy of Colour and Music—Supernumerary Rainbows

IN what I saw of a recent discussion in your paper as to the analogy between the colours of light and musical notes, I did not observe any reference made to an analogy on this subject, published, I believe, in 1845, by Prof. Mossotti, of Pisa. The analogy is pointed out at the end of a paper concerning the diffraction spectrum. This spectrum, the disposition of the colours in which depends solely on the wave-lengths, has its point of maximum brightness in the middle, which in this spectrum is occupied by a shade of colour rather nearer to the line E than



D. Fig. 1 represents the positions of the lines in the diffraction spectrum; and fig. 2 represents the spectrum formed by refraction through a certain flint glass prism which belonged to Fraunhoffer. The ordinate of the curve which is drawn above each spectrum represents the intensity of the light at each place of that spectrum. The curve drawn above fig. 2 is that due to Fraunhoffer's actual observations with the prism above referred to. The intensity of the light in the neighbourhood of the principal lines is given by him by the following numbers:—

B	C	D	E	F	G	H
·032	·094	·64	·48	·168	·031	·0056

These intensities were determined by comparison with the light of a lamp placed at various distances. It is hard to say, however, what physical and physiological facts are included in these numbers.

The curve given in fig. 1 is constructed by Mossotti analytically, on a principle which amounts to this:—He takes hold of the spectrum in fig. 2, and shifts it so that the fixed lines come into the positions of fig. 1, and decreases or increases the ordinate representing the brightness in the neighbourhood of each fixed line in exactly the proportion that the spectrum has been expanded or contracted in the neighbourhood of that line. The change of place of portions of colour not in the immediate neighbourhood of one of these lines is regulated by a formula founded on a certain physical investigation of Mossotti's as to the dependence of the refraction index upon the wave-length, which formula has its constants determined by the method of least squares, so as to represent with sufficient accuracy the truth at the fixed lines.

Following a method similar to that adopted by Newton, Mossotti supposes the spectrum in fig. 1 to be bent round the complete circumference of a circle, and he finds that if x be the wave-length in millionths of a millimetre at a point distant by an arc whose circular measure is x, from the brightest portion of the spectrum, then x is given for the fixed lines with sufficient accuracy by the formula

$$x = 553{\cdot}5 + 184{\cdot}5 \frac{\phi}{\pi},$$

extending this formula to the ends of the spectrum, it constrains the longest wave-length to be 738, and the shortest 369 millionths of a millimetre. This result Mossotti regards as sufficiently near the actual wave-lengths of the extremities of the spectrum.

The longest and shortest wave-lengths taken in conjunction with the wave-lengths of the brightest part of the diffraction spectrum and of the fixed lines B C D E F G H form ten wave-lengths, which Mossotti thus compares with the notes of the diatonic scale:—

1	$\frac{17}{25}$	$\frac{9}{8}$	$\frac{5}{4}$	$\frac{4}{3}$	$\frac{25}{18}$	$\frac{3}{2}$	$\frac{5}{3}$	$\frac{13}{8}$	2
$\frac{1}{738}$	$\frac{1}{688{\cdot}3}$	$\frac{1}{656}$	$\frac{1}{590}$	$\frac{1}{553{\cdot}5}$	$\frac{1}{531}$	$\frac{1}{492}$	$\frac{1}{443}$	$\frac{1}{393{\cdot}5}$	$\frac{1}{369}$
738	688	656	589	553·5	526	484	429	393	369
—	B	C	D	—	E	F	G	H	—

The first line represents the number of vibrations necessary to produce the notes of the diatonic scale. The numbers in the second line have the same ratio as the numbers in the first, and therefore the denominators of these fractions represent the wave-lengths of the respective notes. The third line represents the lengths in millionths of a millimetre of the waves corresponding to the lines respectively placed under them.

I need not here give any opinion as to the utility or inutility of such analogies, but I shall be glad if this letter should call the attention of any of your readers to the remarkable symmetry of the diffraction spectrum, which is in fact Nature's own graphical method of exhibiting the numerical wave-lengths which correspond to each part of the spectrum.

Trinity College, Cambridge, Feb. 9 JAMES STUART

IN your journal of January 20th Mr. Grove has honoured my little note on "Colour and Music" by a letter on the subject, in which attention is directed to a rainbow, or series of rainbows, *within* the primary. Mr. Grove asks if a description of this phenomenon has been published, and whether the effect may not be a repetition of the colours of the spectrum after the manner surmised by Sir John Herschel. I will endeavour as briefly as possible to reply to these inquiries.

So far as I can trace, the mention of inner or "supernumerary" bows first occurs in the Phil. Trans. for 1722, p. 241. It is there described by a Dr. Langwith, who had seen the phenomenon no less than four times in the course of that year. On one occasion it was so favourably seen, and lasted so long, that he is able to give the following careful description. Under the usual primary bow, Dr. Langwith says, "was an arch of green, the upper part of which inclined to bright yellow, the lower to a more dusky green; under this were alternately two arches of reddish purple and two of green, under all a faint appearance of another arch of purple, which vanished and returned several times so quick that we could not readily fix our eyes on it."

I do not know if this be similar to that Mr. Grove has seen, but it evidently corresponds with the appearance Mr. Newall describes in your journal for January 27th. The next mention of inner rainbows is in the Phil. Trans. for 1749, p. 193, when Mr. Daval, the then secretary of the Royal Society, corroborates, from his own experience, Dr. Langwith's description. Dr. Thos. Young next refers to the phenomenon in order to give his explanation of it in the Phil. Trans. for 1804, and he also twice alludes to it in his published lectures on Natural Philosophy. Further, at p. 374 of his "Optics," Brewster describes supernumerary bows that, at different times, he has seen within the primary rainbow; and, also, he mentions an analogous appearance observed without the secondary, a fact previously surmised by Dr. Young.*

An explanation of the phenomenon is first attempted by Dr. Pemberton (Phil. Trans. 1722), who classes it with the colours of thin plates, according to the theory of "fits." Dr. Young, in his paper on Physical Objects (Phil. Trans. 1804), disputes Dr. Pemberton's explanation, and shows that the appearance is readily explicable by the interference of two pencils of light, regularly reflected from the posterior surface of the drops of rain. The drops must, in this case, be between $\frac{1}{70}$th and $\frac{1}{80}$th of an inch in diameter. Evening appears to be the time these supernumerary bows are generally seen, and invariably they are observed beneath the *upper* part only of the primary bow. Hence, I presume, the phenomenon is similar to the diffraction colours seen in the cloud that is precipitated when the first portions of air are promptly removed from a receiver.

I have, in conclusion, to thank Mr. Grove for pointing out, in his second letter, that the word "correlation" implies too much when applied to the relationship of colour and music. "Analogy" is certainly far more appropriate to express what is merely a parallelism, and not a necessary or complementary relationship between light and sound.

Woodlands Grove, Isleworth, Jan. 29 W. F. BARRETT

P.S.—Since the foregoing letter was written,—which was sent to your office on the date it bears,—several contributions on the subject of my "note" have appeared in your journal. I will not now venture to intrude further upon your space, but, with your permission, shall reply to your other correspondents in a subsequent letter. W. F. B.

February 12

Sensation and Perception

HAVING in the *Journal of Mental Science* tried to show how Sensation and Intellect are distinguished from each other, allow me to state, in regard to Dr. Bastian's views on this head, that Dr. Lockhart Clarke, after a careful review of what has been written on Sensation, rejects Sir W. Hamilton's statement that "it is manifestly impossible to discriminate, with any rigour, sense from intelligence." "Although, in the lowest animals, there is this apparent identity of sense and intelligence, which seem as it were to be fused into one common state of consciousness, yet when we find them in the course of development, either in the fœtus or in the scale of animal life, emerge each in a distinct and different form out of that common or indifferent state, are we to ignore the distinction, and assert with Sir W. Hamilton and others, that sensation is simply a function of the intellect? It might with equal reason be maintained that there is no real difference between any other two organs of the body, because in the ovum they are developed out of one homogeneous tissue or common germinal mass."† According to Von Baer's law, it seems that while in the lower animals sense and intelligence are fused into one, in the higher they become differentiated, each having a separate seat. When Dr. Bastian, then, contends, with the metaphysicians, for the identity of sense and intelligence, he seems to be reversing the method of evolution, and going back to the medley out of which well-defined organs with *improved* functions were evolved. He would make us believe that as the sense-ganglia become more defined and eliminate the rudiments of intelligence, they assume a lower function than they had before, one not to be distinguished in kind from that of the excito-motor system previously differentiated. Is this likely? As to the impossibility of discriminating sense from intelligence there are the following facts indicating the contrary. Physiology shows that the external object of the many must be revealed in a seat that is not at the periphery; but such an object is not an idea or notion; therefore, there is a marked distinction between an external object in sense and an idea of one in intellect. A sense-object may be common to two distinct sets of ideas, as when it is now interpreted to be a ghost, now the stump of a tree. A sense-object is antecedent to an ideal object, for the latter only exists as a representation of the former. A feeling in sense may cause coughing or sneezing, *e.g.*, in spite of the veto of the intellect. A feeling in sense may be so intensely painful as, for the time, to paralyse intellectual energy. But what about the following argument? What is known at first hand is known *as it is*, for if you say not as it is; but as it is not, you imply that it is not known at first hand, but through something which does not even represent it, which is absurd. Therefore, as sense and intelligence must be known at first hand, and, as thus known, are distinguishable from each other in *many* respects, pre-eminently, the one as the sphere of objects at first hand, the other at second hand; the one as pertaining to *the organic ego*, the other to the *non-organic ego*—each must be known *as it is*, not *as it is not*.

Abergavenny. W. G. DAVIES

* Sir David Brewster, moreover, refers to the occurrence, spoken of by Mr. Newall, of a dark-coloured zone between the primary and secondary bow: a somewhat similar dark fringe is, on *à priori* grounds, apparently predicted by Dr. Young, at p. 369 of his "Lectures on Natural Philosophy," 1845 edition.

† Medical Critic and Psychological Journal, vol. ii. p. 574, *et seq.*

Transcendent Space

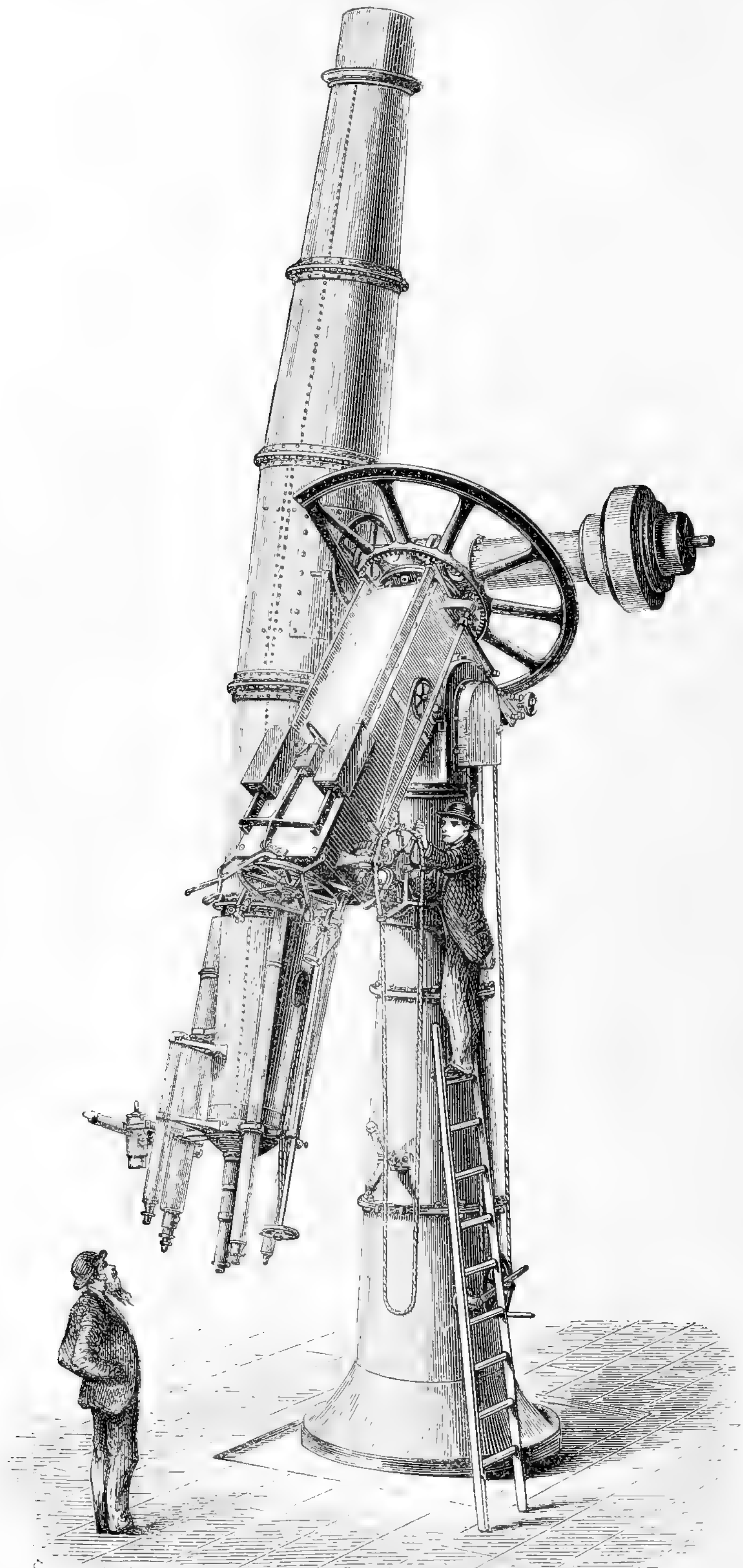
IN NATURE for January 13 I was permitted, as it were, to speak the prologue to the correspondence on "Kant's View of Space," now happily, if not satisfactorily, closed. I now ask permission to speak the epilogue, in strict reference to the subject of my first letter.

The most interesting period of incubation in Sir William Rowan Hamilton's discovery of *Quaternions* was October 15, 1843. On that day, as he relates in a letter to a friend, he was walking from his Observatory to Dublin with Lady Hamilton, when, on reaching Brougham Bridge, he "felt the galvanic circuit of thought *close;* and the sparks which fell from it were the *fundamental equations between i, j, k; exactly such*" as he used them ever since (*North British Review*, September, 1866, p. 57). Two days after he wrote a letter to his friend and coadjutor, Mr. J. T. Graves, a brother of the present Bishop of Limerick, giving a most interesting narrative of his transition from *Triplets* to *Quaternions*. It is here that I found, after much search and research, the confirmation of a notion which had floated for years in my mind, that Hamilton's speculations had borne a very remarkable relation to Transcendent Space of Four Dimensions. The letter in question is printed in the supplement to vol. xxv. (third series) of the L. E. and D. *Philosophical Magazine*, and of late years has escaped the notice of mathematical students, engrossed, as many are, in the geometrical and physical applications of Quaternions. It seems that after Hamilton had completed his Theory of Conjugate Functions, he endeavoured to obtain an Algebra of Pure Space, and for this purpose employed, after the Germans, the symbol i to express one root of negative unity, and introduced a new symbol, j, to express another root of negative unity. Further, he employed an operant, k; and with these elements he worked out a theory of Triplets in which $i^2=j^2=-1$, and $ij=-ji$, while k remained ambiguous. Assuming, at length, that $ij=k$, and $ji=-k$, and leaving it still undecided whether $k=0$ or not, there dawned on him, as he phrases it, "the notion that we must admit, in some sense, *a fourth dimension* of Space for the purpose of calculating in triplets."

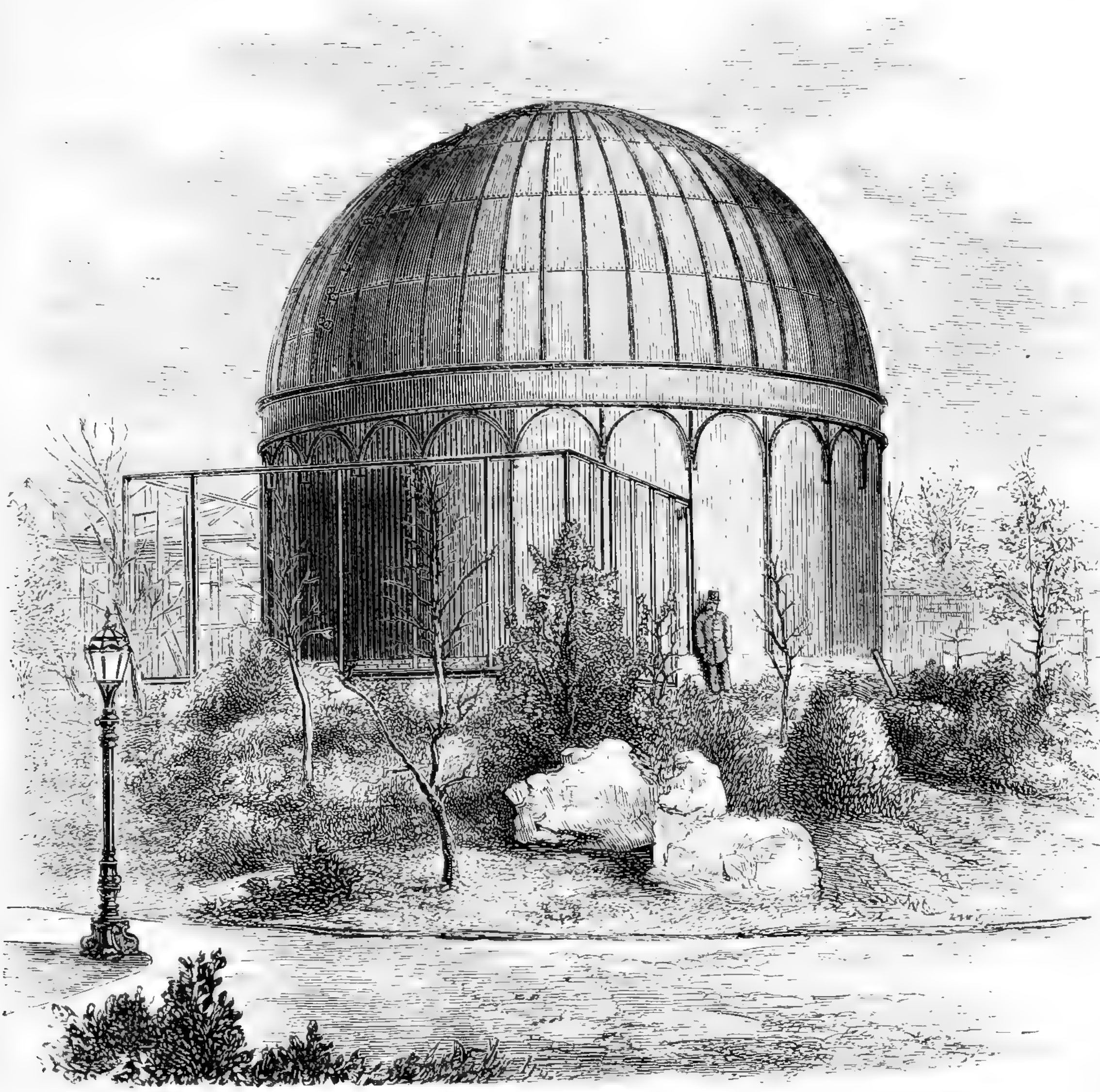
Now this curiously interesting phase in the generation of Quaternions is an admirable instance of what I mean by affirming Quadridimensional Space to be a mathematical figment springing out of an otherwise uninterpretable formula. Observe, in this case, what was the effect of the completion of the theory. So soon as Hamilton had passed from *Triplets* to *Quaternions*, and he had made his k a third root of negative unity, *this transcendent space vanished* out of thought. The ghost of a fourth dimension, which had haunted Hamilton's Triplets, was immediately laid; and thenceforth his system was, what he originally sought, an Algebra of Pure Tridimensional Space. The haunting notion, thus banished from Triplets, took refuge in Quinaries and other transcendent algebraical formulisations. To me it is a spurious product of "mental activity," not, even possibly or potentially, a form of mental receptivity, and *à fortiori* externally denied to experience.

In conclusion, I protest that in denying (for Kant) to Space and Time the title of Forms of Thought, I do *not* restrict the term Thought to the technical limits of Kant, but use it as synonymous with mental activity in general.

Ilford, Feb. 14 C. M. INGLEBY



THE GREAT NEWALL TELESCOPE OF 25 INCHES APERTURE, NOW BEING ERECTED AT GATESHEAD



THE OBSERVATORY FOR THE NEWALL TELESCOPE

THE NEWALL TELESCOPE

THE 25-inch Equatorial Telescope, commenced several years ago by T. Cooke and Sons, of York, for R. S. Newall, Esq., of Gateshead, is now so far completed that it has been removed from the works at York into its observatory in Mr. Newall's grounds, at Fern Deal.

The completion of a telescope with an object glass of 25 inches aperture, marks an epoch in astronomy, and its completion in England again places us in the front rank in the matter of the optical art, as we were in Dolland's time.

The history of the progress of the manufacture of telescopes since the time referred to, shows very clearly the long-lasting effects of bad legislation; for it is not too much to say that the duty on glass entirely stifled, if indeed it did not kill, the optical art in England. Hence we depended for many years upon France and Germany for our telescopes to such an extent indeed that the largest object-glasses at Greenwich, Oxford, and Cambridge are all of foreign make. The labours of the Germans culminated in the two magnificent instruments of 15½ inches aperture in the observatories of Pulkowa and Cambridge, U.S. And then for a time America, thanks to the genius of Alvan Clarke, took the lead with the 18½ inch glass now beginning to do good work in the observatory of Chicago. This instrument is at last eclipsed by the magnificent one now being erected at Gateshead.

In what we have said we have purposely omitted to touch upon reflecting telescopes, in the construction of which, since the time of Newton, England has always been pre-eminent, because we shall take occasion to refer to the reflector of four feet aperture, completed last year by Mr. Grubb, of Dublin, and now erected at Melbourne when it is fairly at work.

The general design and appearance of this monster among telescopes, which will be gathered from the accompanying woodcut, is the same as that of the well-known Cooke equatorials; but the extraordinary size of all the parts has necessitated the special arrangement of most of them.

The length of the tube, including dew-cap and eye-end, is 32 feet, and it is of a cigar shape; the diameter at the object-end being 27 inches, and at the centre of the tube 34 inches. The cast-iron pillar supporting the whole is 29 feet in height from the ground to the centre of the declination axis, when horizontal; and the base of it is 5 feet 9 inches in diameter. The trough for the polar axis alone weighs 24 cwt., the weight of the whole instrument being nearly 9 tons.

The tube is constructed of steel plates rivetted together, and is made in five lengths, screwed together with bolts and flanges. The plates of the central length are one-eighth of an inch thick, and those of each end one-sixteenth thick, so as to reduce the weight of the ends as much as possible, and avoid flexure.

Inside the outer tube are five other tubes of zinc, increasing in diameter from the eye to the object-end: the wide end of each zinc tube overlapping the narrow end of the following tube, and leaving an annular space of about an inch in width round the end of each for the purpose of ventilating the tube, and preventing, as much as possible, all interference by currents of warm air, with the cone of rays. The zinc tubes are also made to act as diaphragms.

The object-glass has an aperture of 25 inches (nearly), and in order as much as possible to avoid flexure from unequal pressure on the cell, it is made to rest upon three fixed points in its cell, and between each of these points are arranged three levers and counterpoises round a counter-cell, which act through the cell direct on to the glass, so that its weight in all positions is equally distributed among the 12 points of support, with a slight excess upon the three fixed ones. The focal length of the lens is 29 feet. A Barlow lens is arranged to slide on a brass framework within the tube. The hand is passed through an opening in the side of the tube, and by means of a handle attached to the cell, the lens may be pushed into or out of the cone of rays.

Attached to the eye-end of the tube are two finders, each 4 inches aperture; they are fixed above and below the eye-end of the main tube, so that one may be readily accessible in all positions of the instrument. It is also supplied with a telescope having an O. G. of $6\frac{1}{2}''$. This is fixed between the two finders, and is for the purpose of assisting in the observations of comets and other objects for which the large instrument is not so suitable. This assistant telescope is provided with a rough position circle and micrometer eye-pieces, and is illuminated by new apparatus lately described in NATURE.

Two reading microscopes for the declination circle are brought down to the eye-end of the main tube; the circle —38 inches in diameter—is divided on its face, and read by means of the microscopes and prisms.

The slow motions in declination and R. A. are given by means of tangent screws, carrying grooved pulleys, over which pass endless cords brought to the eye-end.

The declination clamping handle is also at the eye-end.

The clock for driving this monster telescope is in the upper part of the pillar, and is of comparatively small proportions, the instrument being so nicely counterpoised that a very slight power is required to be exerted by the clock, through the tangent screw, on the driving wheel (seven feet diameter), in order to give the necessary equatorial motion.

The declination axis is of peculiar construction, necessitated by the weight of the tubes and their fittings, and corresponding counterpoises on the other end, tending to cause flexure of the axis. This difficulty is entirely overcome by making the axis hollow, and passing a strong iron lever through it, having its fulcrum immediately over the bearing of the axis near the main tube, and acting upon a strong iron plate rigidly fixed as near the centre of the tube as possible, clear of the cone of rays. This lever, taking nearly the whole weight of the tubes, &c., off the axis, frees it from all liability to bend.

The weight of the polar axis on its upper bearing is relieved by friction rollers and weighted levers; the lower end of the axis is conical, and there is a corresponding conical surface on the lower end of the trough; between these two surfaces are three conical rollers carried by a loose or "live" ring, which adjust themselves to equalise the pressure.

The hour circle on the bottom of the polar axis is 26 inches in diameter, and is divided on the edge,* and read roughly from the floor by means of a small diagonal telescope attached to the pillar; a rough motion in R.A. by hand is also arranged for by a system of cog-wheels moved by a grooved wheel and endless cord at the lower end of the polar axis, so as to enable the observer to set the instrument roughly in R.A. by the aid of the diagonal telescope.

The declination and hour circles will probably be illuminated by means of Geissler tubes, and the dark and bright field illuminations for the micrometers will be effected by the same means.

Mr. Newall, after the preliminary testing of this magnificent instrument at his own residence, purposes to erect it in some climate favourable for astronomical observation. It is very unfortunate that this means in other words that the telescope cannot remain in England. It is or should be among the things generally known that every increase in the size of an object-glass or mirror increases the perturbating effects of the atmosphere, so that the larger the telescope, the purer must be the air. In the absence of this latter condition, a "big" telescope is a "big evil," and skilled observers, mindful of this, reduce the apertures of their instruments when the air is not good.

We may regard this telescope as a clear gain to English science, for Mr. Newall with princely liberality has expressed his intention of allowing observers with a special research on hand to have the use of the instrument during certain regulated hours.

The observatory, of which we also give a sketch, is nearly 50 feet in diameter, and notwithstanding the enormous weight of the dome, like the telescope, it is easily moved into any required position.

When complete it will have attached to it a transit-room and the observer's dwelling. And this reminds us that Mr. Marth, so well known for his good work done at Malta with the Lassell Reflector and elsewhere will have charge of this noble instrument of research.

NOTES

THE anniversary meeting of the Geological Society takes place to-morrow, when Professor Huxley will deliver his address, which, it is expected, will be of great scientific interest. The Wollaston Medal of the society has this year been awarded to the eminent French Malacologist, M. Deshayes, professor at the Musée d' Histoire Naturelle, and the proceeds of the Wollaston fund have been awarded to M. Marie Roualt, who, though in humble circumstances, has contributed largely to the advance of the palæontology of France. The choice of president for the coming year has fallen on Mr. J. Prestwich—a choice which will be hailed on all sides with the liveliest satisfaction.

IN reply to an address of last Session, Her Majesty has made known to the House of Commons that she will give directions for the carrying out of the arrangements necessary for observing the transit of Venus, which will take place in the year 1874.

THE Rev. Charles Pritchard, of St. John's College, Cambridge, has been elected to the Savilian Professorship of Astronomy, as successor of the late Professor Donkin. Astronomers may congratulate themselves on this appointment, as Mr. Pritchard's teaching powers are of the first order, the interest he takes in

* The hour circle is also divided on its face, and read by micrometer microscopes.

the science is well-known, and his labours for its advance, especially in connection with the Royal Astronomical Society, have now extended over many years.

THE President of the Royal Society has sent out cards for two evening receptions, which are to be held at Burlington House on March 5, and April 23.

WE understand that 75 towns have signified their intention of contributing to the fund required by the British Association Committee on the Treatment and Utilisation of Sewage, for the investigation of this subject, Manchester heading the list with a contribution of 100*l*.

AT the ensuing meeting of the Geological Society on the 23rd inst., a paper of especial interest will be read, on the subject of copper mining at deep levels in the South of Ireland, experience having disproved the dictum of Irish geologists as to the non-existence of metalliferous strata at any considerable depth.

THE number of candidates for election as members of the Royal Institution may, we hope, be taken as a fair indication of the daily increasing interest taken in scientific matters. The number elected last year was forty-seven. The number of candidates proposed during the first six weeks of the present year is forty-two.

M. NAUMANN has been elected a corresponding member of the mineralogical section of the Academy of Sciences in Paris, in the place of Sir Roderick Murchison, who has been made a foreign associate. He received 27 votes out of 44, of the remainder 10 being recorded in favour of our countryman, Professor Miller, and 5 for Professor Studer, of Berne.

AT the meeting of the Académie des Sciences, on the 31st of January, M. de la Roche Poncié was erected to the place rendered vacant in the Bureau des Longitudes by the death of M. Darondeau.

M. ALGLAVE announces in the *Revue des Cours Scientifiques*, that the total amount subscribed to the Sars Fund, is now upwards of 160*l*., including the subscriptions of twenty-eight members of the Royal Belgian Academy, the same number of members of the Anthropological Society of Paris, M. Drouyn de Lhuys, and several members of the Zoological Society. We have the satisfaction to announce further subscriptions to the fund in this country, which appear in our advertising columns.

WE hear that the eminent geographer Kiepert is about to proceed to the Holy Land, and spend some time there, for the purpose of personally determining geographical positions. He has the advantage over our University explorers, recently sent out, in being a skilful and experienced geodetist, and of acquaintance with the country obtained during a former sojourn of several years.

A COMMITTEE has been appointed to inquire into the education of naval officers, consisting of Rear-Admiral Shadwell, C.B., President; Captain W. H. Richards, R.N., Hydrographer, Captain A. A. Wood, R.N., Director of Naval Ordnance, the Rev. Dr. Woolley, Admiralty Director of Education, the Rev. A. Barry, D.D., Principal of King's College. S. P. Butler, Esq., Barrister-at-law, Richard Saintbill, Esq., R.N., Secretary.

PRIZES are offered by the Royal Belgian Academy for essays on the following subjects:—1. To give a *résumé* of and to simplify the theory of the integration of equations containing partial derivatives of the first two orders. 2. A study of electrical currents based as far as possible on new experiments. 3. To fix by new researches the place to be occupied in the natural system, by the species *Lycopodium*, *Selaginella*, *Psilotum*, *Tmesipteris*, and *Phylloglossum*. 4. To describe the mode of reproduction of eels. 5. New researches to establish the composition and mutual relations of albuminoid substances. The gold medal to be given for the first and fifth of these questions is to be worth 40*l*., that for the second, third, and fourth questions, 24*l*. The essays must be written in Latin, French, or Flemish, and addressed paid to M. Ad. Quetelet, the Perpetual Secretary, before the 1st of June, 1871. The Academy will require the greatest exactness in the quotations, and the pages as well as the editions of works cited, must be given.

ANTHROPOLOGY is being publicly taught in Paris by one of the most distinguished masters of that science, Dr. Paul Broca. The *conférences* are held every Monday and Friday at 3 o'clock at the Anthropological Laboratory, No. 15, Rue de l'Ecole de Médecine. The instruction given has reference chiefly to craniology and the comparative anatomy of man and the apes. We also learn from Herr F. von Hauer that a new Anthropological Society has been formed at Vienna. It already numbers twenty-four members, among whom are several distinguished men of science. The society will publish a journal. In a prospectus which has been issued it is stated that the study of the natural history of man has now reached a stage in which active support by association appears to be imperatively needful.

AT a recent meeting of the Zoological Society of London, Professor Owen communicated a very interesting letter, which he had lately received from Dr. Julius Haast, F.R.S., of Canterbury, New Zealand, on the subject of the extinction of the Moa, or *Dinornis*. Dr. Haast was of opinion that these gigantic birds had been extinct many hundreds of years, and had been so before the arrival of the Maories in New Zealand, having been exterminated by a race which previously inhabited these islands near the mouth of the river Rakaia. He had recently been so fortunate as to find the remains of a former large encampment of these "Moa hunters." The kitchen-middens and cooking-ovens, which were still completely preserved, were spread over more than forty acres in extent. Numerous stone weapons were discovered, consisting either of hard sandstone or of chipped flint. The Moa bones were very abundant, but belonged chiefly to the smaller species, *Dinornis casuarinus*, *D. didiformis*, and *D. crassus*. There were also some bones of *D. elephantopus*, and of a small *Palapteryx ingens*, but none of *D. giganteus* and *D. robustus*. The leg bones of these birds had all been broken at the ends, so as to allow the marrow to be extracted, and the skulls scooped out from below, so that the brain might be reached. The middens likewise contained bones of the domestic dog, sea-gull, and the tympanic bones of several species of whale, but no human remains had been found amongst the heaps, so that it might be presumed that the Moa-hunters were not cannibals.

PROFESSOR LIEBIG disputes Pasteur's view that the decomposition of sugar in fermentation, depends on the development and multiplication of yeast-cells and that fermentation generally is only a phenomenon accompanying the vital process of yeast. He expresses the opinion that Pasteur's researches have not explained fermentation; but have only made known another phenomenon—the development of yeast—which equally requires explanation.

A NEW Flora of India by Dr. Hooker and Dr. Thomson is in preparation, and the first volume is expected in the course of the present season. This will supersede the old "Flora Indica" by the same authors, the first volume of which was published in 1855. The fifth volume of Mr. Bentham's "Flora Australiensis" is also announced as nearly ready.

AT the monthly session of the Imperial Geographical Society of Russia, held December 3rd, under the presidency of Count F. de Lütke, a memoir was read from M. Popow, of the Russian embassy, Pekin, on the "export of tea from Hankow," amounting to 50,000,000 lbs.—one-third of the total export from China—of which 15,000,000 is sent by twenty-eight Russian merchants. Among the measures adopted by the council in November was one concerning Mr. Hayward's expedition in Central Asia.

At the request of Sir Roderick Murchison, president of the Royal Geographical Society, London, the council sent a request to the Governor-General of Turkestan, that he would welcome Mr. Hayward if he reached the Russian frontier. M. Ivaschintzew read a paper on the "eastern coast of the Caspian Sea, with reference to the commercial routes to Central Asia." The Volga, the only means of communication between the interior of Russia and the Caspian countries, presents great difficulties, there being only one channel available, the Western, which is navigable only by boats drawing four to five feet. The eastern coast of the Caspian is described as generally bare of any vegetation. From the Emba to the Atrek there are no springs; wells of brackish water are found, apparently the sea-water infiltrated. The north-east coast is inaccessible: vessels cannot even approach within sight of the shore. Among the important points on the south-east shore are Sarytasch and Manghischlak coalfields, and the port Tubkaragan, the gulfs of Karabougaz and Balkan. The bay of Krassnovodsk—the occupation of which was recently announced—does not freeze in the winter; navigation, however, is reported by the Turcomans to be impeded for fifteen days by floating ice. The writer gave an account of the various explorations of Central Asia, including the attempts of the English from the sixteenth century, the expedition of Prince Békovitch, the attempt of Voiniovitch to establish commercial relations at Astrabad in 1781. The new routes to Central Asia from the centre of Russia are superior to the old, as avoiding the Kirghiz-steppe. The necessity was shown of interesting the Turcomans and the inhabitants of Khiva in commerce, and of making accurate surveys of the country between the Caspian and the Amu-Daria.

THE *Academy* states that M. Leon de Rosny, Professor of Oriental languages at the Imperial College, has published a French translation of a Japanese treatise on the rearing of silkworms. This work is published "par orde de son Excellence le Ministre de l'Agriculture." It is the first French translation of a Japanese work.

THE *Lancet* in speaking of the arrangements of hospitals, instances, as much needing reform, the system of grouping together indiscriminately in medical wards, cases of various affections, in an atmosphere which may be destructive to some patients while it is suitable to others. Thus we may find lying side by side a case of bronchitis and one of fever; a patient with phthisis and another with gangrene of the lung; next perhaps one of rheumatic fever closely adjacent to a paralytic with offensive bed sores.

THE Royal Irish Academy has voted the sum of 25*l.* to Professor King, to enable him to carry out his researches "on the jointing, foliation and cleavage of rocks," also the same amount to Professor Ball, to enable him to carry out his experiments "on the velocity of smoke rings in air."

A NEW instance of the earnestness and liberality with which the King of Prussia encourages the prosecution of geographical discovery, has been communicated to us. The enterprising traveller, Gerhard Rohlfs, receiving kindness from the ruler of Kuka, he promised that presents should be sent from the King of Prussia, and Herr Nightingale is now on his way as the bearer of the presents. Poor Miss Tinne's death having proved the danger of the way beyond Mursuk, the Prussian Government has consented to send a guard of fifty soldiers (volunteers for the duty) to escort him in safety through the Touaregs to Kuka.

THE *Academy* reports that Herr O. Liebreich has found chloral may be employed with good results as a counteractive to poisoning by strychnine. On the other hand, the evil effects of an overdose of chloral may be remedied by the use of strychnine.

M. GORSEIX states in a letter, communicated to the Academy of Sciences, by M. St. Claire Deville, that Santorin was still in active eruption on the 6th of last month.

MAGNETIC AND SUN SPOT PHENOMENA FOR 1870

APPEARANCES would indicate that we are now approaching the epoch of maximum, both as regards the disturbances of terrestrial magnetism and also as regards solar disturbances or sun spots; for these interesting phenomena are believed to march together. There is still a third phenomenon intimately connected with magnetic disturbances, and that is, the Aurora Borealis, a meteor which seems to sympathise with the terrestrial magnetic system to such an extent that when this is fluctuating and disturbed, displays of the Aurora are almost sure to follow.

Finally, those of us who are of an intensely practical turn of mind will be delighted to know that this interesting chain of facts is bound by one of its links, if not by two, to the practicalities of everyday life. For, in the first place, displays of the Aurora are hardly ever unaccompanied by spontaneous currents making their appearance in telegraphic wires, and causing not a little confusion in the transmission of messages; and, in the next place, some mineralogists are of opinion that these very currents are connected in some way with metalliferous deposits.

Perhaps, after all, the relation between sun spots and California may be that of cause and effect!

The first great magnetic disturbance recorded at Kew Observatory, during the last month, began about 7 a.m. on January 3, by considerably and abruptly diminishing the declination and the horizontal force, without greatly affecting the vertical force. It lasted for about 16 or 17 hours, and during its continuance an Aurora was visible.

A smaller disturbance began on January 8, about 9 p.m., its tendency being to diminish the declination and the vertical force, without much affecting the horizontal force; it was likewise accompanied by an Aurora.

The solar disc was photographed at Kew Observatory nine times during the month of January, with an average of five groups of spots on the sun's surface, one of them being always large. Thus we have:—

January	1	6	groups	2 of them rather large
,,	6	5	,,	2 rather large
,,	10	5	,,	2 large
,,	11	6	,,	1 large
,,	12	5	,,	1 very large, another large
,,	13	5	,,	1 large
,,	14	4	,,	1 large
,,	24	5	,,	1 very large, another large
,,	29	4	,,	1 large

February promises to be a still more active month, but we must wait.

SCIENTIFIC SERIALS

Moniteur Scientifique, February 1.—In this number M. Emile Kopp gives an account of Weldon's well-known process for the regeneration of "manganese." In a note on the Infinitesimal Calculus, M. Néhay maintains that neither the infinitely great nor the infinitely small can be considered as real quantities; that the algebraical relations established in the calculus for such quantities depend solely on the conservation of certain ratios and not on any particular unit, and are hence true for magnitudes as great or as small as we please; and that infinitesimals can always be exchanged for finite proportionals. Bolley finds on analysis that the artificial alizarine of Meister, Lucius, and Co. has very exactly the formula $C_{14}H_8O_4$.

Revue des Cours Scientifiques, February 12.—This number contains a long list of subscribers to the Sars Fund; a report by M. Cazalis de Fondouce, of the proceedings of the Anthropological Congress at Copenhagen; also a lecture delivered at the Faculté de Médecine at Paris, by M. Onimus, on the balanced forces (*forces en tension*) and active forces (*forces vives*) in the animal organism.

INDIAN GEOGRAPHICAL NAMES

THE Committee of the Geographical Society of Bombay appointed to prepare an index of geographical names in India, in vernacular and English spellings, with memoranda—geographical, etymological, antiquarian, and statistical—have published the outline of a general plan to guide in the formation of the proposed index, and to enumerate the particulars it might properly include.

The object is primarily *geographical* and *etymological*, but the Committee hopes information may be placed at its disposal to make it also historical and statistical.

The committee, therefore, considers that a full index of the kind ought to embrace—

1. Names of towns, villages of any size or note, railway stations, &c., with the taluka and district or state in which each is situated, its longitude and latitude; the population; name of the river or stream on which each is situated; altitude above the sea-level; the dates and names of founders; the etymology of the name; the Sanskrit or ancient name; notes of connected events, peculiar products or manufactures; places of note, temples, commemorative pillars, &c., in their vicinity, with references to fuller descriptions already published.
2. Names of the talukas or divisions in each district, with the area, chief town and population.
3. Shrines and places of pilgrimage, with notes of the objects of adoration or pilgrimage, dates of fairs, &c., and precise locality.
4. Rivers, their rise, course, and confluence or debouchure; lakes, with their size or area and products; hot springs, with their temperature.
5. Mountain ranges, with average heights; peaks, with their greatest altitudes; hill forts, with notes of events connected with them and their present condition.
6. Valleys, plateaux, &c., having particular designations, with notes on their peculiarities.
7. Tribes and peculiar sects, with notes of their habitats, castes, race, peculiar deities, occupations, &c.

These notes are not intended to be lengthy and need seldom extend to half-a-dozen lines; but may generally be restricted to one or two: whilst all detailed information collected might be preserved by the Geographical Society for reference.

If this plan can be well filled up, the proposed list will include the names on the maps of Rennell, Arrowsmith, Allen, Walker and Keith Johnston and in the road-books, with many others in addition. It would thus be of considerable extent and require a large amount of patient labour, besides the collection of much information that has never yet been brought together from the many districts of so vast a country.

The Committee proposes to compile every name in the characters of the vernacular or vernaculars of the district in which it occurs and in the language to which the name belongs. Purely Muhammadan names must be given in Urdu and in the characters of the Hindu dialect of the place; Hindu names in the form or forms used by educated Hindus of the vicinity, whether Hindi, Bengali, Panjabi, Kashmiri, Sindhi, Kachhi, Gujarati, Marathi, Uriya, Telugu, Tamil, Malayalim, Singalese, or Burmese; but, for convenience in printing, it may be best to use the Devnagari alphabet for all the Sanskritic dialects at least. Each name should be followed by its transliteration into Roman characters according to the alphabet of Sir William Jones, as now written by the Royal Asiatic and other Societies and by most orientalists, the English spellings in common use and on the Trigonometrical Survey maps, both the English and vernacular forms being arranged so that, either being known, a name may at once be found in its alphabetical place in the index.

The committee hopes to add any peculiar forms of Indian names found in the best-known historical and descriptive works on India, such as the writings of Orme, Dow, Elphinstone, Grant Duff, Mill, Wilson, Thornton, Montgomery Martin, Rennell, Hamilton, &c.; also the Greek and Sanskrit ancient names so far as they have been identified by Lassen, De Saint-Martin, Cunningham, &c.

Considering the nature and extent of the work, the committee feels that it must be mainly dependent upon fresh information from each locality. Believing also that with adequate assistance such an index would be of permanent value to all connected with this country, it recommends the Geographical Society to bring the matter before the Government at Bombay, with the request that the committee and society be afforded that assistance in procuring the desiderated information, which Government alone can afford, by obtaining the services of its officers in the Revenue, Educational and other departments, in collecting the vernacular names and other particulars and that the Government of Bombay graciously use its influence in obtaining for the society similar assistance from the other Governments of India.

SOCIETIES AND ACADEMIES

The Secretary of the Philosophical Society of Glasgow wishes us to state that the report of the proceedings of that Society in our Number of the 3rd inst. was not an official one. In acceding to this request we would point out the desirableness of the Secretaries of all Societies sending us official reports, since it is only by that means that accuracy can be insured. When this clear duty of an official is performed by an ordinary member, who, without having access to documents and notes, is yet anxious that the work of his Society should be represented, and sends a report faute de mieux, *it is impossible always to guard against error. All reports forwarded to us should be as short as possible, distinctly written, and deal only with advances on our previous knowledge.*

LONDON

Royal Society, February 10.—The following papers were read: "On some remarkable Spectra of Compounds of Zirconia and the Oxides of Uranium." No. 1. By H. C. Sorby, F.R.S. We shall return to this communication.—"On linear differential equations," No. 2. W. H. L. Russell.

"On the mathematical theory of stream-lines, especially those with four foci and upwards." W. J. Macquorn Rankine. A *stream-line* is the line that is traced by a particle in a current of fluid. In a steady current, each individual stream-line preserves its figure and position unchanged, marking the track of a filament or continuous series of particles that follow each other. The motions in different parts of a steady current may be represented to the eye and to the mind by means of a group of stream-lines. Stream-lines are important in connection with naval architecture; for the curves which the particles of water describe relatively to a ship, in moving past her, are stream-lines. If the figure of a ship is such that the particles of water glide smoothly over her skin, that figure is a *stream-line surface;* being a surface which contains an indefinite number of stream-lines. The author in a previous paper proposed to call such stream-lines *Neoïds;* that is, ship-shape lines. He refers to previous investigations relating to stream-lines, especially to those of Mr. Stokes, in the Cambridge Transactions for 1842 and 1850, on the "Motion of a liquid past a solid," of Dr. Hoppe, on the "Stream-lines generated by a sphere," in the *Quarterly Journal of Mathematics* for 1856, and his own previous papers on "Plane water-lines in two dimensions," in the Philosophical Transactions for 1864, and on "Stream-lines," in the *Philosophical Magazine* for that year. He states that all the Neoïd or ship-shape stream-lines whose properties have hitherto been investigated in detail, are either *unifocal* or *bifocal;* that is to say, they may be conceived to be generated by the combination of an uniform progressive motion, with another motion consisting in a divergence of the particles from a certain point or focus, followed by a convergence either towards the same point or towards a second point. Those which are continuous closed curves, when unifocal, are circular, when bifocal, they are blunt-ended ovals, in which the length may exceed the breadth in any given proportions. To obtain an unifocal or bifocal neoïd resembling a longitudinal line of a ship with sharp ends, it is necessary to take a part only of a stream-line: there is then discontinuity of form and of motion at each of the two ends of that line.

The author states that the occasion of the investigation described in the present paper, was the communication to him by Mr. William Froude of some results of experiments of his on the resistance of model boats, of lengths ranging from three to twelve feet. A summary of those results is printed at the end of a Report to the British Association on the State of "Existing Knowledge of the Qualities of Ships." In each case two models were compared together of equal displacement and equal length; the water-line of one was a wave-line with fine sharp ends, that of the other had blunt rounded ends, each joined to the midship body by a slightly hollow neck; a form suggested, Mr. Froude states, by the appearance of water-birds when swimming. At low velocities, the resistance of the sharp-ended boat was the smaller; at a certain velocity, bearing a definite relation to the length of the model, the resistances became equal; at higher velocities, the round-ended model had a rapidly increasing advantage over the sharp-ended model.

Hence it appeared to the author to be desirable to investigate the mathematical properties of stream-lines resembling the water-lines of Mr. Froude's bird-like models. He has found that endless varieties of such forms, all closed curves free from discontinuity of form and of motion, may be obtained by using *four* foci instead of two. They may be called from this property *quadrifocal stream-lines*, or, from the idea that suggested such shapes to Mr. Froude, *Cycnoïds*; that is, swan-like lines.*

Those lines are not to be confounded with the lines of a yacht, having at a distance the appearance of a swan, which was designed and built some years ago by Mr. Peacock, for the figure of that vessel is simply oval. The paper contains four chapters. The first three are mainly cinematical and geometrical, relating to the forms of stream-line surfaces in two and in three dimensions, especially those with more than one pair of foci and surfaces of revolution—the method of constructing graphically and without calculation (by means of processes first applied to lines of magnetic force by Mr. Clerk Maxwell) the traces of such surfaces, which methods are exemplified by diagrams drawn to scale—the motions of the particles of liquid past those surfaces. The fourth chapter is dynamical: it treats of the momentum and of the energy of the disturbance in the liquid, caused by the progressive motion of a solid that is bounded by a ship-shape stream-line surface of any figure whatsoever—the ratio borne by the total energy of the disturbance in the liquid to that of the disturbing body when that body displaces a mass of liquid equal to its own mass, which ratio ranges in different cases from $\frac{1}{2}$ to 1—the acceleration and retardation of ships as affected by the disturbance in the water—the use of experiments on the retardation of ships in finding their resistance—the disturbances of pressure which accompany the disturbances of motion in the liquid. Up to this point, the dynamical principles arrived at in the fourth chapter are certain and exact, like the geometrical and cinematic principles in the three preceding chapters. The results obtained in the remainder of the fourth chapter are in some respects approximate and conjectural, being to a great extent designed to suggest plans for future experiments and rules for their reduction. These results relate to the disturbance of level which accompany the disturbances of motion, when the liquid has a free upper surface—to the waves which originate in those disturbances of level and to the action of those waves in dispersing energy and so causing resistance to the motion of the vessel;—to friction, or skin-resistance and to the "wake" or following current which that kind of resistance causes the disturbing solid body to drag behind it—lastly, to the action of propelling instruments in overcoming different kinds of resistance. The resistance caused by viscosity is not treated of, because its laws have been completely investigated by Mr. Stokes, and because, for bodies of the size of ships, moving at their ordinary velocities, that kind of resistance is inconsiderable compared with skin-resistance and wave-resistance. The resistance caused by discontinuity of figure is stated to be analogous in its effects to friction; but it is not investigated in detail, because ships ought not to be built of discontinuous (commonly called "unfair") figures. In a supplement the author calls attention to the agreement between the position of the points at which there is no disturbance of the pressure on the surface of a sphere, as deduced from Dr. Hoppe's investigation, published in 1856 (*Quarterly Journal of Mathematics*), or on the surface of a short vertical cylinder with a flat bottom, as determined by the experiments of the Rev. E. L. Berthon before 1850 (Proc. Roy. Soc. vol. v. 1850; also, "Transactions of the Society of Engineers," 6th December, 1869. The theoretical value of the angular distance of those points from the foremost pole of the sphere is $\sin^{-1}\frac{2}{3} = 41° 49'$; the value deduced from the experiment is $41° 30'$. The author then adds some remarks on a suggestion made by Mr. William Froude, that the wave-resistance of a ship is diminished when two series of waves originating at different points of her surface partially neutralise each other by interference; stating that, with regard to this and many other questions of the resistance of vessels, a great advancement of knowledge is to be expected from the publication in detail of the results of experiments on which Mr. Froude has long been engaged.

Zoological Society of London, February 10.—Mr. John Gould, in the chair. The secretary stated the principal additions to the society's menagerie during January, amongst which was a specimen of the Great Northern Diver (*Colymbus glacialis*), captured in Cornwall, and presented to the society by A. R. Hunt, Esq.—A letter was read from Mr. W. H. Hudson, of Buenos Ayres, containing some observations on the ornithology of La Plata.—A communication was read from Mr. R. Swinhoe, describing a new deer from China, which Mr. Swinhoe regarded as constituting a new genus of the family *Cervidæ*, distinguished by the large canines and the entire want of horns in both sexes. This deer was stated to be common on the islands on the lower part of the river Yangtze-Kiang near Ching-Kiang, and to be often brought into the market of that city, but appeared hitherto to have escaped the observation of naturalists. Mr. Swinhoe proposed to call it *Hydropotes inermis*.—A communication was read from Mr. George Gulliver, on the size of the red corpuscles of the blood of *Moschus*, *Tragulus*, *Orycteropus*, *Ailurus*, and some other mammalia, to which were added some historical notices relating to the same subject.—A communication was read from Surgeon Francis Day, containing the second portion of his paper on the fishes of Burmah.—The Rev. O. P. Cambridge communicated a monograph of the genus *Idiops* belonging to the family Mygalides, in which were included descriptions of three species considered to be new to science.—A communication was read from Mr. John Brazier, containing descriptions of three new species of shells from the Australian coast belonging to the genera *Voluta* and *Conus*.—Mr. Henry Adams communicated a description of a new species of mollusk of the genus *Colus* from the L'Agulhas Bank, Cape of Good Hope, which he proposed to call *Colus ventricosus*.

* Κυκνοειδής.

Ethnological Society, February 8.—Dr. A. Campbell in the chair. The following new members were announced: Sir Charles Wentworth Dilke, Bart., M.P., Rev. A. S. Farrar, Messrs. M. C. Fisher, F. R. Munton, and F. B. Wright. "On some flakes of flint and chert discovered in the angular *detritus* beneath a submerged forest at Porlock and Minehead in West Somerset." Mr. Boyd Dawkins. These objects of human workmanship prove that man must have lived on the old land-surface before the destruction of the forest, and the accumulation of the series of overlying deposits. It has been supposed that this *detritus* was of glacial age; but the author doubts this. He believes, however, that there is evidence to show that the latest date which can be assigned to these remains is an early stage in the Neolithic period. Dr. Richard King, Colonel Lane Fox, Rev. Dr. Nicholas, and Mr. McLennan spoke upon this communication.—The Chairman then read some notes introductory to a paper on the remains of prehistoric man in the neighbourhood of the Crinan Canal in Argyleshire. This canal is nine miles in length, and connects Loch Fyne with Loch Crinan. The Rev. Mr. Mapleton described with great precision the prehistoric remains in this locality, among which the most curious were some peculiar cup-shaped cavities and concentric rings rudely sculptured on certain stones. In addition to these petroglyphs, there are many menhîrs, and numerous cairns of various forms: crannoss occur in most of the lochs, but are usually merely solitary dwellings. Several duns, a vitrified fort, a brough, and a flint-manufactory are also among the remains in this district. The Rev. Dr. Nicholas and Colonel Lane Fox made some remarks upon this paper.—The assistant-secretary exhibited and described a stone hammer-head found by Mr. R. Mouat in the old workshop of a copper-mine in Portugal.

Entomological Society, February 7.—Mr. A. R. Wallace, president, in the chair.—Mr. Bates, Major Parry, and Mr. Pascoe were nominated as vice-presidents. It was announced that the council offered two prizes of the value of five guineas each, for essays of sufficient merit, drawn up from personal observation, on the anatomy or economy of any insect or insects. The essays to be sent in before the end of November next.—Mr. Bond and Prof. Westwood exhibited several butterflies, the colouration of each being partly that of the male and partly that of the female character. Mr. Bond, on behalf of Dr. Wallace, exhibited cocoons from various parts of the world, of *Bombyx Yamamai* and *Antheræa Pernii*. Mr. Stainton exhibited a large box full of *Micro-Lepidoptera*, each specimen being separately labelled to show the locality and date of capture. Mr. Bond exhibited some more specimens of *Acridium peregrinum*, from Plymouth; Mr. Fred. Smith made some observations upon the *Locusta migratoria* of Linné, and *L. Christii* of Curtis. Prof. Westwood exhibited a new form of *Cynipidæ*, from the Sula

Islands. Mr. Janson, on behalf of Mr. Crotch, exhibited *Philonthus cicatricosus*, *Dyschirius angustatus*, *Hydroporus unistriatus*, and *H. minutissimus*, four recent additions to the list of British beetles.—Major Parry exhibited *Hicagus obscurus*, a North-American species placed by Leconte among the *Scarabæidæ*, of which it has since been suggested that it might possibly belong to the *Lucanidæ*.—The secretary read a letter from Mr. Roland Trimen, on the habits of some South-African species of *Paussidæ*.—The following papers were read:—"A revised catalogue of the *Lucanoid coleoptera*, with remarks on the nomenclature and descriptions of new species" (the concluding part), by Major Parry; "On the species of *Charaxes* described in the 'Reise der Novara,' with descriptions of two new species," by Mr. A. G. Butler. Mr. M'Lachlan presented the MS. of "A catalogue of the *Neuroptera* of the British Isles," being the first instalment of the proposed list of all our indigenous insects.

EDINBURGH

Royal Physical Society, January 26.—Mr. R. F. Logan, president, in the chair. Mr. F. W. Lyon, M.D., and Mr. B. N. Peach, of the Geological Survey, were elected resident members. The following communications were read:—

"Notes on the meteoric shower of November 1869, as observed at the Cape of Good Hope; and on the supposed fall of an aerolite there." By D. R. Kannemeyer. A number of specimens of star-fish and echini, recently added to the British fauna, from Shetland, &c., were exhibited and commented on by Mr. Charles W. Peach. The specimen first mentioned by Mr. Peach was *Comatula rosacea*, for a long time the only known representative, in our seas, of the fossil encrinites; two other species are now known, viz., *Antedon Sarsii*, of which several specimens have been taken in 80 to 100 fathoms off Unst, and *Antedon Celticus*, which has been captured in the Minch and Sleat of Sound, and about 10 years ago in the Sound of Skye. The other specimens exhibited were as follows:—*Ophiura affinis*—got on both sides of Shetland, at Wick, N.B., and off the coast of Northumberland; was taken for *Ophiocoma bellis*. *Luidia Sarsii*—Shetland in deep water, at Wick, N.B., and in Cornwall. *Archaster Parleii*—Two specimens only were taken off Shetland in 1864 and 1867; the most beautiful of our native stars. *Goniaster aculeatum*—Variety of *G. phyrgianus*; very deep water off Unst, Shetland, 1864, two specimens only. *Cribella curta*—Variety *C. sanguinolenta*, occurs between tide-marks from Cornwall to Shetland. *Cidaris papillata*—the "Piper" of the Shetland fisherman, although not new, has hitherto been considered as very rare; has turned up in numbers on the west coast of Shetland in 100 to 110 fathoms. *Echinus Norvegicus* has been also found occasionally in great numbers in deep water, same locality, with *Toxopneustes pictus*, another beautiful addition. The one of the greatest interest is *Spatangus meridionalis*, from equally deep water, same locality, it being especially a Mediterranean form; it is a magnificent species. Several of the above species are also found in the Mediterranean and as these are living in the same spot with Boreal and Arctic forms, it would be interesting to know how they got there, as it is now well ascertained that the Gulf Stream does not reach those seas. All the above are additions to the British list. He was at present unable to give their names. Although he was aware that many new *Holothuriæ* had been found, he did not notice them.

Remarks on the Bill and Food of the Indian Skimmer (*Rynchops albicollis*). By Mr. William Bell. Communicated by Dr. Davidson. It has been stated that the African species of the genus feed on the ground, searching the soft mud with their bills. Mr. Bell had watched these birds near Saharunpore; he had seen them on the mud, but never searching it as if for food. They were well named skimmers, as with their long and powerful wings they flew along the surface of the water; they opened their bills very wide and struck the water at a low angle of 10 deg. or 15 deg., dipping into it in this way to catch small fish and other inhabitants of the water and he had found their stomachs filled with the bones of fish.

Notice of *Larus minutus*, the Little Gull, recently captured in Berwickshire, &c. By John Alex. Smith, M.D. (the specimen was exhibited).—This rare gull, the smallest of the genus *Larus*, was shot in the harbour of Coldingham, Berwickshire, on the 27th of December. It was the property of Mr. Andrew Wilson, Coldingham. It is a native of Eastern Europe, migrating from the Baltic and Gothland, where it breeds, to the South of Europe and Caspian Sea in the winter and is a rare straggler to Scotland, only some two or three specimens having been previously observed. The bird is a young male in immature plumage. Temminck states that it feeds on insects and worms and very little is known of its habits. Dr. Smith found the stomach and gullet of this bird filled with fishbones and was able to detect among these part of the fifteen-spined stickleback, *Gasterosteous spinachia*. The bird was easily distinguished by its small size, measuring only 11½ inches from the bill to the extremity of the tail. Dr. Smith exhibited a fine adult male *Mergusalbellus*, the seamew recently shot, he believed, in Forfarshire; also a specimen of the *Mergulus alle*, the little rotche shot in the end of December at Seacliff. He had hoped to be able to exhibit a very fine specimen of the rare *Alauda alpestris*, the shore lark, which he had examined. It was killed at St. Andrews in company with a flock of snow buntings, on the 31st of December and is the property of Mr. R. Wardlaw Ramsay, jun. He had just learned that another specimen had been killed at Dunbar in the beginning of this month and was in the possession of Mr. F. Balfour of Whittinghame. Very few instances are on record of this bird having been seen in Scotland. Mr. Scott Skirving was inclined to think that the general resemblance borne by this bird to the buntings might help to make it overlooked, and that it might not be so very rare as it was considered to be.

DUBLIN

Royal Irish Academy, January 24.—The Rev. Dr. Jellett, president, in the chair. Mr. Eugene A. Conwell read a paper on a tumulus and chamber in the Island of Gavr' Inis, Morbihan, Brittany; and described the conditions of the purchase of the Island in 1832, in regard to the treasure supposed to be concealed in this tumulus, and the subsequent clearing out of the interior chamber and gallery, measuring 50 feet 8 inches in length. The large blocks composing the walls and roof were not of the native rock of the island; and, excepting three, which were quartz, were granite, and must have been procured from the adjoining continent. Supposing this monument to have been erected by an essentially primitive people, and at a period subsequent to the time when the present island of Gavr' Inis was a portion of the adjoining continent, what a miracle of mechanical power must have been exerted to drag these immense blocks to the shore, to place them on solid rafts, and, after disembarking them, to haul them to the opposite end of the island, where the tumulus is erected, adjoining a cliff! The paper was illustrated by three large sheets giving minute details of the general plan and section of the tumulus, with ground plan, elevations, and measurements of the stones composing the interior chamber—planned and drawn in 1869 by Sir Henry Dryden, Bart., and Rev. W. C. Leukis—together with 21 sheets of drawings of the sculptures on the stones, executed by Sir Henry Dryden. No capstone, and only one pavement-stone, was found sculptured. Twenty-two of the upright stones were profusely covered with sculptures, of the intended significance of which, whether ideographic, symbolic, or intended merely for ornamentation the author could offer no explanation.—Mr. Conwell also exhibited two series of drawings from the cairns on Sliabh-na-Caillighe, one to show the kindred character of the ancient sculptures of Ireland and Brittany, and the other the sculptures on twenty-eight inscribed stones in a single cairn on Sliabh-na-Caillighe, exhibiting an elaborate diffuseness and a variety of characters unequalled in any single cairn hitherto opened and described in any part of the world.—Professor R. S. Ball read a paper "On the small oscillations of a rigid body about a fixed point under the action of any forces, and more particularly when gravity is the only force acting."—Dr. Sigerson read an account of some examinations of the minute organisms found floating in the air of cities, comparing them with those met with in the sea breezes and in country air.

Royal Geological Society of Ireland, February 9.—Mr. G. Dixon in the chair. Professor Macalister read the Annual Report of the Council. The Rev. Professor Haughton, M.D., read a paper "on the mineral constituents of the granites of Scotland." Dr. J. E. Reynolds exhibited a new mode of exhibiting ordinary hand specimens of minerals to a class, by means of the lime light.

Institution of Civil Engineers in Ireland, February 9.—Mr. J. Ball Greene in the chair. The chairman delivered the annual address.

GLASGOW

Geological Society of Glasgow, January 27.—Mr. John Young, vice-president, in the chair. On the "Sutherlandshire gold-fields." Mr. William Cameron. The author referred to a paper he had read before this society in 1866 upon the Auriferous Rocks and Drifts of Victoria, in which he stated that it was possible there might yet be found in Scotland fields where, with modern appliances, gold might be profitably worked. This conjecture has since been realised as a fact. He exhibited a rough-sketch map, showing the geographical position and geological structure of the gold-bearing districts of Scotland, also several interesting sections of the rocks and drifts in the vicinity of Kildonan, describing the prominent geological features of the country as lower Silurian, consisting of mica schist, gneiss, granite, chloritic schist, &c., with occasional quartz veins. No discovery of gold *in situ* had yet been made, and the question as to the true matrix of the Sutherland gold had yet to be decided. In regard to this question, it was pointed out that the materials associated with gold in the drifts are the same as those of the surrounding rocks. Moreover, the gold of each stream varies in character, apparently pointing to some local peculiarity rather than to a glacial origin. The chairman said he could not detect glacial striæ in the drift, which resembled usual river gravel. Dr. Boyce agreed with Mr. Cameron as to the probable local origin of the gold.

NORFOLK

Norfolk and Norwich Naturalists' Society, January 25.—The president, the Rev. J. Crompton, in the chair. Two Richards pipits, two shore larks, an immature goshawk, and a fulmar petrel were exhibited by Mr. Gunn, all procured on the Norfolk coast during the present winter. The Rev. J. A. Lawrence, of Bergh Apton, exhibited some remarkable fasciated stems of the holly (*Ilex aquifolium*), one specimen resuming its ordinary growth at the summit, the branches into which it separated being clothed with leaves in the usual manner.—Mr. Stevenson read a paper on the rare birds which have visited us during the past autumn and winter, in which he stated that no less than thirteen shore larks had been killed on the Norfolk coast between the 7th of November and the 12th of January. Of this species, at one time considered a very great rarity, thirty-two specimens have been procured in Norfolk since 1830. Of those recently obtained, it was remarkable that only four out of thirteen proved to be males, whereas out of eleven examples killed between 1830 and 1862, all were males but two; but in the winter of 1866–7, four pairs were males and females. Six specimens of Richards pipits had been procured in Norfolk; and the present season was remarkable for the number which had been obtained in other and more southern counties, amounting to eleven examples in the neighbourhood of Brighton alone. This species was apparently a bird of passage, but out of its ordinary line of migration, when thus accidentally met with upon our Eastern coast. The goshawk may now be ranked amongst the rarest of our raptorial visitants. He knew of only ten examples procured in Norfolk during the last forty years, of which all but two were young birds. Mr. Stevenson alluded to the unusual number of woodcocks killed during the past autumn, including a strange melanoid variety killed near Cromer. He mentioned the following birds as having been killed on the coast in October and November:—the pomarine skua, Buffon's skua, purple sandpiper, little gull (immature), and a considerable number of storm petrels, some of which had been found far inland. Mr. Southwell stated that the food of one of the Richards pipits, which he examined, consisted of a small species of lady-bird, and that two of the shore larks (which were very fat) had been feeding entirely on seeds of *Arenaria peploides*.—Mr. Crowfoot, of Beccles, read a paper on rare European birds, their nests and eggs, and exhibited eggs of the wall creeper (*Tichodroma muraria*), taken in Switzerland; Baillon's crake, from Potter Heigham, Norfolk, in 1866; the little crake, and little gull, the latter eggs taken on 31st of May, on Lake Ladoga.

PARIS

Academy of Sciences, February 7.—M. C. Sainte-Claire Deville communicated a note by M. C. Naudin, describing an extraordinary fall of snow at Collioure, in the Eastern Pyrenees. This fall commenced on the 21st January, about 5 A.M., and lasted until the morning of the 23rd, or for at least forty-four hours. M. Naudin estimates the average thickness of snow which fell during this period at 0·80 metre (about thirty-two inches); the thermometer during the fall departed very little from the freezing point (0° C). Great damage was done to the olive-trees, which were broken by the weight of the snow, but the author stated that palms, although pressed flat by the snow and afterwards encased in ice for ten or twelve days, received no injury.—M. de Saint-Venant presented a report on a memoir by M. Maurice Lévy, entitled "An essay on a rational theory of the equilibrium of recently moved soils, and its applications to the calculation of the stability of supporting walls," supplementing it by a memoir of his own on the approximate determination of the thrust exerted by soils without cohesion, against a wall of a certain inclination.—M. E. J. Maumené presented a memoir on the general theory of chemical action, embodying a fresh proof of the breaking down of the chemical type in the so-called actions of substitution.—M. Delaurier forwarded some investigations on thermo-electricity, M. de Plagniol a further note on the silk-worm disease (*Morts-flats*), and M. Gaudin a letter relating to his mode of manufacture of artificial gems.—M. Bontemps offered for the acceptance of the Academy some manuscript works of M. Charles, who first employed hydrogen gas in balloons.—M. Faye communicated a note by M. Laussedat on the application of the graphic method to the prediction of eclipses of the sun; and also two notes by M. Heis on observations of the zodiacal light and of the aurora borealis at Münster in Westphalia.—A note was received from M. H. de Kéricuff on the determination of the parallax of Venus.—The fourth and concluding portion of the paper by M. Pierron de Mondesir, "On a new method for the solution of mechanical problems," was presented by M. Sainte-Claire Deville, who also communicated a paper by MM. L. Troost and P. Hautefeuille "On the heat of combination of silicium with chlorine and oxygen," to which he appended some remarks.—Other chemical papers communicated were:—"On a new method for the synthesis of the organic acids," by M. Berthelot, and "On the simultaneous formation of isomers in definite proportions," by M. A. Rosenstiehl.—M. E. Becquerel communicated a note by M. E. Bouchotte on a simplification of Holtz's electrical machine, and on a process for the estimation of the relation existing between the dynamical work expended and the electricity produced.—MM. A. Béchamp and A. Estot presented a note "On the nature and origin of the blood-corpuscles," in which they maintain that these globules are "aggregations of microzymata," which may become developed into Bacteria, Bacteridia, &c.—M. Lacaze-Duthiers communicated a valuable paper "On the organisation of the *Aspergillum javanum*.—A note by M. G. Cotteau on the genus *Asterostoma*, a group of fossil sea-urchins, probably of cretaceous date, was communicated by M. de Verneuil. The author described two new species from Cuba, viz., *A. jimenoi* and *A. cubensis*; only a single species was previously known.—A note by M. Gorseix on the present state of the volcano of Santorin was also read, and M. F. Lenormant presented a note on the antiquity of the ass and horse among the Aryan peoples.

BERLIN

Royal Prussian Academy of Sciences, November 8, 1869.—M. Hagen read a paper on the movement of water in tubes directed vertically downwards.—Prof. Ehrenberg communicated an extract from a letter received from Dr. Julius Haast, of Canterbury, New Zealand, describing his discovery of an old dwelling of moa-hunters, with its cooking-places and other objects of interest. The stone implements found in this place were made of flint, and not polished; they resembled those found at Amiens. Dr. Haast considers that his researches confirm the opinion that the moa-hunters belonged to a different race from the Maories, who, he added, have no tradition concerning the former existence of the extinct gigantic birds.

November 25.—Prof. Poggendorff read a long and elaborate paper on Holtz's rotation electricity and the force manifested by it, which he regards as the most powerful yet produced by frictional electricity.—Prof. W. Peters communicated descriptions of some new species of Saurian reptiles and Batrachia, namely: *Polychrus* (*Chaunolæmus*, subg. n.) *multicarinatus*, from Costa Rica; *Tropidolepisma Richardi*, from North Australia; *Gymnodactylus Steudneri*, from Sennaar; *Cyclorhamphus fasciatus*, from Chili; and *Hyla gracilenta*, from North-east Australia.—Professor Hoffmann read a memoir on the sulphuretted urea-compounds, and another upon the action of iodine upon thiobenzamide.—A supplement to the November *Monatsbericht* contains M. du Bois-Reymond's memoir on the movement of magnets under the influence of moisture.

VIENNA

Imperial Geological Institution, January 4.—A note by M. von Lipold relating to M. Krezci's views on the "colonies" of the Silurian basin of Bohemia was communicated by Mr. J. Barrande, who also presented his reply to M. Lipold's remarks.

M. J. Rumpf presented a notice of the magnetic pyrites of Leoben in Carinthia, and of crystals of magnesite from Maria-Zell in Styria. M. C. von Ettingshausen read a paper on the fossil flora of Sagor in Carniola, which presents the characters of the Aquitainian flora. Prof. E. Suess noticed the occurrence of *Fusulinæ* in the upper carboniferous limestone of the Southern Alps, which he had already compared with the Russian *Fusulina*-limestone. The species found agrees with the *F. robusta* of Meek, from California. Abich has described a *F. sphærica* from the upper carboniferous limestone of Armenia, whch is probably identical with *F. robusta*. *F. cylindrica* occurs in Spain. M. Karl von Hauer communicated a paper on the occurrence of sulphur near Szwosyowice in Galicia; and M. K. M. Paul exhibited the geological map of the northern parts of the counties of Zemplin and Ungh in Hungary, and made some remarks upon the geology of the district.

PHILADELPHIA

Academy of Natural Sciences.—August 17.—Dr. Leidy made some remarks on a tooth of *Equus fraternus*, reading an extract from a letter by T. C. Broadhead relating thereto.—A paper on "Brevoortia" by Alphonzo Wood was read.

September 7.—Mr. Meehan made some remarks upon the development of the buds of plants. He said it was well known that all vegetable physiologists taught there were two classes of buds in plants—one called adventitious buds, which had a kind of nomadic existence, the other axillary buds, which were supposed to owe their origin to the leaf from the base of which they sprang. It was customary to speak of these as the parent leaves of the axillary buds. He would show that the leaf not only did not aid the axillary bud formation, but was rather a foe to bud development. He exhibited vigorous shoots of the Kentucky coffee and honey locust trees, and hichorins of walnuts, showing what had either been entirely overlooked by other botanists or passed over of no importance, that there were in these two or three buds instead of the usual axillary bud, one above another in direct line, and that in all these instances the farthest removed from the base of the leaf, and, of course, the one the least under its influence, was the largest and best developed. He gave the results of extended observations as proof of the same principle from single bud cases. He exhibited specimens of some maple shoots of the present season's growth.—Mr. C. H. Redfield stated that the *Aspidium aculeatum* (L.), though widely distributed over the globe, had, in the United States, been restricted, as was supposed, to the mountains and mountain gorges of New Hampshire, Vermont, and Northern New York, and to Northern Minnesota. He had, however, recently found it growing in abundance in the Stony Clove of the Catskill Mountains, about two degrees farther south than it had before been noticed, and under conditions very similar to those in which it grows in the notch of Mount Mansfield, Vermont.

October 5.—A written communication was received from Prof. Ennis, entitled "Meteors, their composition and the Cause of their Ignition," and another, "On variations in the genus *Ægieothus*," by Elliott Cours, A.M., Ph.D.

October 12.—Mr. Meehan presented a paper for publication, entitled "On the Law ofDevelopment in the Flowers of *Ambrosiæ artemisillfolia*." Mr. Meehan accompanied the presentation with verbal remarks illustrated by the plants.

October 19.—Mr. A. H. Smith made some remarks in regard to a plant discovered some years back by Michaux, and named by him *Carex miliaris*. Some time ago, near Moosehead Lake, Mr. Smith discovered plants which, when submitted to Gray, were called by him *Carex retundata*, and *Carex pulla*. These plants were immature; afterwards procuring perfect plants Mr. Smith thought that they were identical with the *Carex miliaris* of Michaux.

December 21.—Prof. Cope made some remarks on a cranium of the *Hyperaodron bidens* from the coast of Rhode Island, presented by Samuel Powell of Newport. He stated that it was a female which entered the harbour of the latter place with a calf. A male was some time after cast ashore dead near Dennis, Mass., and was preserved complete in the Mus. Comp. Zoology, Cambridge. (See Allen, Mammals, Massachusetts.) He said that the muzzle of the female was longer than represented for European specimens, but that of the male was as short, and that no difference could be detected in the skeleton of either. He, therefore, retained the name *H. bidens.* He stated that *Mesoplodon Sowerbiensis* also occurred on the coast of Nantucket. He next exhibited the left ramus of the mandible of a finner whale of the miocene of Edgecombe Co. North Carolina. He pointed out its characters were nearest those of the *Eschrichtius cephalus*, but that there was a groove inside the upper edge of the jaw. He called it *Eschrichtius polyporus*. He exhibited a number of remains of fossil reptiles from Sampson Co. North Carolina, of cretaceous age, which were intrusive in miocene beds. Among these were humerus, tibia, fibula, metatarsus, caudal vertebra, and, perhaps, cervical vertebra and dermal bone of a gigantic Dinosaur, found together by Prof. H. C. Kerr, Director of the Geological Survey of North Carolina. The remains indicated a species having the same general form and size as the *Hadrosaurus Foulkei*. The caudal vertebra was of very different form, and resembled more that of Hylæosaurus *minus* the diapophysis. This vertebra was elongate, depressed, and angulate. The animal presented various other points distinguishing it from *Hadrosaurus*, and was named *Hypsiberma crassicauda*.

Two caudal vertebræ of another animal from the same county, but different locality, indicated a true *Hadrosaurus*. One, near the thirtieth caudal, was twice the size of that of *H. Foulkei*, the vertical diameter of the centum being 4·5 inches. It presented so many peculiarities of form that Prof. Cope thought it to have belonged to a species distinct from *H. Foulkei*. A caudal apparently *terminal* was shorter than the same in that species. He named it *Hadrosaurus tripos*. Another reptile from the same locality was indicated by an elongate conic tooth. He named it *Polydectes biturgidus*.

January 4.—Dr. Linz exhibited the broken extremity of the snout of a large extinct mammal brought by Dr. Hayden from Colorado Territory, which resembled in some respects the genus *Sivatherium*, especially in presenting a horn core on each side of the front. The nasals were even shorter than in *Sivatherium*, and the horn cores appear to be in advance of the orbits. He suggested that it might belong to *Titanotherium*, but named it *Megacerops coloradensis*. He stated that he had received from the same region remains of a large reptile allied to *Porcilopleurum*. Prof. Cope exhibited the ischiatic bones of two *Dinosauria*. One of these, the *Megadactylus polyzebus* of Hitchcock, had probably been one of those that left its tracks in the strata of the Connecticut valley sandstone. With these a subround bilobed impression had frequently been found, just behind the heels on the median line. This he showed to be the impression of the extremities of the ischia. These bones were directed backwards, and for the posterior half of their length were in close contact, forming an elongate rod, on which the animal rested when in a sitting position. The structure in *Laelaps* was shown to be quite similar.—Prof. O. C. Marsh, of Yale College, exhibited a tooth of a new species of Rhinoceros from the miocene of Squankum, New Jersey, which he regarded as representing a species distinct from those already known. He called it *R. matutinus*, and stated that it was the first species discovered east of the Mississippi. He exhibited several vertebræ of a Hadrosaurus from the upper cretaceous greensand of Bamerbaro, New Jersey, which belonged to a species of smaller size than the *H. Foulkei*. He regarded it as distinct, and called it *H minor*. He exhibited a large tooth of a mosasauroid reptile, of a shorter and thicker form than usual, and which had been taken from a fragment of a jaw, which indicated a species with short, massive muzzle. It is from North Carolina. He proposed to call it *Mosasaurus crassidus*. The vertebra of another Mosasauroid was exhibited, which he referred to the genus *Liodon* (regarded by Prof. Cope as synonymous with *Macrosaurus*), and which presented peculiarities which separated it from *L. laevis* and *L. validis*. Its diapophyses were prolonged to an unusual distance on the caudal series of vertebræ. He proposed for it the name of *Liodon laticaudus*.—Thomas Mecham referred to his former observations that the so-called leaves of coniferæ were but phylloid branchlets, and that the real leaves existed chiefly in the form of adnate scales. In some coniferæ these adnate leaves had the power of elongating into free foliaceous awns. The larch was an instance. In *Pinus* this had never been noticed. He now exhibited specimens of *Pinus serotina*, in which the leaf scales under each fascicle of phylloidæ had developed into leafy awns two inches in length, demonstrating the correctness of his original observation. He further remarked that those adnate true leaves were as different on different species, as the leaves of other plants, and afforded excellent specific characters, much better in fact than many derived from the number of phylloidæ in a fascicle, or even from many points in the cones. Specimens to illustrate this were exhibited.

BUFFALO

Society of Natural Sciences, December 9, 1869.—Annual meeting.—The president, G. W. Clinton, in the chair. The following officers were elected for the ensuing year:—President, Geo. W. Clinton, LL.D.; vice-presidents, A. T. Chester, D.D., Everard Palmer, and Henry A. Richmond; treasurer, James Sweeney; librarian, Otto Bessar. Dr. Bird, of Sioux City, Iowa, and Johnson Pettit, of Grimsby, Ontario, were chosen corresponding members.

BOSTON

Society of Natural History, December 15, 1869.—The following paper was presented:—"Notes on the mammals of Iowa." By Mr. J. A. Allen.

The list of the mammals given in this paper is based mainly upon notes gathered during three months spent in the state of Iowa in the summer of 1867, for the purpose of collecting and studying its animals and plants. A few species have been inserted upon the authority of other authors, while a few others are given from their known occurrence in nearly all the adjoining states, though not, to the author's knowledge, yet reported from this. The whole number enumerated is forty-eight, and probably but two or three remain to be added to perfect the list of the indigenous mammals of the state. Attention is also called to such others as are most likely to occur. If three or four northern ones be found to reach the northern parts of the state, the whole number, including the introduced house-rats and mice, may be increased to about fifty-five or fifty-six, which is a number somewhat greater than is found in many of the Atlantic states, excluding the marine species, the seals and cetaceans. Iowa being situated in a prairie region, it necessarily differs considerably in the general character of its fauna, and especially in respect to its mammalia, from that of the wooded portion of the United States to the eastward, as all who have given attention to the geographical distribution of animals must be aware. Yet we do not in this state fairly enter upon the so-called Middle Province of the continent, which differs so markedly, both in fauna and flora, from the Eastern Province. A great change in the fauna and flora is met with, however, at the point of junction of the wooded and woodless regions of the eastern half of the continent, which in the latitude of Iowa occurs more than a hundred miles to the eastward of that state. At this point as great and as abrupt a change occurs as usually takes place between two contiguous faunal districts, one of which lies to the north or to the south of the other, or where the line of division is an isothermal one, separating different climatic and zoological zones. A few only, if any, of the species embraced in this list seem to find their eastern limit of distribution in this state; but, with two or three exceptions, they range through southern Wisconsin, Illinois, and even into north-western Indiana and southern Michigan, or to the eastern limit of the prairies. Also, with very few exceptions, none are restricted to it in either their northward or southward range. A few of the more northern species, whose southern range is restricted to the southern border of the Alleghanian fauna, may reach the northern counties of Iowa, as a few essentially southern species may approach, or even be found occasionally within its southern borders. Iowa is hence mainly embraced within the Carolinian fauna, at least so far as its mammals, birds, and reptiles are concerned, though generally heretofore supposed to belong, in great part, at least, to the Alleghanian. Among the strictly prairie mammals represented, are at least four rodents (*Spermophilus tridecemlineatus, S. Franklinii, Geomys bursarius, Hesperomys michiganensis*), two carnivores (*Canis latrans, Taxidea americana*), and at least one insectivore (*Scalops argentatus*). Only one eastern species, the red squirrel (*Sciurus hudsonius*), appears to find at the prairie line its western limit, if, as some have supposed, it be true that this animal does not range across the continent. Hence the difference between the mammalian fauna of the prairies of the Upper Mississippi valley and that of the forest region to the eastward consists in the addition of a number of species peculiar to the prairies. Since all the larger species of mammalia are everywhere rapidly disappearing before the revolutionising influences of civilisation, and since great and general changes occur in the faunal and floral features of every country when brought under cultivation, it becomes a matter of unusual interest to preserve as correct a record as possible of the primitive conditions of our own country in this respect, for comparison with its subsequent altered status, as well as a history of the change.

DIARY

THURSDAY, FEBRUARY 17.

ROYAL SOCIETY, at 8.30.—On a Distinct Form of Transient Hemiopsia: Dr. Hubert Airy.—Account of the Great Melbourne Telescope, from April, 1868, to its commencement of operations in Australia in 1869: A. Le Sueur.
LINNEAN SOCIETY, at 8.—On the Tree Ferns of British Sikkim: Mr. Scott.
CHEMICAL SOCIETY, at 8.
ZOOLOGICAL SOCIETY, at 4.
ANTIQUARIES, at 8.30.—On Some Monastic Inventories: Rev. M. E. C. Walcott.—On Some Roman Antiquities: S. Sharp.
ROYAL INSTITUTION, at 3.—On the Architecture of the Human Body: Prof. Humphry.

FRIDAY, FEBRUARY 18.

ROYAL INSTITUTION, at 8.—Theories of the Physical Forces: Mr. W. K Clifford.
PHILOLOGICAL SOCIETY, at 8.30.
GEOLOGICAL SOCIETY, at 1.—Anniversary Meeting.

SATURDAY, FEBRUARY 19.

ROYAL INSTITUTION, at 3—Science of Religion: Prof. Max Müller.

MONDAY, FEBRUARY 21.

VICTORIA INSTITUTE, at 8.—Spontaneous Generation, or the Problem of Life: Rev. Prof. Kirk.
LONDON INSTITUTION, at 4.
MEDICAL SOCIETY, at 8.
ENTOMOLOGICAL SOCIETY, at 7.
ROYAL ASIATIC SOCIETY, at 3.

TUESDAY, FEBRUARY 22.

ETHNOLOGICAL SOCIETY, at 8.—On Recent Archæological Discoveries in Yorkshire: C. Monkman, Esq.—On the Natives of Naga, Philippine Island: Dr. Jagor.
INSTITUTION OF CIVIL ENGINEERS, at 8.
ROYAL MEDICAL AND CHIRURGICAL SOCIETY, at 8.30.
ROYAL INSTITUTION, at 3.—On the Architecture of the Human Body: Prof. Humphry.

WEDNESDAY, FEBRUARY 23.

ARCHÆOLOGICAL ASSOCIATION, at 8.
GEOLOGICAL SOCIETY, at 8.—Additional observations on the Neocomian Strata of Yorkshire and Lincolnshire, with notes on their relations to the Beds of the same age throughout Northern Europe: By Mr. J. W. Judd.—On Deep-mining with relation to the Mineral-bearing Strata in the S.W. of Ireland: By Mr. Samuel Hyde. Communicated by Mr. R. Etheridge.—On the Structure of a Fern-stem from the Lower Eocene at Herne Bay, and on its allies, recent and fossil: By Mr. W. Carruthers.
SOCIETY OF ARTS, at 8.—On Economy of Fuel for Domestic purposes: Mr. D. Galton, C.B.

THURSDAY, FEBRUARY 24.

ZOOLOGICAL SOCIETY, at 8.30.—On the Classification of the Capitonidæ: Messrs. Marshall.—On the White Wag-tails of China: Mr. R. Swinhoe.—On the Deer living in the Society's Menagerie: Mr. Sclater.

BOOKS RECEIVED

FOREIGN.—Les Oiseaux décrits et figurés d'après la Classification de Georges Cuvier mise au courant des progrès de la science, 72 Planches, les espèces remarquables et les caractères, génériques tirés du bec et des pattes: texte explicatif; Figures Coloriées.—Pétrifications remarquables des Alpes Suisses, le Corallien de Wimmis; W. A. Ooster; avec une Introduction Geologique et 24 Planches des Fossiles: C. de Fischer-Ooster.—Monographique der Molluskengattung Venus: Linné; Dr. Edward Römer.—Fossile Flora der jüngsten Steinkohlenformation und des Rothliegenden im Saar-Rhein Gebiete: Ch. Ernst Weiss. (Williams and Norgate.)

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*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH

No. 17] THURSDAY, FEBRUARY 24, 1870

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THURSDAY, FEBRUARY 24, 1870

THE MINISTER OF PUBLIC INSTRUCTION

ENGLISH politicians have peculiar ways of giving us what we want. For some time every one has felt, as it were, by a sort of instinct, that we shall at last have what all other civilised nations have long known to be indispensable,—a Minister of Public Instruction. Out of Parliament this has been on all sides spoken of as a matter of course. But in Parliament it is different. When the inevitable time comes for it to be spoken of there, it must be carefully avoided, or only coyly glanced at, by those who have thoroughly determined to give it, for etiquette imposes on them the necessity of appearing to yield to external importunity. A very pretty example of this parliamentary coquetry occurred last week on the first reading of the new Education Bill. Mr. Forster displayed no little ingenuity in avoiding the slightest allusion to a provision which everyone of his hearers knew to be absolutely essential to the success of the great measure he was introducing. He said, "The first thing that would suggest itself probably to the minds of all hon. members would be a system of organisation throughout the country," knowing perfectly well that "the first thing" that must suggest itself would be a central authority to create and direct that organisation. But the suggestion must not come from a Minister. It was not long, however, in coming from other quarters. Sir John Pakington, as a leading member of the Opposition, and other speakers, promptly supplied the deficiency, and the proposal was received with "ministerial cheers." All men know that the meaning of this amusing, and no doubt most necessary, little comedy is, that we may now hope soon to have a Minister of Public Instruction. That being the case it may not be amiss therefore that the probable scope of the duties connected with such an office should be briefly considered.

Such a Minister should, we think, take charge of the whole range of natural knowledge in all matters in which the State in any way intervenes to advance such knowledge. We understand the comprehensive term natural knowledge to include Education, Science, the Fine Arts, and Music. Towards the promotion of all these the Government at present, more or less contributes its direct influence. In order to ensure continuity of system and avoid its interruption when the head of the department vacates office with the change of Ministers, it will, we believe, be found necessary to place over each of these subdivisions a permanent, that is unparliamentary, Under Secretary of State; unless indeed the two last, Fine Arts and Music, may be found capable of being united under one head. But Education, Science, and Fine Arts, with Music, should certainly be kept distinct, not only with a view to division of labour, but to the special efficiency of each.

The Education branch would include the national system of compulsory primary education about to be established, public schools, universities, and agencies of all kinds aided by the State, which have for their object the training of youth. It would include also general literature in so far as that is recognised or subsidised in any way by the State.

The Science branch would include all establishments, in receipt of Government assistance, in which Science is taught as a special study; all those in which scientific observations or investigations are conducted under State auspices, and all museums in which natural objects are displayed for scientific purposes.

The Fine Arts branch would include all national collections of paintings, sculpture, and decorative works, national schools of design, the national buildings and monuments, whether of the present or the future.

The Music branch would include subsidies for cultivation of music, and rewards for pre-eminence in the art.

Such, it can hardly be doubted, will be the broad classification. No doubt a debateable ground will be found to exist between the different subdivisions, through which it will be difficult to trace a clear line of separation. For instance, between Science and Fine Arts there will be points of contact requiring perhaps careful re-adjustment; as in the cases of the British and South Kensington Museums, in each of which both Art and Science collections are under one roof. The opportunity presented by the institution of the new Minister is perhaps the last that will ever be afforded us of deciding whether collections differing so entirely in their characters and objects as those of Art and Science should be in juxtaposition. It is certain that the classes who visit collections of Natural History, *bonâ fide* for instruction, are not at all aided, and but little interested, by the immediate presence of antiquities and objects of *vertu*. The classes who only visit museums for amusement, are doubtless interested in both. But in creating a consistent system, which of these two classes should be chiefly considered? If the latter, is there not considerable danger of our falling into the error of making such collections mere places of amusement? Again, the minds best qualified to organise and maintain Art collections do not usually possess equal knowledge of, or feel equal interest in, Science, and *vice versâ*. It seems desirable then that the question of separating the two of kinds collections should now be settled once for all.

Coincident with the re-classifying of our national collections should be an endeavour to engraft on some of them, in which the want has long been felt, arrangements for facilitating the study of their contents.

Assuming that the scope of the new Minister's jurisdiction will be generally such as we have indicated, we may be at ease with respect to the Education branch. This has received so much attention of late, and the whole subject has been so thoroughly mastered by Mr. Forster, who will, let us hope, be our first Minister of Public Instruction, that he will enter with confidence on this part of his duties. But with Science it is far different. Our present very meagre and partial scientific arrangements are dislocated and scattered over every existing department of the State, as if with the express object of putting consistency, system, and efficiency out of the question. The first step towards organising this branch of knowledge must be by collecting facts and opinions relating to it. This step can only be taken through the agency of a Royal Commission instructed to give the widest possible scope to its inquiries into everything relating to both Instruction and Investigation in Science.

PROTOPLASM

As regards Protoplasm, in relation to Professor Huxley's Essay on the Physical Basis of Life. Pp. 68. By James Hutchinson Stirling, F.R.C.S., LL.D., Edinburgh. (Blackwood and Sons. 1869.)

WHEN one of the most powerful representatives of the Transcendental school of philosophy, himself possessing a knowledge of biological science, consents to do battle against the modern doctrines concerning Life and its assumed material substratum, *Protoplasm*, we may expect, at least, that the strongest arguments which can be adduced will be brought to bear against the obnoxious theories and their supposed materialistic tendencies. Still more especially must we prepare ourselves for battle *à outrance*, when the champion that steps forward is one who has already grappled so manfully with the "Secret of Hegel" and is otherwise so distinguished a leader amongst the adverse school of thinkers.

Although differing altogether from Prof. Huxley on the main subject of his essay, we find that in one respect the opinions expressed therein are perfectly in accordance with those of Mr. Stirling. With reference to the views enunciated concerning Comte and his writings, Mr. Stirling says: "I acknowledge in Mr. Huxley's every word the ring of a genuine experience." Mr. Stirling is even more severe on the hitherto much-lauded Positive philosopher than Prof. Huxley himself. He says:—

> There is not a sentence in his book that, in the hollow elaboration and windy pretentiousness of its build, is not an exact type of its own constructor. On the whole, indeed, when we consider the little to which he attained, the empty inflation of his claims, the monstrous and maniacal self-conceit into which he was *exalted*, it may appear, perhaps, that charity to M. Comte himself—to say nothing of the world—should induce us to wish that both his name and his works were buried in oblivion.

When the phrase "Physical Basis of Life" was employed, this was intended to convey the notion that there was one kind of matter, that is, one genus—including an almost infinite number of specifically different, though closely related, kinds—common to all living beings: this matter being named Protoplasm. In connection with this doctrine, though based upon other facts, there was a further inference. Life was believed to be a function of living *matter* rather than of living *form*—whether cellular or other. No secondary visible organisation, at all events, was supposed to be needed, though a primary but invisible *molecular* organisation was deemed all essential for the display of vital manifestations. Such a doctrine being once admitted, there is, as Mr. Stirling points out, no logical halting-place short of Prof. Huxley's further conclusion, "*that all vital action whatever, intellectual included, is but the result of the molecular forces of the protoplasm which displays it.*"

Let us see, then, what is to be said in favour of a *matter* of Life, and how far Mr. Stirling's objections to this doctrine are valid.

At the time when the doctrines of Schleiden and Schwann—that the 'cell' was the ultimate morphological unit capable of displaying 'vital' manifestations—were announced, and long after, the simplest independent living things, whether animal or vegetable, were supposed to be unicellular organisms. *Form* and visible organisation were, therefore, regarded by most as necessary for the manifestation of Life: it was supposed that a more or less spherical structure was needed, possessing a distinct cell-wall, with a nucleus, and other cell contents. But, of late years, increasing knowledge and faithful investigation has necessitated much change of doctrine, in regard to the nature of those simplest parts of complex organisms which are capable of displaying a vitality of their own, and in regard to the nature of the simplest independent living things.

Some of the principal modifications in the 'cell' doctrine of organisation are thus sketched by Mr. Stirling himself:—

> The first step taken in resolution of this theory was completed by Max Schultze, preceded by Leydig. This was the elimination of an investing membrane. Such membrane may, and does ultimately form; but, in the first instance, it appears the cell is naked. The second step in the resolution belongs, perhaps, to Brücke, though preceded by Bergman, and though Max Schultze, Kühne, Haeckel, and others ought to be mentioned in the same connection. This step was the elimination, or at least subordination, of the nucleus. The nucleus, we are to understand now, is necessary neither to the division nor to the existence of the cell.
>
> Thus, then, stripped of its membrane, relieved of its nucleus, what now remains of the cell? Why, nothing but what *was* the contained matter, the intracellular matrix, and *is*—Protoplasm.

Thus, then, we seem to reach our elementary life-stuff—our living *matter*. But Mr. Stirling would warn us against coming to any such conclusion—he will not so easily yield. He tells us we are quite wrong if we think we have got rid of the cell and have reduced ourselves to a simple matter of Life. And why? "Because," as he says, "all the great German histologists still hold by the cell, and can hardly open their mouths without mention of it." But, if this be so, after what Mr. Stirling has himself told us, to what else can we ascribe the practice, save to a seeming reality of that reputed fondness in the German mind for courtesy or conventional titles? Some such excuse there may be, but assuredly no other. We would ask Mr. Stirling to reconsider the bearing of the statements which he has himself adduced. In place of the old morphological vital unit—the cell—with its definite characters, we are reduced to a mere naked, non-nucleated bit of protoplasm, as the simplest material substratum adequate to display all those vital manifestations, previously considered to be the essential attributes of the formed elements above mentioned. The power of displaying vital manifestations has, in fact, been transferred from definitely formed morphological units, to utterly indefinite and formless masses of Protoplasm. Instead, therefore, of an obvious *form* of Life, we are reduced to a *matter* of Life, presenting no appreciable morphological characters. It becomes evident, moreover, that if the old term "cell" is still applied to these mere bits of living stuff or protoplasm—not because they are morphological units, but simply because biologists have been compelled to transfer the power of manifesting vital characteristics to such indefinite protoplasmic masses—then this term, thus employed, must be seen to have so entirely lost its old signification, that it can be regarded only as a mere courtesy title. Vital power has obviously been transferred from a definite morphological unit—the cell—to mere living matter, and if any people do persist in still calling a portion of such mere matter by the name of the morphological unit, simply because this was of old also *assumed* to be the vital unit, *we* must not allow such mere confusion in language to confuse us as to the real facts and inferences.

There is another point of view, also, to which Mr. Stirling does not seem to have given an adequate attention. The old doctrine did well enough at a time when the lowest known living things were "unicellular organisms," closely approximating in their characters to those morphological units of which the higher plants and animals are built up. But, since our knowledge has increased—since we have become more familiar with the various living things constituting the lowest groups of Professor Haeckel's third organic kingdom—PROTISTA—the maintenance of such doctrines has become impossible. Do we not now know that although the *Protoplasta* are amœboid animals possessing the old cell characters—that is, having a distinct nucleus, and a definite bounding membrane—there are, nevertheless, adult animals, leading an entirely independent existence, composing the lowest group *Monera*, some of which have no bounding membrane, though they have a nucleus, whilst others, simpler still, are mere bits of protoplasm—naked, non-nucleated, structureless? Yet, such minute, homogeneous, and altogether indefinite bits of protoplasm, are as capable of displaying the fundamental characteristics of life, as are the more definite unicellular organisms to which such attributes were formerly supposed to be restricted. Without visible structure, they nevertheless assimilate materials from their environment, and grow; they constantly vary their shape, and are capable of executing slow movements; though possessing no nucleus, they are able to divide and reproduce their kind.

It seems only fair to mention in this place, that so far back as 1853, before the doctrine as to the constitution of the "cell" had undergone such a modification, or rather, as we should have said, before it had been generally acknowledged that vital manifestations could be displayed by mere bits of protoplasm lacking the supposed necessary elements of *form*, Professor Huxley had put forth a powerful remonstrance against the then all-prevalent "cell theory" of organisation.* His opinions were announced even five years before Virchow, the last great champion of the doctrine, issued his celebrated "Cellular Pathologie." Following, in the main, the doctrine of Wolff and Von Baer, Prof. Huxley contended that the primitive organic substance is a homogeneous plasma, in which a certain differentiation takes place, but that there is no evidence whatever to show that the molecular forces of this living matter ("vital forces" of most modern writers) are, by this differentiation, localised in any one part rather than in any other part—be it cell, or be it intercellular tissue. "Neither is there any evidence," he says, "that any alteration or other influence is exercised by the one over the other; the changes which each subsequently undergoes—though they are in harmony—having no causal connection with one another, but each proceeding, as it would seem, in accordance with the general determining laws of the organism." Whilst believing that the *periplast*—corresponding with the cell-wall and intercellular tissue of other writers—is the seat of all the most important metamorphic processes out of which the various tissues are produced, he also believes that this differentiation is not brought about by any mysterious action on the part of the cell or nucleus, but that it is rather the result of intimate *molecular* changes taking place in the plastic matter itself, after a definitely successive though inexplicable fashion. Prof. Huxley's fundamental position was, in fact, that "the primary differentiation is not a *necessary* preliminary to further organisation—that the cells are not machines by which alone further development can take place; they are rather mere indications of accustomed modes of evolution." This main position he has further illustrated by saying: "We have tried to show that they [the cells] are not instruments, but indications—that they are no more the producers of the vital phenomena than the shells *scattered in orderly lines* along the sea-beach, are the instruments by which the gravitative force of the moon acts upon the ocean. Like these, the cell only marks where the vital tides have been, and how they have acted."

* Brit. and For. Med. Chir. Review, 1853, p. 306.

Certainly the essence of this doctrine is, that the vital forces are "molecular forces"—that they are not dependent upon morphological forms or "cells" and, therefore, that essentially vital manifestations may take place in mere formless living matter—Protoplasm, if you will. As we have just seen, this is precisely the doctrine to which so many other distinguished biologists have now given in their adhesion. They too—Max Schultze, Haeckel, Kühne, and others—have gradually recognised that a something of definite form is no longer necessary: that there are independent living things, even lower in the scale than the old "unicellular organisims": that to constitute one of these, or to constitute a vital unit of one of the higher living things, all that is needed is mere formless, indefinite Protoplasm—or, as Mr. Stirling contemptuously expresses it, a mere "shred" of the matter of Life.

Much of what immediately follows, in Mr. Stirling's essay, we consider to be somewhat irrelevant. We think it has been written under the influence of a misconception as to Professor Huxley's real meaning. Mr. Stirling argues against Protoplasm, on the assumption of its being a substance definite in kind—as definite, we may say, as chloride of sodium—whilst apparently, Professor Huxley's meaning was rather that Protoplasm was the name of a genus of matter, or else of a species including almost innumerable varieties: that it was a proteinacious substance, in fact, of which there might be as many hundreds of isomeric modifications, as there are similar varieties of protein itself.

We regret that we are unable to follow Mr. Stirling into this second part of his essay. It seems to us to be the most interesting part of it, and we recommend our readers to study it for themselves. Much, however, of its reasoning, is, for us, deprived of its seeming cogency, because we cannot agree with Mr. Stirling in his previous conclusion as to the non-existence of a matter of Life. This, as he fully admits, is the really fundamental question about which the difference of opinion exists. And, if we cannot agree with him upon this first point, it is useless for us to follow him into his subsequent reasonings. We cannot, however, but admire his candour when he says:

It is to be acknowledged . . . that Mr. Huxley would be very much assisted in his identification of differences, were but the theories ot the molecularists* on the one hand, and of Mr. Darwin on the other, once for all established. The three modes of theorising indicated, indeed, are not without a tendency to approach one another; and it is precisely their union that would secure a definitive triumph for the doctrine of materialism. Mr. Huxley, as we have seen—though what he desiderates is an autoplastic living *matter* that, produced by ordinary chemical processes, is yet capable of continuing and developing itself into new and higher forms—still begins with the egg. Now, the theory of the molecularists would, for its part, remove all the difficulties that, for materialism, are involved in this beginning; *it would place protoplasm undeniably at length on a merely chemical level; and would fairly enable Mr. Darwin, supplemented by such a life-stuff, to account by natural means for everything like an idea or thought that appears in creation.*

Nothing could be more outspoken and candid than this utterance of Mr. Stirling. He evidently believes that such doctrines of the "molecularists" concerning the new evolution of living things will have long to "await the proof"; but we, on the contrary, firmly believe the time to be not far distant when this will be as much an accredited dictum of science as are the other doctrines of the Correlation of the Physical Forces, and of the Correlation of the Vital and Physical Forces which have been its necessary predecessors. We would ask the Transcendentalists, at least, to speculate upon the possibility of this. Let them learn in the meantime how they may best readjust their doctrines, so that when the time comes in which such change will be absolutely necessary—if their views are to be in accordance with the established truths of science—there may be no sudden bewilderment, no feeling as if the very ground were being swept from underneath their feet. To such a thinker as Mr. Stirling, we should imagine the necessary modification of doctrine would not prove difficult. For, after all, the acceptation, to the fullest extent, of the doctrines concerning Life to which we have been alluding, involves, even from the Transcendentalists, only a somewhat different point of view. So long as Matter, and Force or Spirit, are but two aspects of a something one and indivisible, there is still room for opposite philosophical systems. The old questions may be discussed as earnestly as ever by those who have the leisure and the taste for such ontological inquiries. And, if perchance lured into such discussions, it would often be found that he who was most vehemently charged with Materialism would, from an ontological point of view, prefer to rank himself amongst those who professed the principles of a pure Idealism.

H. CHARLTON BASTIAN

AGRICULTURAL CHEMISTRY

How Crops Grow: A Treatise on the Chemical Composition, Structure, and Life of the Plant, for Agricultural Students. By Samuel W. Johnson, M.A., of Yale College, U.S. Revised, with numerous additions, and adapted for English use, by A. H. Church and W. T. Thiselton Dyer. 1 vol. 8vo., pp. 399. (London, 1869.)

THIS revised edition of an excellent American work ought to find its way into the hands of a very numerous class of youths whose future avocations will require a special acquaintance with the phenomena concerned in the growth of plants—either naturally or under the influence of cultivation—some familiarity with the general structure of plants, with the functions of their several organs and the nature of the various materials which it is the work of vegetation to produce for the food of animals and for numerous other purposes.

It is surprising that in a country where the practice of agriculture is one of the chief sources of wealth and is, directly or indirectly, the means of employing a vast

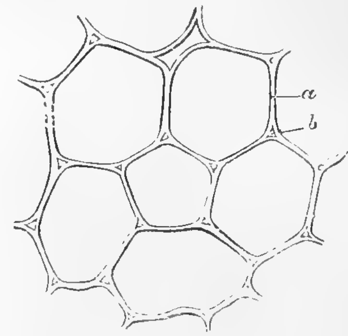


Fig. 1.—Section of cells in a cabbage stem, shewing at *a* the union of the cell-walls and the intercellular spaces at *b*.

amount of capital and labour, very little should have been done towards the scientific elucidation of agricultural practice so as to ensure improvement of the art. Yet such is still the case in this country with some rare exceptions like the experimental farm at Rothamsted, where Messrs. Lawes and Gilbert have done so much to aid the farmer in applying manures and cattle-feeding materials to the best advantage. The Royal Agricultural Society, the Highland Agricultural Society, and the Agricultural College at Cirencester, have also contributed towards the attainment of the same object; but, as a rule, agriculture is practised almost exclusively under the guidance of mere traditional principles and habitual routine, without those engaged in this business having any appreciation of the phenomena and natural laws which govern the growth of plants, even so far as they are known to science. This fact is, in part, no doubt a consequence of the general

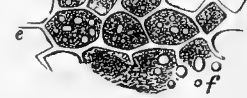


Fig. 2.—Section of a flax-seed, highly magnified, exhibiting *a* cells containing mucilage, *e* cells containing caseine and drops of oil *f*.

disregard of scientific teaching in this country; but it is also referable in some degree to the absence of any organised scientific investigation of plant-life in relation to agriculture, such as that carried on of late years in Germany by the aid of the various governments and with the hearty support of farmers. It is indeed strange that in a country like ours, where agriculture is no longer a mere

* Mr. Stirling so designates those who believe in the possibility of an evolution of living things; or, in other words, those who believe in the possibility of a so-called "spontaneous generation."

gathering of the natural produce of the earth, but has become, more thoroughly than elsewhere, the art of manufacturing food, there should not be an activity in the teaching and prosecution of agricultural science proportionate to that existing where agriculture is in a more primitive state.

However, a beginning is being made in this direction, and it is to aid students in acquiring a knowledge, both technical and scientific, of the less obvious aspects of plant-life, that the volume mentioned above has been written. The classification of the subjects treated of is

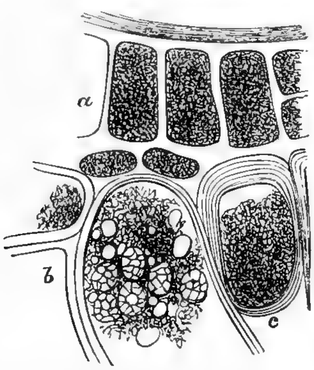


Fig. 3.—Section of outer cells of an oat grain; *a* and *c* containing chiefly caseine, and *b* starch granules.

adapted both to this object and to the wants of the lecture-room, while the illustrations of particular phenomena are in all cases chosen with reference to agricultural practice.

The first division is devoted to the chemical composition of the plant. Here the elementary substances of which plant organs and their materials consist are briefly described, chemical force is defined and the technical language of chemistry explained; then follows an account of the characters and composition of substances which are common products of vegetation in all its forms, of others which are more or less peculiar to certain plants; and lastly, the important subject of the ash of plants is discussed in regard to its general and special character, the extent to which its constituent parts are accidental or essential, and the functions it or its several parts may perform in the growth and development of the plant.

The special organized forms in which the common materials of plants present themselves are well illustrated

Fig. 4.—Forms of various albuminoid grains; *a* from vetch seed; *b* from the castor bean; *c* from flax seed; *d* from *Myrica Cerifera*; and *e* from the aril of the nutmeg.

by numerous woodcuts, of which figs. 1, 2, 3, and 4 will serve as examples.

Copious references to special investigations and monographs are given throughout this division of the book; but unless we have credit for doing even less than has been done in this country, it would seem that the references are too exclusively to German authorities. Only in one instance are the elaborate observations of Lawes and Gilbert mentioned (p. 316), and French experimenters are also but rarely referred to.

One excellent feature of this division consists in the tabulated statements of the amounts of particular constituents contained in various plants, in a form that will be not only instructive to the student, but very useful for reference.

The second division deals with the structure of the plant, the offices of its organs, the nature of the plant cell, the organs of nutrition and of reproduction, with their several functions.

The third division treats generally of the life of the

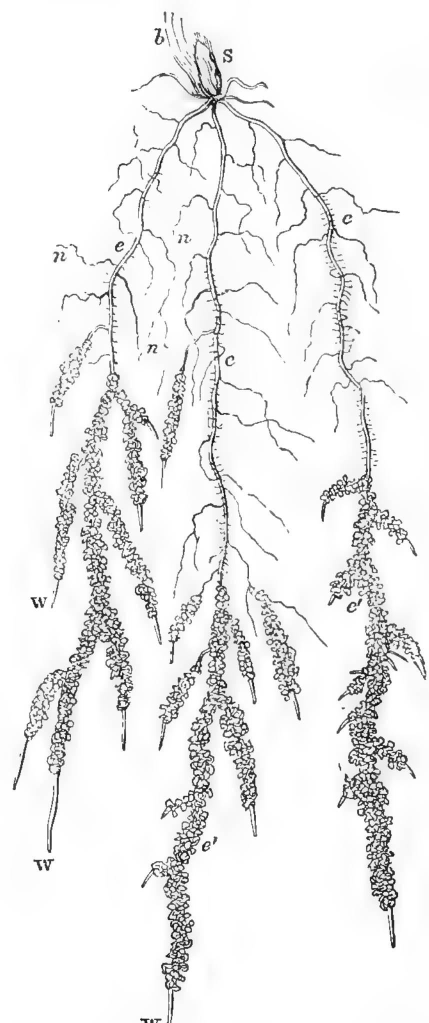


Fig. 5.—Young wheat plant with earth adhering to roots at *e'*, while the root tips W, and the other parts of the primary roots *e*, and of the secondary roots *n* are bare. *S* is the seed and *b* the blade.

plant, describes how the seed germinates, what is the food of plants, how it is taken up, the nature and the motion of the sap and the various forces by which this is influenced, the mode of reproduction, and, lastly, the death of the plant.

Then follows an appendix, with copious tables of the composition of agricultural plants and products, cattle feeding materials, &c., which cannot fail to be useful.

The first and third divisions of this work seem unexceptionable; but the more purely botanical portion might be improved by revision, thus, for instance, at p. 178, cystoliths and crystallised concretions in plant-cells are treated of in a manner which suggests want of familiarity with the microscopic examination of plants, and is calculated to make a beginner suppose all the crystalline concretions of plants are cystoliths of some sort.

At p. 216, it is stated that "In some cases, cells consist only of protoplasm and nucleus, being destitute of cell-walls during a portion or the whole of their existence," and a single line might have been added to explain the exceptional conditions under which these cells—that are not cells—present themselves. Again, at p. 218, after the passage "many cells are altogether empty, and consist of nothing but the cell-wall," there might have been added "after cessation of the functions."

The Screw pine referred to at p. 227 is not a palm; and while the term "imbricated buds" is awkward, the reference, on the same page, to roots that have no buds seems to suggest that buds are generally present on roots inconsistently with what precedes.

Before concluding the notice of this work we must refer to one part of the introductory chapter, where the author very justly condemns as a delusive error the notion that there is any opposition or conflict between science and art, or between theory and practice. "They are, as they ever have been, and ever must be, in the fullest harmony. If they appear to jar or stand in contradiction, it is because we have something false or incomplete in what we call our science or our art; or else we do not perceive correctly; but are misled by the narrowness and aberrations of our vision. It is often said of a machine, that it is good in theory, but fails in practice. This is as untrue as untrue can be. If a machine fail in practice, it is because it is imperfect in theory. It should be said of such a failure—the machine was good, judged by the best theory known to its inventor, but its incapacity to work demonstrates that the theory had a flaw."

It is the boast of some who affect to glory in the sufficiency of practice and to decry theory, that the former is based upon experience, which is the only safe guide. But this is a one-sided view of the matter. Theory is also based upon experience, if it be truly scientific. The vague surmise of an ignorant and undisciplined mind is not theory. Theory, in the proper and good sense, is always a deduction from facts—the best deduction of which the stock of facts in our possession admits. It is the interpretation of facts. It is the expression of the ideas which facts awaken when submitted to a fertile imagination and well-balanced judgment.

If the appreciation of these views were at all equal to their truth, and if the importance of their bearing on the advancement of agriculture were at all adequately recognised, there would probably be little reason to lament the want of attention either on the part of the farmer or the statesman, to the scientific aspects of that pursuit, and less scope for that blatant obstructive, the "practical man," who shuts his eyes and ears against everything his grandfather did not know of, believes only in the folly of wisdom, and is supremely happy in his own ignorance.

OUR BOOK SHELF

A Geographical Handbook of all known Ferns, with Tables to show their Distribution. By K. M. Lyell. (Murray, 1870.)

THIS useful and unpretending, but elegant little volume, consists of two parts. In the first, the genera and species of ferns are enumerated under a number of geographical divisions and subdivisions, which appear to have been judiciously selected. The stations, habitats, and geographical range of each species, are given with much care, and the authorities fully quoted. It thus forms a series of fern catalogues for eighteen divisions of the globe. The second part consists of a systematic list of all the species, with their range of distribution indicated in eighteen columns. Sir William Hooker's arrangements and limitations of species have been followed throughout, and this gives a unity to the work which has its value. But as ferns have generally so wide a range that genera restricted to any one part of the globe are exceptional, we think it would be as well in a work of this nature, to adopt the additional genera of John Smith and others.

We would also suggest for another edition, that a summary of the genera and species might be usefully given at the head of each geographical subdivision. Thus for "Europe Proper" we should have:

1. Woodsia . .	2 species	13. Asplenium . .	17 species
2. Dicksonia . .	1 ,,	14. Scolopendrium .	2 ,,
3. Hymenophyllum	1 ,,	15. Aspidium . .	2 ,,
4. Trichomanes .	1 ,,	16. Nephrodium. .	6 ,,
5. Davallia . .	1 ,,	17. Polypodium. .	4 ,,
6. Cystopteris .	4 ,,	18. Nolhochlæna .	2 ,,
7. Adiantum. .	2 ,,	19. Gymnogramme.	2 ,,
8. Cheilanthes .	3 ,,	20. Osmunda . .	1 ,,
9. Cryptogramme	1 ,,	21. Ophioglossum .	2 ,,
10. Pteris . . .	4 ,,	22. Botrychium . .	5 ,,
11. Lomaria . .	1 ,,		—
12. Woodwardia.	1 ,,		55 species

Such summaries would offer useful materials for comparison, and show at a glance what genera were abundant, rare, or wanting, in a given district. We also think the specific names should have been printed with some difference of type, so as more readily to catch the eye; but these are small matters in so useful a work, which must have been a labour of love to its author, and which no lover of ferns should be without. A. R. W.

Agricultural Analysis.—*Agricultural Qualitative and Quantitative Chemical Analysis.* After E. Wolff, Fresenius, Krocker, and others. Edited by G. C. Caldwell. Pp. vi. and 307. 8vo. (New York: Judd. London: Trübner, 1869.)

MR. CALDWELL (Professor of Agricultural Chemistry in the Cornell University) prepared this compilation for the use of his own pupils and agricultural students generally. Many of the chapters consist of translations from Wolff's "Anleitung," and much more is taken from Fresenius's well-known works on analysis. The metric system of weights and measures, and the centigrade thermometric scale are adopted throughout; and a useful, but not sufficiently extensive set of tables is given at the end of the work.

The merit of a treatise of this kind consists in a proper selection and arrangement of materials; and Prof. Caldwell seems to have performed his task satisfactorily, though, as he admits, somewhat hastily. It is hardly necessary to add, that the book would be quite as much out of place in the hands of an unassisted student as any of those of which it is an adaptation. Under the guidance of a teacher, however, it would undoubtedly be of much service in an agricultural laboratory.

Jahrbuch der Erfindungen. H. Hirzel und H. Gretschel. (Leipzig: Quandt und Händel, 1869.)

THIS is one of a type of books which is not published in this country, either because our publishers are not sufficiently energetic, or because our public has not as yet sufficient interest in science. We may hope that in the yearly volumes of a periodical like NATURE, the general reader will find everything brought down to the latest date, with a sufficiently clear account of all important discoveries. There is needed, however, a sort of "bird's-eye view" book of the year's work, in which a great deal that emerges every week and is of little permanent importance, may be left out, and really considerable discoveries alone given. It is necessary, besides, that the narrative of these discoveries should not be written from the point of view of the man of science, who knows at once where to place them in relation to his previous knowledge. A brief account must be added of that part of what has been accepted or known which the new acquisition illustrates, supplements, or contradicts.

Thus in the description of Wüllner's interesting investigations, confirming those of Frankland and Lockyer as to the alterations which take place in gas spectra when the pressure of the gas is altered, it is necessary to give some account of the previously accepted doctrine of Plücker's "spectra of the first order," and "spectra of the second order." Again, it is useless to describe discoveries relating to circular polarisation without recalling to the general reader the meaning of the term.

We need not attempt in this place to give any account of the new discoveries which are explained in the *Jahrbuch*. It is a closely-printed volume of 416 pages, with 43 illustrations, and its execution appears to us as excellent as its plan. There is a full account of the acquisitions in solar and stellar physics, which have made the year 1868 memorable in science. In molecular physics we have Graham's discussion of the absorption of hydrogen by palladium. In acoustics we have a careful compendium of Regnault's recent laborious and excellent work on the velocity of sound propagation and of the less gigantic experiments by Kundt, which have since been followed out by Schneebeli and Seebeck with promise of bringing us to results more interesting and important from a theoretical point of view than those of Regnault. In heat there is a full account of the investigations, especially with regard to dark heat by Magnus and Dessains. We have all the modifications and improvements in "influence machines," like that of Holtz, which have been realised in the year. For domestic readers there are 25 pages on the sewing machine—single stitch, double stitch, and lock stitch, and 7 more on the knitting machine. Finally, there is a mass of detail, much of it extremely interesting, on the latest chemical discoveries, appropriately introduced by an account of Bunsen's method of washing and filtering precipitates under the pressure of a column of water. W. J.

Mohr's Titrirmethode.—*Lehrbuch der Chemisch-Analytischen Titrirmethode.* Von Dr. Friedrich Mohr. Third and improved edition. Part I. (Brunswick: 1870.)

WE are glad to see that Dr. Mohr's well-known work on volumetric analysis has reached a third edition, and that the author, who well deserves to be called the foster-parent of this branch of chemistry, has taken advantage of the opportunity to recast it entirely. We cannot do better than state his own account of its contents:—

"The work proffers, in the first place, an introduction to the manipulation and use of instrumental appliances, of which the best forms are completely described. Then follows Alkalimetry, under which are comprised all analyses that terminate with the saturation of acids and alkalies. The determination of potash, soda, ammonia, earths, and free acids generally is here described.

"The third section embraces analyses by reduction and oxidation, and especially their subdivision, according as permanganate, dichromate, or iodine solution is added in the final stage. It will be found to contain the determination of chlorine, iodine, bromine, chromic acid, all peroxides, and generally all substances which evolve or combine with oxygen, chlorine, cyanogen, &c. The next section includes analyses by precipitation, the estimation of silver, chlorine, cyanogen, copper, lead, &c.—where a precipitation begins or ends the process.

"The conclusion of the work" (which has not yet reached us) "is the practical part, which teaches the application of individual methods to the entire course of an analysis. Complete methods are stated for the analysis of alkalies, salt-cake, mineral waters, soils, guanos, and the ores of copper, zinc, and iron."

Those of our readers who are acquainted with the previous edition will perceive, from the above account of the contents of the present one, that Dr. Mohr has very much extended his original plan. Accordingly the new *Lehrbuch* contains six additional sheets, and thirteen fresh woodcuts. We need hardly say that the author has executed his work with the detailed care and enthusiasm which are known to characterise him; and the numerous illustrations, for which Messrs. Vieweg are responsible, are as remarkable for sharpness and portraiture as those in most English manuals are deficient in these respects. We shall feel much interested in reading the conclusion of the book, which will supply a want long felt in certain departments of manufacture. For the sake of English experimenters who are not familiar with German, a translation of the entire work, adapted to the prevailing notation, would be very desirable.

THE TRIAL OF THE PYX

THE trial of the Pyx is the formal testing of the coin of the realm, to ensure its being of the requisite weight and fineness. The name is derived from the Pyx, or chest, in which the coins selected for the purpose are contained. The first trial of the Pyx took place in the ninth and tenth years of Edward I. And as the last observance of this ancient ceremony was held during the past week, a few brief notes may not be without interest.

The authority under which the trials were made varied considerably. First, the members of the King's Council, then the Barons of the Exchequer constituted the court, King James I. presiding at one trial. The court now consists of several members of the Privy Council, under the presidency of the Lord High Chancellor and a jury selected from the Hon. Company of Goldsmiths.

Last week the high officers of the Mint assembled at the Treasury, and in their presence the Lord Chancellor charged the jury to examine the coin of the late Master of the Mint, Thomas Graham, F.R.S., and to ascertain whether it was within the latitude of "remedy" allowed by law.

This remedy amounts to 12 grains on each troy pound of gold coin, or to 0·257 grain on each sovereign; and 24 grains on each pound troy of silver coin. Portions cut from standard test-plates were handed to the jury who adjourned to Goldsmiths' Hall. They then opened the Pyx-chest and tested the coin by weight; having done this, a certain number of gold coins were melted into an ingot, which was then assayed; the same process being adopted with the silver coin. In the present instance the Pyx represented a coinage of 14 millions gold and 1 million of silver coin; the verdict of the jury being, that the coin both as to weight and fineness was within the remedy allowed by law. The details, however, were most favourable to the late illustrious Master who has so lately passed away.

An adverse verdict would probably have been followed by no more serious penalty than the forfeiture of the Master's sureties, but it is interesting to note that in the reign of Henry I. the money was so debased as to call for the exemplary punishment of the "Moneyers," while in Anglo-Saxon times the chief officer or Reeve would have been punished by the loss of his hand should he fail to clear himself of the charge of producing false coinage.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Red-Necked Grebe

A FINE specimen of the Red-necked Grebe, picked up alive, but wounded, near Bedford, on the 11th of February, has been sent to me dead, and is being stuffed. It is a female, in winter plumage.

Taunton, Feb. 16 W. TUCKWELL

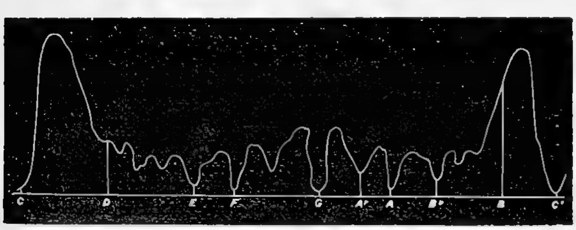
Professor Listing's Amplifier

IN reference to your report of the Boston Natural History Society in NATURE of 27th January, nothing more is requisite to amplify the power of a microscope than to cut off the rims of two or three eye-pieces and insert them in pairs into the ends of a draw tube. Any degree of *amplification* can be obtained whilst the achromatism is preserved. The Huyghenian eye-piece has generally been preferred because the dust accumulating on the inverted eye lens of a positive eye-piece is inconveniently magnified, and obscures the field of view. To those who are desirous of trying Professor Listing's plan, described in your last number, this simple method of mounting may be acceptable.

Lansdowne Crescent, W. ROYSTON PIGOTT

Analogy of Colour and Music

IT appears to me that in the discussion raised by Mr. Barrett's letter in your columns, too little attention has been paid to differences between harmony in music and harmony in colour, which are sufficiently great to show that the coincidences pointed out cannot be regarded as more than *numerical*. Your correspondents have hitherto regarded the subject rather from an optical than a musical point of view. I propose, with your permission, to make a few remarks from the latter stand-point. It is well known that to get a good concord, exact tuning is requisite—*i.e.*, that a slight deviation from the right pitch is sufficient to make a concord into a discord. Moreover, the better the concord, the more intolerable is any appreciable variation of its pitch. Thus unisons, fifths, and octaves are the most sensitive to defective tuning, while the intervals adjacent to them, such as minor seconds, sharp fourths, and sevenths are the harshest discords in the scale. The degree to which this holds will be seen at once by the following diagram, roughly copied from Helmholtz's "Ton-empfindungen." The ordinates of the curve represent the amount of "roughness"—*i.e.*, discordancy corresponding to the intervals marked on the line of abscissæ. The *quality* of tone selected is that of the violin.



A glance at the figure will show that the sounds which produce the most discordant effects with the key-note lie in the immediate neighbourhood of the unison, the octave and the fifth; and further, that a very slight departure from accurate pitch in any concord will provoke a harsh dissonance.

If we now turn to the spectrum, the state of things is widely different. The various colours shade off insensibly one into the other, and in any one colour there is very little, if any, change of tint, except close to its extremities. Thus, then, as far as mere colour goes, any part of any one colour-division produces an equally harmonious effect on the eye, and has an equal claim to be compared to a concord of the gamut.

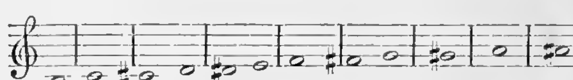
Mr. Barrett, by taking the *central point* of each band of the spectrum as the basis of his comparison, has left this important circumstance out of sight. If we take it into consideration, the result will, I think, be to deprive Mr. Barrett's comparison of any serious importance.

In order to fix our ideas, let us assume that the *mean* red of the spectrum corresponds to *middle C* of the pianoforte with 264 vibrations per second. Taking the limiting and mean wave-lengths as quoted from Prof. Listing by Mr. Barrett, and calculating the number of corresponding sound-vibrations per second, we get the following table:—

	Wave-lengths in 10 millionths of a millimetre.	Number of sound vibrations per second.	Corresponding positions on gamut, with number of vibrations.	
	7234	250	247·5	B
Red	6853	264	264	C
	6472	280 –	282 –	C♯
Orange	6164	293·5		
	5856	309 –	297	D
Yellow	5601·5	323 –	317 –	D♯
	5347	338 +	330	E
Green	5133	352·5	352	F
	4919	368 –	376	F♯
Blue	4737	382 –		
	4555	397 +	396	G
Indigo	4398	411 +		
	4241	427 –	422	G♯
Violet	4104	441 –	440	A
	3967	456 +	469 +	A♯

(+ or – means that the number of vibrations given is a fraction less than ½ above or below the actual amount. In the last column are given the vibration-numbers of the sounds of the chromatic scale.)

By comparing the last two columns it will be seen that Red covers very nearly the portion of the scale between B natural and C sharp: Orange that from C♯ to half-way between D and D♯, and so on. The whole relation is exhibited in the following figure:—



It will be seen that each colour, on the whole, corresponds to *very discordant* intervals in the scale of pitch, and that only at one point in each (and that by no means always the middle point of each band) can it answer to a concord.

What has been said is probably enough to show how little real "correlation" Mr. Barrett's letter has succeeded in establishing. I will now notice the observations on Newton's rings contained in that signed "W. S. Okely." The diameters of these rings vary in lights of different refrangibility, as the *square root* of the wave-lengths,* and therefore they give a spectrum unfit for the purpose to which Mr. Okely applies them. Indeed this is otherwise obvious from the lengths of these diameters given in his letter from a work by Prof. Zannotti. They are as 1, $\sqrt[3]{\frac{8}{9}}$, $\sqrt[3]{\frac{5}{6}}$, $\sqrt[3]{\frac{3}{4}}$, $\sqrt[3]{\frac{2}{3}}$, $\sqrt[3]{\frac{3}{5}}$, $\sqrt[3]{\frac{9}{16}}$, $\sqrt[3]{\frac{1}{2}}$, and therefore, of course, the intervals between them are not as Mr. Okely makes them, $\frac{9}{8}$, $\frac{16}{15}$, $\frac{10}{9}$, $\frac{9}{8}$, $\frac{10}{9}$, $\frac{16}{15}$, $\frac{9}{8}$, but the *cube roots* of these fractions. The interval from red to red $\sqrt[3]{\frac{1}{2}}$, comes out rather less than 1·26, which lies between a major third and a fourth. Mr. Okely's view, which requires the interval from red to red to correspond to an octave, must therefore fall to the ground at once.

Mr. Deas' conception of "millions" of violinists performing "every conceivable sound within" the octave, with a view to the production of the "purest and most ethereal of sounds," seems to me the wildest delusion. Let us suppose the comparatively modest number of thirty-three at work on the interval from middle C to D, so that the first produces 264 vibrations per second, the second 265, the third 266, and so on up to the last, with 297 vibrations. We should obtain a charming variety of *beats*, one a second, two a second, three a second, &c., up to thirty-three a second, those near the higher limit adapted to produce the very worst barking dissonance attainable. Mr. Deas' million-fiddler-power sound, so far from being "pure" or "ethereal," would not be a musical sound at all, but a mere bewildering chaos of noises, likely to drive the inventor himself,

* See Airy's Tracts or Lloyd's Wave Theory of Light.

after one trial of this *spectral* music, to take refuge in the awful solitudes described by Dante:—

" —— dove *il Sol tace.*"

Trinity College, Cambridge SEDLEY TAYLOR

Solar Spots Visible to the Naked Eye

OWING to the smoke and clouds which generally obscure the sky at Glasgow, opportunities to observe the phenomena of the heavens are very rare.

When gazing at the sun this morning (February 16th), I observed on its disc a dark line on the upper half of the disc. In order to convince myself that it was not a delusion, I directed a small pocket telescope (magnifying power about six times linear) and observed several spots. The principal one, as near as I could guess, was 5′ long by 1′ broad.

I would be glad to hear the extent of it from any one of your correspondents, who has measured it, as it must have been of enormous dimensions.

Argyle Street, Glasgow ROBERT M'CLURE

[The dimensions of this spot have been taken by M. Tremischini, who communicated his observations to the French Academy of Sciences at the meeting on the 14th inst., as will be seen from our report of the proceedings further on.—ED.]

Flight of Birds

IN reply to J. H.'s query respecting the flight of the albatross mentioned in a paper of mine on the flight of birds, read at the November meeting of the Norfolk and Norwich Naturalists' Society, I beg to assure him that no bird is able to fly without flapping its wings.

The birds observed by your correspondent's brother were performing one of the most beautiful feats of "wingmanship"—a feat which can only be indulged in, to any extent, by birds possessed of a superabundance of wing-power. The albatross is the great master of this style of flight. Having by repeated flappings of the wings raised itself into the air, and acquired a certain degree of velocity, it brings its body and outstretched wings to such an angle that the pressure of the breeze against its surface is sufficient, or nearly so, to neutralise the force of gravity; it can then "sail" on as long as the momentum lasts. It has been known to sail in this way, with the wings and body perfectly motionless, for more than an hour (though this is an unusually long time), and when the momentum becomes exhausted, a few strokes of the wing are sufficient to restore it. From its frequent indulgence in this sailing flight, the albatross may be said seldom to flap its wings, but certainly cannot be said *never* to do so.

Inserting this explanation may be what J. H. requires.

Norwich, February 7 T. SOUTHWELL

Relations of the State to Scientific Research

AS an old worker in science, and as one who, had Nature not been unkind, might have been eminent, I desire to say a few words on the relations of the State to Scientific Research, a matter likely, I understand, to be the subject of a "Commission."

I take it for granted that it is a natural and proper function of the State to assist and develop labours, the results of which are of national importance, though their market value cannot be satisfactorily ascertained at the time they are being carried on, and therefore they can seldom be immediately remunerative. Of the seed sown to-day, the nation will reap in years to come, long after the sower is dead and gone. It is only right that the nation should help in the sowing. To continue, as of old, merely to reap where others have sown, may seem good in the sight of temporising politicians; but it will not seem so when there comes to be a scanty harvest by reason of the sowers having been feeble and few. It was bad political philosophy when the rulers of the great city overlooked the poor wise man.

But what I wish more particularly to deal with now, is the manner in which the State can best perform this acknowledged duty. In what way can Government most beneficially interfere with the spontaneous energy of original scientific labourers? And this I confess is a matter of no little difficulty. Let us suppose that a certain large sum of money should be set aside, in order to enable a large body of elect men to prosecute original inquiries undisturbed by the bark of the wolf at the door; in other words, let us suppose that Government pays directly for simple scientific investigation. In that case, such elect men will either have to work by the piece, being paid for and by their results when they have brought them forward, or they will have to receive a salary, —to be paid beforehand for work which they will be expected to do. The former plan is, in the first place, impracticable, for the simple reason that the value of the work cannot be satisfactorily gauged,—in the second place it would be most pernicious, and inevitably bring about a deluge of delusions. It would be a gigantic system of prize essays, and we all know that nothing but lies and nonsense proceed out of the mouths of prize essays.

The second plan flies in the face of a fundamental law of human nature. Suppose a hundred men to receive each, say, seven hundred a year, paid quarterly, in order that they may devote themselves to original research. How much of the divine afflatus would list to come into the minds of ninety and nine of them? The morning after they had received their quarter's salary, they would take up their apparatus and sit down by the side of the pool waiting till the waters should be stirred. But the stirring would never come. They would always be paulo-post-futurists; they would ever be writing title-pages of books that would never be seen. They would become admirable critics, keenly sensitive of the follies and errors of the pushing, squabbling, busy, outside mob of unpaid workers; but they, the ninety and nine, would not produce. As they grew old they would ask permission to retain their salaries while they went to live in a land in "which it always seemed afternoon." And when they, the first batch, died, those who succeeded them would boldly declare, as I am told the Fellows of the old Universities do, that they were paid not for the work of which their ability gave promise, but as a reward for having shown themselves worthy of filling the posts. The one man who would do any work at all would be the man who would find the greatest difficulty of getting into the guild, and he, most probably, would only get in by accident after all.

There may be a little exaggeration in the above. As an old man I am prone to be garrulous; but of this I feel above all things assured, that in all the higher functions of the scientific man, in all work that is not mechanical, help from Government or from elsewhere must be given—not directly and in exchange for actual scientific work, but indirectly for some other tasks that do not demand original thought—and given in such a way that active private research may comfortably be carried on at the same time.

In the good old times when the ties which bound together State and Church were not such ticklish ties as now, they used to reward abstract unremunerative learning indirectly by bestowing on it the rich offices of religion. Greek and philosophy took the bishoprics which rightly belonged to piety.

It is possible for science to copy the indirectness and yet to avoid the injustice of this old method; to retain the good while rejecting the evil of such a method of payment *not* by results. How such a plan may be carried out, I will venture with your permission, Sir, to trace in a succeeding letter.

IN SICCO

NOTES

IN the last number of the *Revue des Cours Scientifiques*, M. Alglave again announces further subscriptions to the Sars Fund amounting to 40*l.*, half this sum being a prize awarded by the Zoological Society of Paris in recognition of Sars's works.

M. STAS has been elected director of the Classe des Sciences in the Royal Academy of Belgium.

A DEPUTATION consisting of Earl Fortescue, the Right Hon. C. B. Adderley, Dr. Farr, and others, had an interview with Mr. Shaw-Lefevre at the Board of Trade on Saturday to recommend the legalisation of metric weights and measures in the Post Office, and the legal substitution of metric weights for the troy weight which the Standard Commissioners propose to abolish.

ALL who are interested in the science of ethnology in this country, and their number is daily on the increase, will be glad to learn that the Council of the Royal College of Surgeons are in treaty with Dr. Nicolucci of Nola di Sora, for the purchase of his fine collection of Italian and Greek skulls. This collection, comprising 165 specimens of ancient and modern crania, upon which the celebrated Italian ethnologist's well-known researches into the history of the races of Southern Europe have been mainly founded, will prove a valuable acquisition to the already extensive series in the Hunterian Museum.

MR. SCOTT, the Director of the Meteorological Office, has requested us to state that the French minister of the marine department has made arrangements for hoisting the "drum" signal at all semaphore stations on the French coast, between Dunkerque and Nantes, on receipt of telegraphic intelligence from the Meteorological Office. This signal will, therefore, have the same significance at those ports as on the Elbe and at our own stations. Herr von Freeden in the report of the Norddeutsche Seewarte states, that out of thirty telegrams which might be considered real storm-warnings, there were thirteen instances when the storm followed the same evening or next day; four when it was the previous day (in three of these instances a Sunday intervened and no telegram could be sent), six instances when the weather proved squally, and seven when it remained fine. On two occasions no telegram was received; in one of them on account of an interruption of the wires. As the result of observation, Herr von Freeden considers that the N.W. gales take a southerly direction from Ireland towards the Bay of Biscay, and therefore, do not affect the mouth of the Elbe. He also thinks further investigation would show a connection between them and S.W. winds, further westward, which have been blowing hard before reaching the Channel and have veered to N.W., though not enough to exclude the British Isles from their effect, while in North Germany the compensating current comes from S.E. These facts are of value in showing the utility of the system of "Weather telegraphy" instituted by the Meteorological Committee of the Royal Society.

WE have just received from Herr F. von Hauer the three first sheets of his geological map of the Austro-Hungarian Empire, compiled from the Survey of the Geological Institute; also a map by Mr. Foetterle, showing the occurrence, production, and distribution of coal in Austria. The subsequent sheets of the geological map are in the press and will appear in a few weeks.

AT the dinner of the Foremen Engineers on Saturday, Sir J. Whitworth referring to the depressed state of trade and the signs of improvement that are visible, observed that the progress made during the last forty years in the construction of self-acting machinery has been very remarkable. Twelve shillings a foot was formerly paid for the labour of chipping and filing iron surfaces and it was now done by the planing-machine for a penny. Mr. Bessemer's method of making steel has reduced the cost of some kinds of steel to one-half or one-third what it was. The consumption of coal for manufactures has been reduced more than one-half. The saving on English railways last year by using coal instead of coke was 1,200,000*l*. Mechanical and civil engineers, chemists, and other scientific men, are continually finding out new modes of producing wealth, and the owners of self-acting machinery generally go on improving and increasing their productions, from which those who have fixed incomes derive great advantage. The full employment of such machinery required a free exchange of the produce of all countries. Engineers have so reduced the cost and time of transit that when we have that free exchange, England will probably be the cheapest country in the world to live in. Sir Joseph went on to say, that looking to the immediate future, we may congratulate ourselves on the great opportunity arising for the development of engineering enterprise. The cultivation of land by steam power is greatly on the increase. In regard to the use of horse tramways now being urgently pressed forward, Sir Joseph protested that they were not suited to the present time. He considered that if toll gates were abolished, and roads kept in good order, engineers would soon produce a small, light locomotive that would do its work quietly and efficiently. The consumption of fuel per horse-power is now so small that road locomotives could be employed at far less cost than horses.

WE learn from *L'Institut* that M. Tchibatcheff has published the eighth and last volume of his work on the physical geography, climatology, botany, geology, and palæontology of Asia Minor. The fossils described in this volume belong chiefly to the Devonian tertiary and quaternary series. The Jurassic rocks are represented by only four ammonites found near Angora; the cretaceous rocks by twenty-seven different species, the Devonian by seventy-nine, and the carboniferous by fourteen. The remainder of the 604 species in Asia Minor belong to the tertiary or quaternary rocks. An appendix contains descriptions of fossils found in Devonian strata near Constantinople by Colonel Abdullah Bey. The knowledge of the fossils of Asia Minor, furnished by this work, does not introduce any change in the views previously entertained. The succession of organisms at different epochs has been the same in Asia Minor as in other countries already studied in this respect.

THE *Athenæum* states that the Rev. A. E. Eaton, of Trinity College, Cambridge, is preparing a monograph on the Ephemeridæ, or May-flies, in two parts. Part I. (which will treat of their generic and special nomenclature) is to contain a chronological catalogue of authorities and a synonymic alphabetical index to their works, descriptions of the known genera and species, figures of some organs characteristic of the genera and drawings of many of the species. Part II. will be occupied with an account of the anatomy and development of one or more characteristic British species.

THE Melbourne correspondent of the *Times* remarks, that as a partial set-off against the rabbit and sparrow scourges resulting from ill-considered introductions of European animals to Australia, we now and then light on what seems a new fact in natural history. Among other importations is the ostrich, and being a strong, long-legged bird of uncertain temper, it was deemed unsafe company for children and nurses in the Park. The Acclimatisation Society, therefore, fixed an inquisitive and zoological squatter with the flock of ostriches up country, where he was to look after the birds. Mr. S. Wilson, writing from his station at Longeranong, informs the Society that twelve young birds have been hatched in one nest, and "are getting on nicely." Referring to a common notion, derived from such books as "Goldsmith's Natural History," that the ostrich lays her eggs in the sand, leaving them to be hatched by the heat of the sun, Mr. Wilson says that during the period of incubation —about six weeks—the male and female sit on the nest by turns, both being seldom absent at the same time. As it is not to be assumed that the ostrich departs from its natural domestic arrangements in a new country, we must believe that the female has been hitherto commonly maligned, and the peculiar virtues of her husband altogether overlooked. Another nest of eleven eggs came to no good, as they were laid too early in the winter. The nest is "in a sandy hollow, without grass or rubbish, and the eggs are entirely without any cover."

AT the meeting of the Linnean Society, held Feb. 17, a paper was read by Mr. C. B. Clark on the *Commylenaceæ* of Bengal, of which order he proposes a new system of classification, based on characters of the capsules and the seeds; a paper on the Tree-Ferns of British Sikkim by Mr. Scott, which comprise eight indigenous species belonging to the genera *Cyathea*, *Hemitelia*, and *Alsophila*, an intoxicating drink being obtained by the natives from three different species; and an interesting letter addressed to Dr. Hooker by Dr. Hunce, from Whampoa near Canton, on the Flora of some little investigated districts in that neighbourhood.

WE have to record the decease of Mr. J. E. Sowerby, so well-known in connection with the illustration of botanical works, especially the new edition of the English Flora, edited by Mr. J. Boswell-Syme, now nearly completed.

THE Professorship of Medical Jurisprudence in the Royal College of Surgeons, Ireland, is vacant by the death of Dr. Geoghegan. The election by the Council was to take place on the 17th inst.

DURING the recent discussion on Easter Island at the Royal Geographical Society, it was stated that the layers of guano could be traced and the deposit of each twenty-four hours distinguished. It was calculated that it must have taken 4,000 years to form the 20 feet deposits on the Chincha Islands.

THE town of Dantzic having given a concession of the sewage to Messrs. Aird of Berlin and granted them land for its utilisation, preparations are now being made for carrying out the work under the direction of Mr. Baldwin Latham.

WE have received a report of the Birmingham Natural History and Microscopical Society, which appears to be actively at work, and we notice that Mr. Fiddian read a paper, of which he has sent us a copy, on a "Screw Motion" to remedy the defects in the adjustment of compound microscopes.

THE *Bulletin de la Société d'Acclimatation* contains an article on the use of the skins of the Kangaroo for glove-making, which seems to promise a successful result in this respect, and as furnishing a new source of animal food, as these animals thrive well in Europe.

THE Warsop aero-steam engine has lately been much talked of, and was the other day prominently described in the *Times*. The invention consists essentially in mixing heated air with the steam before its admission into the engine, and results have been obtained which show considerable advantages in the case of certain engines and boilers. *Engineering* referring to the subject remarks, that it is to be regretted that those interested in the invention should not have afforded means of judging whether its application to engines of an economical class would furnish results as satisfactory as those obtained with the defective boiler of the *Fox*.

A CORRESPONDENT in the *Society of Arts Journal* suggests the necessity of a new house for that body, with sufficient room for an extensive library and museum, and adds, that if a hundred of our trade magnates were to set down their names for 1,000*l.* each, the object would be accomplished, and they would be the Greshams of a New Exchange, where art and science would incessantly supplement and extend an ever-growing commerce, and lessen the sphere of human want.

THE *British Medical Journal*, referring to the general impression that the mortality attending the larger operations performed in hospitals has diminished during the last two or three years, suggests that if this be due to really improved plans of treatment, the introduction and free use of carbolic acid may have been one of the measures most influential, and recommends the use of this material in hospitals for preventing accidental contagion.

WE have received, from the Editor, the "Year Book of Photography, and Photographic News Almanac for 1870," containing a number of interesting and useful papers and memoranda.

THE *Journal of the Society of Arts* states that application has been made by the French Government for plans and statements relating to the organisation of the South Kensington Museum and Schools. Schemes based on the same principle and method have, it is understood, been proposed in New York and Boston.

CAPTAIN HANS BUSK has issued a circular in which he expresses his conviction that much may yet be done to diminish loss of life by shipwreck, and suggesting the construction of an experimental steam life-ship of 80 to 100 tons and 50 horse-power, capable of keeping the sea in any weather. An institute has been established for this purpose, and Captain Busk offers a donation of 200*l.* on condition that 1,400*l.* be contributed by the public towards the cost of the vessel during the present month. Upwards of 700*l.* has already been received. Subscriptions are to be sent to the Hon. Secretary, Major Wallace Campbell, or Captain Busk, 3, Garden Court, Temple, or to Messrs. Coutts' Bank.

WE have received from the publishers the January number of the *North British Review*, in which we notice an admirable series of notices of contemporary literature, in which there are among the scientific works referred to Ångström's "Researches on the Solar Spectrum," Ladenburg's "History of Chemistry," Micé's "Report on the Progress of Chemistry," Odling's "Outlines," Foster's "Physical Geography of the Mississippi Valley," Sir J. Lubbock's "Pre-Historic Times," and Newman's "British Moths."

A METHOD of protecting iron from atmospheric influences has been proposed by Messrs. Macmillan and Macgregor, of Dumbarton and Glasgow. They bring melted sulphur into contact with the cold metallic surface to be coated. The sulphur chills and sets into a hard, thin, protecting covering.

MR. RUGGLES states in his report to the International Statistical Congress held at the Hague that, in 1868, the extent of land under wheat, rye, barley, oats, buckwheat, and maize in the United States was upwards of sixty-six million acres, the cereal crop amounting to more than four times as much as was needed for the population of the country.

THE Secretary of State for India announces, at the request of the Governor-General of India, that the Government of India offers a prize of 5,000*l.* for machinery or a method suitable for the separation of the fibre and bark of the Rheea or China-grass from the stem and for separating the fibre from the bark. Dried stems and specimens of the fibre will be suppled on application to the Secretary to the Government of India in the Home Department.

WE learn from a paper by Mr. Bartley in the *Society of Arts Journal*, that Science classes, attended by artizans, were in active operation last year in Chelsea, Hampton, Knightsbridge, Nine Elms, and Wandsworth, the total number of students being 223. The Chelsea School has just been enlarged by the students themselves, working from six to eleven at night. It will accommodate 200, the outlay being 50*l.* for material. This school has now 206 students in all. They are taught by Mr. Bickerton—formerly a cabinet-maker in Gloucestershire—who has distinguished himself as a pupil at the Royal School of Mines. With the exception of a few prizes, no local aid of any kind has been given to the school.

WE have received from Vienna the catalogue of a book-sale which is to take place during March, in which we notice the titles of many valuable works on Natural Science, History, Political Economy, Mathematics, &c., in various languages. Commissions for purchases are received by Messrs. Trübner in London.

A COURSE of eight lectures on English History, from the accession of Edward III. to the date of the Council of Constance, is now being delivered in the Pimlico Rooms, by Archibald Milman, Esq., under the auspices of the Committee for the higher education of women.

A DEPUTATION from the Society of Arts waited upon Earl Grey and Mr. Forster at the Privy Council Office on Friday, to present a memorial representing in reference to the system of State aid to science classes, the hardship of the new orders which are looked upon by teachers as a breach of faith by the department. Lord De Grey promised to consider the matter carefully.

IN consequence of the appointment of Mr. Dyer to the chair of Botany in the College of Science, Dublin, the Professorship of Natural History at the Royal Agricultural College at Cirencester is vacant.

VIEW OF PART OF THE MERCED CAÑON WITH THE VERNAL FALL, YOSEMITE VALLEY, CALIFORNIA
(From Report on Geological Survey of California by C. J. D. Whitney, State-Geologist)

CAÑONS

TO the south of Salt Lake and the Mormon Territory lies a dreary series of plateaux traversed by the Colorado river and its tributaries, which bear their burthen of waters into the Gulf of California. Though this region possesses many considerable streams, it is over large areas a kind of desolate wilderness, for instead of irrigating the ground these streams flow in profound gorges, which serve as natural drains to carry off the water which may fall upon the tablelands. Many fabulous tales have been told of these regions, their natural marvels receiving many amplifications as they came to be rehearsed by Indians, trappers, and adventurous wanderers into the far west. In 1857 the Government of the United States despatched an expedition to explore that little known portion of the Continent, and the report published by the expedition in 1861 gave the first trustworthy and detailed account of the Colorado region. The truth turned out to be almost stranger than the fiction. A vast territory was found to be intersected by ravines leading into the main line of gorges of the Colorado. These ravines, or cañons as they are termed, meander over the table-land as rivers do over alluvial meadows; but they are thousands of feet deep—hundreds of miles long, and so numerous that the country traversed by them is said to be impassable, save to the fowls of the air.

The longest and deepest gorge is the Grand Cañon of the Colorado. Its length was set down by Dr. Newberry as about 300 miles; and its walls were described as rising steeply, sometimes vertically, from the margin of the river which filled the bottom of the ravine, to a height of from 3,000 to 6,000 feet—a line of precipice or natural section which has not yet found its equal on any other part of the globe.* Attention has lately been again called to this remarkable gorge by the interesting narrative in Mr. Bell's "New Tracks in North America," and by the fuller details, as yet only partially published, obtained by an exploring party under Colonel Powell, of the United States army. By successive travellers and Government expeditions the gorges of the Colorado had been reached here and there. The surveying party of 1857-58 mapped them out and gave many admirable drawings of them, but declared the river not to be navigable above the Black Cañon. Profiting by previous failures, and by all the information which he could receive from Indians and others, Colonel Powell conceived the bold idea of attempting the descent of the Colorado in boats. After months of toil and danger, he succeeded in forcing the passage of these forbidding gorges, and emerging safely at their further end. From his survey it appears that the Grand Cañon is 238 miles long, and from 2,500 to 4,000 feet deep. But though this is the longest, there are other ravines of hardly inferior dimensions. On the Green River, Col. Powell's party navigated a series 190 miles long. From where the Green River joins the Colorado, they passed through a succession of cañons for a distance of 256 miles before they came to the Grand Cañon.

HEAD OF MERCED AND TUOLUMNE RIVERS (See Geology of the Sierra Nevada in Whitney's Geological Survey of California, pp. 415—419)

Each cañon has tributary cañons: these again have often also their tributaries. In some places the lateral gorges crowd so closely together where they join the main one, that they are divided by perpendicular walls of rock, which seem so narrow at top as hardly to furnish footing for a man, though in reality large enough to support cathedrals. And these walls shoot 2,000 or 3,000 feet above the river, "while rocks and crags and peaks rise still higher, away back from the river, until they reach an altitude of nearly 5,000 feet." They consist to a large extent of brown, grey, and orange-coloured sandstones, gently inclined or horizontal, beneath which marble and granite in some places have been deeply trenched. In some places

* See Dr. Newberry's section of this gorge in NATURE, No. 6, p. 163.

the walls are so absolutely vertical, that it is impossible to find a pathway between their base and the water. But where, owing to rapids, some portage was necessary, the explorers usually succeeded in carrying their stores, and sometimes even their boats, along the base of the cliffs.

The water of the Colorado River is red and muddy. It receives some tributary streams of clear water, but others are very turbid, particularly one which the expedition appropriately marked as the Dirty Devil. Moreover, after every heavy shower of rain, "cascades of red mud pour over the walls from the red sandstone above, with a fall of hundreds of feet." We await with interest the detailed report which Colonel Powell will furnish of these features of the river.

Dr. Newberry, who described this territory in the report of the former Exploring Expedition above referred to, declared his opinion that, notwithstanding the stupendous scale on which these cañons or ravines had been formed, they were all nevertheless true river-gorges, excavated by the erosive action of running water. Some geologists, as Dr. Foster of Chicago, in his recent work on the Mississippi Valley, have opposed this opinion, and have suggested that "the form and outline of these chasms were first determined by plutonic agency." But Dr. Newberry's explanation has been very generally accepted. He showed that there is nowhere any trace of fracture or disturbance, and that when the Cañon is dry its rocky bottom shows no mark of dislocation. Indeed, when we consider the intricate ramifications of these cañons, so precisely similar to the ordinary outlines of a drainage system over a low flat ground, it seems impossible to conceive of any agency capable of producing such ravines save the streams which flow in them.

But if cañons are merely the results of ordinary river erosion, why do they not occur everywhere? To such a question we may reply that river-ravines do occur everywhere, but it is only where the special circumstances which favour the formation of such ravines are most fully developed that they grow into the depth and length of cañons. What then are these special circumstances?

If we watch what takes place along the course of the rivers of this country, we can mark two kinds of erosion distinctly at work. First there is the river, grinding down the sides and bottom of its channel by sweeping along sand and shingle; and, secondly, there is the action of rain, springs, and frosts perpetually loosening the sides of the water-course, and sending the débris into the river which sweeps it away. If the river were not interfered with by these other subaërial agents, it would in time dig out for itself a gorge with more or less precipitous sides. But in proportion as these agents come into play, the ravine-like character passes into that of a valley with sloping sides. Where river erosion predominates we have ravines, where it is modified by rains and springs, but especially by frosts, we have valleys. Many of our rivers run both through gorges and along valleys, the changes in the nature of their banks being determined by corresponding changes in the nature and grouping of the rocks of which these banks consist, and the greater or less facility with which the rocks have been worn away by the one form of denudation or the other. The conditions needful for the formation of cañons, therefore, appear at present to be chiefly these:—1st. The erosive power of the streams must be greatly in excess of that of the other forms of atmospheric denudation. The rainfall must be small, or, at least, so equally distributed over the year as to reduce pluvial action to a minimum. Frosts must be equally rare and unimportant. The main streams drawing their supplies of water from a distance, either from melted snow or abundant rainfall in the upper parts of their basins, must be maintained in sufficient volume to keep their channels full, either for the whole, or a good part of the year. 2nd. There must be a considerable uniformity in the character of the rock which the stream has first to cut through. It is not necessary that the rock should be soft, but it should preserve for a long distance, and present to the erosive action of the river, the same kind of geological texture and structure. Hence, horizontal or gently undulating strata, as of sandstone, or limestone, offer the greatest facilities for the erosion of cañons, as we know they do in our own country for the formation of ordinary river-ravines. When once the river has excavated its channel so deep that it cannot quit it, the nature of the rock may vary indefinitely without materially altering the aspect of the cañon. Hence on the Colorado, while the upper and chief part of the cañon has been cut through flat sandstone, limestone, and other strata, the lower portion has been excavated in marble and even in granite. 3rd. The country must be sufficiently elevated above the sea, either originally or by subsequent upheaval, to permit of a considerable declivity in its river-channels. The slope must be sufficient, not merely to let the water run off, but to give rise to currents strong enough to sweep along sand and gravel, and to excavate pot-holes. It is by the ceaseless grinding of such detrital material along the bottom of the river that the ravine is slowly deepened. Geologists, although they have constantly recognised this action, have not, perhaps, been always fully aware of its rapidity and extent, partly, no doubt, from the want of reliable data as to the nature and amount of the detritus pushed by rivers along the bottom of their beds. Messrs. Humphreys and Abbot computed that the Mississippi annually pushes into the Gulf of Mexico 750,000,000 cubic feet of gravel and sand, "which would cover a square mile about twenty-seven feet deep." The writer of the present paper was surprised a few years ago to find that the Rhine, after escaping from all its ravines and entering the low country about Bonn, retained force enough to drive along shingle upon its bed. By laying the ear to the bottom of a boat floating down mid-channel, it was easy to hear the grating of the stones as they rolled over each other. Hence we see that a river, which may be perfectly navigable by steamers, may yet have rapidity enough to scour its bed with coarse shingle. The scour will, of course, be greater in proportion to the narrowing of the breadth of the stream and the increase of the slope.

It is mainly this eroding action which, so far as we know at present, has carved out the cañons of the Colorado. These wonderful ravines, meandering as ordinary rivers do, have sunk inch by inch into the country, retaining their original curves and windings, though continually increasing in depth. Unassisted, or aided but feebly, by the other subaërial agents, which, in such a country as ours, tend to break down the walls of ravines; and undisturbed by the inequalities of surface so characteristic of regions that have been under the influence of glacier-ice,* the rivers, probably once much fuller than now, have been allowed to dig out their gorges through the table-lands of the Colorado, and to convert a tract of country, originally, perhaps, green and well-watered, into a dreary desert, intersected by a network of profound impassable ravines.

ARCH. GEIKIE

SCIENTIFIC SERIAL

Revue des Cours Scientifiques, February 19.—This number contains a list of subscribers to the Sars Fund; also a lecture delivered at the Sorbonne by M. A. Cazin, on "Motive Power," in which are described the laws obtaining in regard to those natural forces which are already made available as sources of motive-power and the application of some other forces which may probably be turned to account in the same way as science progresses; for instance, the application by M. Mouchot and Ericsson of solar heat for working a steam engine is especially mentioned as worthy of consideration; and the application of the force of tides suggested by M. Tommasi.

* The absence of any trace of glacial action on the Pacific slope is noted by Whitney (Proc. Acad. Nat. Sciences, California, iii. 272), and by Foster ("Mississippi Valley," p. 338).

ON THE PROGRESS OF PALÆONTOLOGY

ANNIVERSARY ADDRESS DELIVERED BEFORE THE GEOLOGICAL SOCIETY

It is now eight years since, in the absence of the late Mr. Leonard Horner, who then presided over us, it fell to my lot, as one of the secretaries of this society, to draw up the customary Annual Address. I availed myself of the opportunity to endeavour to "take stock" of that portion of the science of biology which is commonly called "palæontology," as it then existed; and discussing one after another the doctrines held by palæontologists, I put before you the results of my attempts to sift the well-established from the hypothetical or the doubtful. Permit me briefly to recall to your minds what those results were.

1. The living population of all parts of the earth's surface which have yet been examined, has undergone a succession of changes which, upon the whole, have been of a slow and gradual character.

2. When the fossil remains which are the evidences of these successive changes, as they have occurred in any two more or less distant parts of the surface of the earth, are compared, they exhibit a certain broad and general parallelism. In other words, certain forms of life in one locality occur in the same general order of succession as, or are *homotaxial* with, similar forms in the other locality.

3. Homotaxis is not to be held identical with synchronism without independent evidence. It is possible that similar, or even identical, faunæ and floræ in two different localities may be of extremely different ages, if the term "age" is used in its proper chronological sense. I stated that "geographical provinces or zones may have been as distinctly marked in the Palæozoic epoch as at present; and those seemingly sudden appearances of new genera and species, which we ascribe to new creation, may be simple results of migration."

4. The opinion that the oldest known fossils are the earliest forms of life, has no solid foundation.

5. If we confine ourselves to positively ascertained facts, the total amount of change in the forms of animal and vegetable life since the existence of such forms is recorded, is small. When compared with the lapse of time since the first appearance of these forms, the amount of change is wonderfully small. Moreover, in each great group of the animal and vegetable kingdoms, there are certain forms which I termed PERSISTENT TYPES, which have remained, with but very little apparent change, from their first appearance to the present time.

7. In answer to the question "What then does an impartial survey of the positively ascertained truths of palæontology testify, in relation to the common doctrines of progressive modification, which suppose that modification to have taken place by a necessary progress from more to less embryonic forms, from more to less generalised types, within the limits of the period represented by the fossiliferous rocks?" I reply, "It negatives these doctrines, for it either shows us no evidence of such modification, or demonstrates such modification as has occurred to have been very slight; and, as to the nature of that modification, it yields no evidence whatsoever that the earlier members of any long continued group were more generalised in structure than the later ones."

I think I cannot employ my last opportunity of addressing you, officially, more properly—I may say more dutifully—than in revising these old judgments with such help as further knowledge and reflection, and an extreme desire to get at the truth, may afford me.

1. With respect to the first proposition, I may remark that whatever may be the case among physical geologists, catastrophic palæontologists are practically extinct. It is now no part of recognised geological doctrine that the species of one formation all died out and were replaced by a bran-new set in the next formation. On the contrary, it is generally, if not universally, agreed that the succession of life has been the result of a slow and gradual replacement of species by species; and that all appearances of abruptness of change are due to breaks in the series of deposits, or other changes in physical conditions. The continuity of living forms has been unbroken from the earliest times to the present day.

2, 3. The use of the word "homotaxis" instead of "synchronism" has not, so far as I know, found much favour in the eyes of geologists. I hope, therefore, that it is a love for scientific caution, and not mere personal affection for a bantling of my own, which leads me still to think that the change of phrase is of importance; and, that the sooner it is made, the sooner shall we get rid of a number of pitfalls which beset the reasoner upon the facts and theories of geology.

One of the latest pieces of foreign intelligence which has reached us is the information that the Austrian geologists have, at last, succumbed to the weighty evidence which M. Barrande has accumulated, and have admitted the doctrine of colonies. But the admission of the doctrine of colonies implies the further admission that even identity of organic remains is no proof of the synchronism of the deposits which contain them.

4. The discussions touching the *Eozoon* which commenced in 1864, have abundantly justified the fourth proposition. In 1862, the oldest record of life was in the Cambrian Rocks; but if the *Eozoon* be, as Principal Dawson and Dr. Carpenter have shown so much reason for believing, the remains of a living being, the discovery of its true nature carried life back to a period which, as Sir William Logan has observed, is as remote from that during which the Cambrian Rocks were deposited, as the Cambrian epoch itself is from the tertiaries. In other words, the ascertained duration of life upon the globe was nearly doubled, at a stroke.

5. The significance of persistent types, and of the small amount of change which has taken place even in those forms which can be shown to have been modified, becomes greater and greater in my eyes, the longer I occupy myself with the biology of the past.

Consider how long a time has elapsed since the Miocene epoch. Yet, at that time, there is reason to believe that every important group in every order of the *Mammalia* was represented. Even the comparatively scanty Eocene fauna yields examples of the orders *Cheiroptera, Insectivora, Rodentia*, and *Perissodactyla;* of *Artiodactyla* under both the Ruminant and the Porcine modifications; of *Carnivora, Cetacea*, and *Marsupialia*.

Or, if we go back to the older half of the Mesozoic epoch, how truly surprising it is to find every order of the *Reptilia*, except the *Ophidia*, represented; while some groups, such as the *Ornithoscelida* and the *Pterosauria*, more specialised than any which now exist, abounded.

There is one division of the *Amphibia* which offers especially important evidence upon this point, inasmuch as it bridges over the gap between the Mesozoic and the Palæozoic formations, often supposed to be of such prodigious magnitude, extending, as it does, from the bottom of the Carboniferous series to the top of the Trias, if not into the Lias. I refer to the Labyrinthodonts. As the address of 1862 was passing through the press, I was able to mention, in a note, the discovery of a large Labyrinthodont, with well-ossified vertebræ, from the Edinburgh coal-field. Since that time eight or ten distinct genera of Labyrinthodonts have been discovered in the carboniferous rocks of England, Scotland, and Ireland, not to mention the American forms described by Principal Dawson and Professor Cope. So that, at the present time, the Labyrinthodont Fauna of the Carboniferous rocks is more extensive and diversified than that of the Trias, while its chief types, so far as osteology enables us to judge, are quite as highly organised. Thus it is certain tha ta comparatively highly organised vertebrate type, such as that of the Labyrinthodonts, is capable of persisting, with no considerable change, through the period represented by the vast deposits which constitute the Carboniferous, the Permian, and the Triassic formations.

The very remarkable results which have been brought to light by the sounding and dredging operations, which have been carried on with such remarkable success by the expeditions sent out by our own, the American, and the Swedish Governments, under the supervision of able naturalists, have a bearing in the same direction. These investigations have demonstrated the existence, at great depths in the ocean, of living animals in some cases identical with, in others very similar to, those which are found fossilised in the white chalk. The *Globigerinæ*, Coccoliths, Coccospheres, Discoliths, in the one are absolutely identical with those in the other; there are identical, or closely analogous, species of Sponges, Echinoderms, and Brachiopods. Off the coast of Portugal, there now lives a species of *Beryx*, which, doubtless, leaves its bones and scales here and there in the Atlantic ooze, as its predecessor left its spoils in the mud of the sea of the Cretaceous epoch.

Many years ago* I ventured to speak of the Atlantic mud as "modern chalk," and I know of no fact inconsistent with the view which Professor Wyville Thomson has advocated, that the modern chalk is not only the lineal descendant of the ancient

* *Saturday Review*, 1858, "Chalk, Ancient and Modern."

chalk, but that it remains, so to speak, in the possession of the ancestral estate; and that from the cretaceous period (if not much earlier) to the present day, the deep sea has covered a large part of what is now the area of the Atlantic. But if *Globigerina*, and *Terebratula caput-serpentis* and *Beryx*, not to mention other forms of animals and of plants, thus bridge over the interval between the present and the Mesozoic periods, is it possible that the majority of other living things underwent a "sea change into something new and strange" all at once?

7. Thus far I have endeavoured to expand, and to enforce by fresh arguments, but not to modify in any important respect, the ideas submitted to you on a former occasion. But when I come to the propositions touching progressive modification, it appears to me, with the help of the new light which has broken from various quarters, that there is much ground for softening the somewhat Brutus-like severity with which I have dealt with a doctrine, for the truth of which I should have been glad enough to be able to find a good foundation, in 1862. So far indeed as the *Invertebrata* and the lower *Vertebrata* are concerned, the facts and the conclusions which are to be drawn from them appear to me to remain what they were. For anything that, as yet, appears to the contrary, the earliest known Marsupials may have been as highly organised as their living congeners; the Permian lizards show no signs of inferiority to those of the present day; the Labyrinthodonts cannot be be placed below the living Salamander and Triton; the Devonian Ganoids are closely related to *Polypterus* and to *Lepidosiren*.

But when we turn to the higher *Vertebrata*, the results of recent investigations, however we may sift and criticise them, seem to me to leave a clear balance in favour of the doctrine of the evolution of living forms one from another. In discussing this question, however, it is very necessary to discriminate carefully between the different kinds of evidence from fossil remains, which are brought forward in favour of evolution.

Every such fossil which takes an intermediate place between forms of life already known, may be said, so far as it is intermediate, to be evidence in favour of evolution, inasmuch as it shows a possible road by which evolution may have taken place. But the mere discovery of such a form does not, in itself, prove that evolution took place by and through it, nor does it constitute more than presumptive evidence in favour of evolution in general. Suppose A, B, C to be three forms, of which B is intermediate in structure between A and C. Then the doctrine of evolution offers four possible alternatives. A may have become C by way of B; or C may have become A by way of B; or A and C may be independent modifications of B; or A, B, and C may be independent modifications of some unknown D. Take the case of the Pigs, the *Anoplotheridæ* and the Ruminants. The *Anoplotheridæ* are intermediate between the first and the last; but this does not tell us whether Ruminants have come from the pigs, or pigs from Ruminants, or both from *Anoplotheridæ*, or whether pigs, Ruminants, and *Anoplotheridæ* alike may not have diverged from some common stock.

But, if it can be shown that A, B, and C exhibit successive stages in the degree of modification, or specialisation, of the same type; and if, further, it can be proved that they occur in successively newer deposits, A being in the oldest, and C in the newest, then the intermediate character of B has quite another importance, and I should accept it without hesitation as a link in the genealogy of C. I should consider the burden of proof to be thrown upon any one who denied C to have been derived from A by way of B; or in some closely analogous fashion. For it is always probable that one may not hit upon the exact line of filiation, and, in dealing with fossils, may mistake uncles and nephews for fathers and sons.

I think it necessary to distinguish between the former and the latter classes of intermediate forms, as *intercalary types* and *linear types*. When I apply the former term I merely mean to say, that as a matter of fact, the form B, so named, is intermediate between the others, in the sense in which the *Anoplotherium* is intermediate between the Pigs and the Ruminants—without either affirming, or denying, any direct genetic relation between the three forms involved. When I apply the latter term, on the other hand, I mean to express the opinion that the forms A, B, and C constitute a line of descent, and that B is thus part of the lineage of C.

From the time when Cuvier's wonderful researches upon the extinct Mammals of the Paris gypsum first made intercalary types known, and caused them to be recognised as such, the number of such forms has steadily increased among the higher Mammalia. Not only do we now know numerous intercalary forms of *Ungulata*, but M. Gaudry's great monograph upon the fossils of Pikermi (which strikes me as one of the most perfect pieces of palæontological work I have seen for a long time) shows us, among the *Primates*, *Mesopithecus* as an intercalary form between the *Semnopitheci* and the *Macaci*; and among the *Carnivora*, *Hyænictis*, and *Ictitherium* as intercalary, or, perhaps, linear, types between the *Viverridæ* and the *Hyænidæ*.

Hardly any order of the higher Mammalia stands so apparently separate and isolated from the rest as that of the *Cetacea*, though a careful consideration of the structure of the fissipede *Carnivora*, or seals, shows in them many an approximation towards the still more completely marine mammals. The extinct *Zeuglodon*, however, presents us with an intercalary form between the type of the seals and that of the whales.

The skull of this great Eocene sea monster, in fact, shows, by the narrow and prolonged interorbital region; the extensive union of the parietal bones in a sagittal suture; the well-developed nasal bones; the distinct and large incisors implanted in premaxillary bones, which take a full share in bounding the fore part of the gape; the two-fanged molar teeth with triangular and serrated crowns, not exceeding five on each side in each jaw; and the existence of a deciduous dentition—its close relation with the seals. While, on the other hand, the produced, rostral form of the snout, the long symphysis and the low coronary process of the mandible, are approximations to the cetacean form of those parts.

The scapula resembles that of the cetacean *Hyperoodon*, but the supra-spinous fossa is larger and more seal-like; as is the humerus, which differs from that of the *Cetacea* in presenting true articular surfaces for the free jointing of the bones of the fore-arm. In the apparently complete absence of hinder limbs, and in the characters of the vertebral column, the *Zeuglodon* lies on the cetacean side of the boundary line; so that, upon the whole, the Zeuglodonts, transitional as they are, are conveniently retained in the cetacean order. And the publication, in 1864, of M. Van Beneden's memoir on the miocene and pliocene *Squalodon*, furnished much better means than anatomists previously possessed, of fitting in another link of the chain which connects the existing *Cetacea* with *Zeuglodon*. The teeth are much more numerous, although the molars exhibit the zeuglodont double fang; the nasal bones are very short, and the upper surface of the rostrum presents the groove, filled up during life by the prolongation of the ethmoidal cartilage, which is so characteristic of the majority of the *Cetacea*.

It appears to me that, just as among the existing *Carnivora*, the walruses and the eared seals are intercalary forms between the fissipede *Carnivora* and the ordinary seals; so the Zeuglodons are intercalary between the *Carnivora*, as a whole, and the *Cetacea*. Whether the Zeuglodonts are also linear types in their relation to these two groups cannot be ascertained, until we have more definite knowledge than we possess at present, respecting the relations in time of the *Carnivora* and the *Cetacea*.

Thus far, we have been concerned with the intercalary types which occupy the intervals between families, or orders, of the same class. But the investigations which have been carried on by Prof. Gegenbaur, Prof. Cope, and myself, into the structure and relations of the extinct reptilian forms of *Dinosauria* and *Compsognatha*, have brought to light the existence of intercalary forms between what have hitherto been always regarded as very distinct classes of the vertebrate sub-kingdom, namely, *Reptilia* and *Aves*. Whatever inferences may, or may not, be drawn from the fact, it is now an established truth that, in many of these *Ornithoscelida*, the hind limbs and the pelvis are much more similar to those of birds than they are to those of reptiles, and that these Bird-reptiles, or Reptile-birds, were more or less completely bipedal.

When I addressed you in 1862, I should have been bold indeed had I suggested that palæontology would before long show us the possibility of a direct transition from the type of the lizard to that of the ostrich. At the present moment we have, in the *Ornithoscelida*, the intercalary type, which proves that transition to be something more than a possibility. But it is very doubtful whether any of the genera of *Ornithoscelida* with which we are at present acquainted are the actual linear types by which the transition from the lizard to the bird was effected. These are, very probably, still hidden from us in the older formations.

Let us now endeavour to find some cases of true linear types, or forms which are intermediate between others because they stand in a direct genetic relation to them. It is no easy matter to find clear and unmistakeable evidence of filiation among fossil animals. For, in order that such evidence should be quite satisfactory, it is necessary that we should be acquainted with all the most important features of the organization of the animals which are supposed to be thus related; and not merely with the fragments upon which the genera and species of the palæontologist are so often based. M. Gaudry has arranged the species of *Hyænidæ*, *Proboscidea*, *Rhinocerotidæ*, and *Equidæ* in their order of filiation from their earliest appearance in the Miocene epoch to the present time, and Professor Rütimeyer has drawn up similar schemes for the Oxen—with what I am disposed to think is a fair and probable approximation to the order of Nature. But as no one is better aware than these two learned, acute, and philosophical biologists, all such arrangements must be regarded as provisional, except in those cases in which, by a fortunate accident, large series of remains are obtainable from a thick and wide-spread series of deposits. It is easy to accumulate probabilities—hard to make out some particular case in such a way that it will stand rigorous criticism.

After much search, however, I think that such a case is to be made out in favour of the pedigree of the Horses.

The genus *Equus* is represented as far back as the latter part of the Miocene epoch; but, in deposits belonging to the middle of that epoch, its place is taken by two other genera, *Hipparion* and *Hipparitherium* (or *Anchitherium*); and, in the lowest Miocene and upper Eocene only the last genus occurs. A species of *Hipparitherium* was referred by Cuvier to the *Palæotheria* under the name of *P. Aurelianense*. The grinding teeth are in fact very similar in shape and in pattern, and in the absence of cement, to those of some species of *Palæotherium*, especially Cuvier's, *Palæotherium minus*, which has been formed into a separate genus, *Plagiolophus*, by Pomel.

But in the fact that there are six full-sized grinders, the first premolar being very small; that the anterior grinders are as large as, or rather larger than, the posterior ones; that the second premolar has an anterior prolongation; and that the posterior molar of the lower jaw has, as Cuvier pointed out, a posterior lobe of much smaller size and different form, the dentition of *Hipparitherium* departs from the type of the *Palæotherium*, and approaches that of the horse.

Again, the skeleton of *Hipparitherium* is extremely equine. M. Christol, who founded the genus, goes so far as to say that the descriptions of the bones of the horse, or the ass, current in veterinary works, would fit those of *Hipparitherium*. And, in a general way, this may be true enough, but there are some most important differences, which, indeed, are justly indicated by the same careful observer. Thus the ulna is complete throughout, and its shaft is not a mere rudiment, fused into one bone with the radius. There are three toes, one large in the middle, and one small on each side. The femur is quite like that of a horse, and has the characteristic fossa above the external condyle. In the British Museum, there is a most instructive specimen of the leg bones, showing that the fibula was represented by the external malleolus and by a flat tongue of bone, which extends up from it on the outer side of the tibia, and is closely ankylosed with the latter bone. The hind toes are three, like those of the fore leg; and the middle metatarsal bone is much less compressed from side to side than in the horse.

In the *Hipparion* the teeth nearly resemble those of the Horses, though the crowns of the grinders are not so long; like those of the Horses they are abundantly coated with cement. The shaft of the ulna is reduced to a mere style ankylosed throughout nearly its whole length with the radius, and appearing to be little more than a ridge on the surface of the latter bone until it is carefully examined. The front toes are still three, but the outer ones are more slender than in *Hipparitherium*, and their hoofs smaller in proportion to that of the middle toe. In the leg, the distal end of the fibula is so completely united with the tibia that it appears to be a mere process of the latter bone, as in the Horses.

In the Horses, finally, the crowns of the grinding teeth become longer, and their patterns are slightly modified; the middle of the shaft of the ulna vanishes, and its proximal and distal ends ankylose with the radius. The phalanges of the two outer toes in each foot disappear, their metacarpal and metatarsal bones being left as the "splints."

The *Hipparion* has large depressions on the face in front of the orbits, like those for the "larmiers" of many ruminants; but traces of these are to be seen in some of the fossil horses from the Sewalik Hills.

When we consider these facts, and the further circumstance that the Hipparions, the remains of which have been collected in immense numbers, were subject, as M. Gaudry and others have pointed out, to a great range of variation, it appears to me impossible to resist the conclusion that the types of the *Hipparitherium*, of the *Hipparion*, and of the ancient Horses constitute the lineage of the modern Horses, the *Hipparion* being the intermediate stage between the other two, and answering to B in my former illustration.

The nature of the process by which the *Hipparitherium* has been converted into the horse is one of specialisation or of more and more complete deviation from what might be called the average form of an ungulate mammal. In the Horses, the reduction of some parts of the limbs, together with the special modification of those which are left, is carried to a greater extent than in any other hoofed mammals. The reduction is less, and the specialisation is less in the *Hipparion*, and still less in the *Hipparitherium*; but yet as compared with other mammals, the reduction and specialisation of parts in the *Hipparitherium* remains great.

Is it not probable, then, that, just as in the Miocene epoch we find an ancestral equine form less modified than the horse, so, if we go back to the Eocene epoch we shall find some quadruped related to the *Hipparitherium*, as *Hipparion* is related to *Equus*, and consequently departing less from the average form?

I think that this desideratum is very nearly, if not quite, supplied by *Plagiolophus*, remains of which occur abundantly in some parts of the upper and middle Eocene formations. The patterns of the grinding teeth of *Plagiolophus* are similar to those of *Hipparitherium*, and they are similarly deficient in cement; but the grinders diminish in size forwards, and the last lower molar has a large hind lobe, convex outwards and concave inwards, as in *Palæotherium*. The ulna is complete and much larger than in any of the *Equidæ*, while it is more slender than in most of the *Palæotheria*. It is fixedly united, but not ankylosed with the radius. There are three toes in the fore-limb, the outer ones being slender, but less attenuated than in the *Equidæ*. The femur is more like that of the *Palæotheria* than that of the horse, and has only a small depression above its outer condyle in the place of the great fossa which is so obvious in the *Equidæ*. The fibula is distinct, but very slender, and its distal end is ankylosed with the tibia. There are three toes on the hind-foot having similar proportions to those on the fore-foot. The principal metacarpal and metatarsal bones are flatter than they are in any of the *Equidæ*.

In its general form, *Plagiolophus* resembles a very small and slender horse, and totally unlike the reluctant, pig-like creature depicted in Cuvier's restoration of his *Palæotherium minus* in the Ossemeus Fossiles.

It would be hazardous to say that *Plagiolophus* is the exact radical form of the Equine quadrupeds; but I do not think there can be any reasonable doubt the latter animals have resulted from the modification of some quadruped similar to *Plagiolophus*.

We have thus arrived at the Middle Eocene formation, and yet have traced back the Horses only to a three-toed stock. But these three-toed forms, no less than the Equine quadrupeds themselves, present rudiments of the two other toes which appertain to what I have termed the "average" quadruped. If the expectation raised by the splints of the horse that, in some ancestor of the horse, these splints would be found to be complete digits, has been verified, we are furnished with very strong reasons for looking for a no less complete verification of the expectation that the three-toed *Plagiolophus*-like "avus" of the horse must have had a five-toed "atavus" at some earlier period.

No such five-toed "atavus," however, has yet made its appearance among the few middle and older Eocene Mammalia which are known.

Another series of closely-affiliated forms, though the evidence they afford is perhaps less complete than that of the Equine series, is presented to us by the *Dichobune* of the Eocene epoch, the *Cainotherium* of the Miocene, and the *Tragulidæ*, or so-called "Muskdeer" of the present day.

The *Tragulidæ* have no incisors in the upper jaw, and only six grinding teeth on each side of each jaw, while the canine is moved up to the outer incisor, and there is a diastema in the lower jaw. There are four complete toes on the hind-foot, but the middle metatarsals usually become, sooner or later, ankylosed into a cannon bone. The navicular and the cuboid unite, and the distal end of the fibula is ankylosed with the tibia.

In *Cainotherium* and *Dichibune* the upper incisors are fully developed. There are seven grinders; the teeth form a continuous series without diastema. The metatarsals, the navicular and cuboid, and the distal end of the fibula, remain free. The *Cainotherium*, also the second metacarpal, is developed, but is much shorter than the third, while the fifth is absent or rudimentary. In this respect it resembles *Anoplotherium secundarium*. This circumstance, and the peculiar pattern of the upper molars in *Cainotherium*, lead me to hesitate in considering it as the actual ancestor of the modern *Tragulidæ*. If *Dichobune* has a four-toed front foot (though I am inclined to suspect it resembles *Cainotherium*) it will be a better representative of the oldest form of the Traguline series. But *Dichobune* occurs in the middle Eocene, and is, in fact, the oldest known artiodactyle mammal. Where, then, must we look for its five-toed ancestor?

If we follow down other lines of recent and tertiary *Ungulata*, the same question presents itself. The pigs are traceable back through the Miocene epoch to the upper Eocene, where they appear in the two well-marked forms of *Hyopotamus* and *Chæropotamus*. But *Hyopotamus* appears to have had only two toes.

Again, all the great groups of the Ruminants, the *Bovidæ*, *Antelopidæ*, *Camelopardalidæ*, and *Cervidæ*, are represented in the Miocene epoch, and so are the camels. The upper Eocene *Anoplotherium*, which is intercalary between the pigs and the *Tragulidæ*, has only two or, at most, three toes. Among the scanty mammals of the lower Eocene formation we have the perissodactyle *Ungulata* represented by *Coryphodon*, *Hyracotherium*, and *Pliolophus*. Suppose for a moment, for the sake of following out the argument, that *Pliolophus* represents the primary stock of the perissodactyles, and *Dichobune* that of the Artiodactyles (though I am far from saying that such is the case) then, we find in the earliest fauna of the Eocene epoch, to which our investigations carry us, the two divisions of the *Ungulata* completely differentiated, and no trace of any common stock of both or five-toed predecessors to either. With the case of the horse before us, justifying a belief in the production of new animal forms by modification of old ones, I see no escape from the necessity of seeking for these ancestors of the *Ungulata* beyond the limits of the tertiary formations.

I could as soon admit special creation, at once, as suppose that the perissodactyles and artiodactyles had no five-toed ancestors. And when we consider how large a portion of the tertiary period elapsed before *Hipparitherium* was converted into *Equus*, it is difficult to escape the conclusion that a large proportion of time anterior to the tertiary must have been expended in converting the common stock of the *Ungulata* into perissodactyles and artiodactyles.

The same moral is inculcated by the study of every other order of tertiary monodelphius *Mammalia*. Each of these orders is represented in the Miocene epoch:—the Eocene formation, as I have already said, contains *Cheiroptera*, *Insectivora*, *Rodentia*, *Ungulata*, *Carnivora*, and *Cetacea*. But the *Cheiroptera* are extreme modifications of the *Insectivora*; just as the *Cetacea* are extreme modifications of the Carnivorous type; and therefore it is to my mind incredible that monodelphous *Insectivora* and *Carnivora* should not have been abundantly developed along with *Ungulata* in the Mesozoic epoch. But, if this be the case, how much farther back must we go to find the common stock of the monodelphous *Mammalia*? As to the *Didelphia*, if we may trust the evidence which seems to be afforded by their very scanty remains, that a Hypsiprymnoid form existed at the epoch of the Trias, side by side with a carnivorous form. At the epoch of the Trias, therefore, the *Marsupialia* must have already existed long enough to have become differentiated into carnivorous and herbivorous forms. But the *Monotremata* are lower forms than the *Didelphia*, which last are intercalary between the *Ornithodelphia* and the *Monodelphia*. To what point of the palæozoic epoch then must we, upon any rational estimate, relegate the origin of the *Monotremata*?

The investigation of the occurrence of the classes and of the orders of the *Sauropsida* in time, points in exactly the same direction. If, as there is great reason to believe, true Birds existed in the Triassic epoch, the ornithoscelidous forms by which Reptiles passed into Birds must have preceded them. In fact, there is even, at present, considerable ground for suspecting the existence of *Dinosauria* in the Permian formations. But in that case Lizards must be of still earlier date. And if the very small differences which are observable between the *Crocodilia* of the older mesozoic formations and those of the present day, furnish any sort of approximation towards an estimate of the average rate of change among the *Sauropsida*; it is almost appalling to reflect how far back in palæozoic times we must go, before we can hope to arrive at that common stock from which the *Crocodilia*, *Lacertilia*, *Ornithoscelida*, and *Plesiosauria*, which had attained so great a development in the Triassic epoch must have been derived.

The *Amphibia* and *Pisces* tell the same story. There is not a single class of vertebrated animals, which, when it first appears, is represented by analogues of the lowest known members of the same class. Therefore, if there is any truth in the doctrine of evolution, every class must be vastly older than the first record of its appearance upon the surface of the globe. But if considerations of this kind compel us to place the origin of vertebrated animals at a period sufficiently distant from the upper Silurian, in which the first Elasmobranchs and Ganoids occur, to allow of the evolution of such fishes as these from a Vertebrate as simple as the *Amphioxus*; I can only repeat that it is appalling to speculate upon the extent to which that origin must have preceded the epoch of the first recorded appearance of vertebrate life.

Such is the further commentary which I have to offer upon the statement of the chief results of palæontology, which I formerly ventured to lay before you.

But the growth of knowledge in the interval makes me conscious of an omission of considerable moment in that statement, inasmuch as it contains no reference to the bearings of palæontology upon the theory of the distribution of life; or takes note of the remarkable manner in which the facts of distribution, in present and past times, accord with the doctrine of evolution —especially in regard to land animals.

That connection between palæontology and geology on the one hand, and the present distribution of terrestrial animals, which so strikingly impressed Mr. Darwin thirty years ago, as to lead him to speak of a "law of succession of types"; and of the wonderful relationship on the same continent between the dead and the living, has recently received much elucidation from the researches of Gaudry, of Rütimeyer, of Leidig, and of Alphonse Milne-Edwards, taken in connection with the earlier labours of our lamented colleague Falconer. And it has been instructively discussed in the thoughtful and ingenious work of Mr. Andrew Murray "On the geographical distribution of mammals."

I propose to lay before you, as briefly as I can, the ideas to which a long consideration of the subject has given rise in my own mind.

If the doctrine of evolution is sound, one of its immediate consequences clearly is, that the present distribution of life upon the globe is the product of two factors: the one being the distribution which obtained in the immediately preceding epoch; and the other, the character and the extent of the changes which have taken place in physical geography between the one epoch and the other. Or, to put the matter in another way—the Fauna and Flora of any given area, in any given epoch, can consist only of such forms of life as are directly descended from those which constituted the Fauna and Flora of the same area, in the immediately preceding epoch; unless the physical geography (under which I include climatal conditions) of the area has been so altered as to give rise to immigration of living forms from some other area.

The evolutionist therefore is bound to grapple with the following problem whenever it is clearly put before him:— Here are the Faunæ of the same area during successive epochs. Show good cause for believing, either that these Faunæ have been derived from one another by gradual modification, or that the Faunæ have reached the area in question by migration from some area in which they have undergone their development.

I propose to attempt to deal with this problem so far as it is exemplified by the distribution of the terrestrial Vertebrata, and I shall endeavour to show you that it is capable of solution in a sense entirely favourable to the doctrine of evolution.

I have, elsewhere,* stated, at length, the reasons which lead me to recognise four primary distributional provinces for the terrestrial Vertebrata in the present world; namely, firstly, the *Novozelanian*, or New Zealand province: secondly, the *Australian* province, including Australia, Tasmania, and the Negrito Islands: thirdly, *Austro-Columbia*, or South America plus North America as far as Mexico; and fourthly, the rest of the world, or *Arctogæa*, in which province America, north of Mexico, constitutes one sub-province; Africa, south of the Sahara, a second; Hindostan a third; and the remainder of the old world a fourth.

* "On the classification and distribution of the Alectoromorphæ." Proceedings of the Zoological Society, 1868.

Now the truth which Mr. Darwin perceived and promulgated as "the law of the succession of types" is, that in all these provinces the animals found in Pliocene or Pleistocene deposits are closely affined to those which now inhabit the same provinces, and that conversely, the forms characteristic of other provinces are absent. North and South America, perhaps, present one or two exceptions to the last rule, but they are readily susceptible of explanation. Thus, in Australia, the later tertiary Mammals are Marsupials (possibly with exception of the Dog and a Rodent or two, as at present). In Austro-Columbia the later tertiary Fauna exhibits numerous and varied forms of Platyrhine apes, Rodents, Cats, Dogs, Stags, *Edentata*, and Opossums; but, as at present, no Catarhine apes, no Lemurs, no *Insectivora*, Oxen, Antelopes, Rhinoceroses or *Didelphia* other than opossums. And, in the widespread Arctogæal province, the Pliocene and Pleistocene Mammals belong to the same groups as those which now exist in the province. The law of succession of types, therefore, holds good for the present epoch as compared with its predecessor. Does it equally well apply to the Pliocene Fauna when we compare it with that of the Miocene epoch? By great good fortune an extensive Mammalian Fauna of this epoch has now become known, in four very distant portions of the Arctogæal province which do not differ greatly in latitude. Thus Falconer and Cautley have made known the Fauna of the sub-Himalayas and the Perim Islands; Gaudry that of Attica; many observers that of Central Europe and France; Leidig, that of Nebraska on the eastern flank of the Rocky Mountains. The results are very striking. The total Miocene Fauna comprises many genera and species of Catarhine apes, of Bats, of *Insectivora*, of Arctogæal types of *Rodentia*, of *Proboscidea*, of Equine Rhinocenti, and Tapirine quadrupeds; of cameline, bovine, antelopine, cervine, and traguline Ruminants; of Pigs and Hippopotamuses; of *Viverridæ* and *Hyænidæ* among other *Carnivora;* with *Edentata* allied to the Arctogæal *Orycteropus* and *Manis*, and not to the Austro-Columbian Edentates. The only type present in the Miocene, but absent in the existing, Fauna of Eastern Arctogæa is that of the *Didelphidæ*, which, however, remains in North America.

But it is very remarkable, that while the Miocene Fauna of the Arctogæal Province, as a whole, is of the same character as the existing Fauna of the same province as a whole, the component elements of the Fauna were differently associated. In the Miocene epoch, North America possessed Elephants, Horses, Rhinoceroses, and a great number and variety of Ruminants and Pigs which are absent in the present indigenous Fauna. Europe had its Apes, Elephants, Rhinoceroses, Tapirs, Musk-deer, Giraffes, Hyenas, great Cats, Edentates, and opossum-like Marsupials, which have equally vanished from its present Fauna. And in Northern India, the African types of Hippopotamuses, Giraffes, and Elephants were mixed up with what are now the Asiatic types of the latter and with Camels, Semnopithecine and Pithecine apes of no less distinctly Asiatic forms.

In fact, the Miocene Mammalian Fauna of Europe and the Himalayan regions contains associated together the types which are now separately located in the South African and Indian sub-provinces of Arctogæa. Now there is every reason to believe, on other grounds, that both Hindostan, south of the Ganges, and Africa, south of the Sahara, were separated by a wide sea from Europe and North Asia, during the middle and upper Eocene epochs. Hence it becomes highly probable that the well-known similarities and no less remarkable differences between the present Faunæ of India and South Africa have arisen in some such fashion as the following. Sometime during the Miocene epoch, possibly when the Himalayan chain was elevated, the bottom of the nummulitic sea was upheaved and converted into dry land, in the direction of a line extending from Abyssinia to the mouth of the Ganges. By this means, the Dekhan on the one hand, and South Africa on the other, became connected with the Miocene dry land and with one another. The Miocene Mammals spread gradually over this intermediate dry land, and if the condition of its eastern and western ends offered as wide contrasts as the valleys of the Ganges and Arabia do now, many forms which made their way into Africa must have been different from those which reached the Dekhan, while others might pass into both these sub-provinces.

That there was a continuity of dry land between Europe and North America during the Miocene epoch, appears to me to be a necessary consequence; the fact that many genera or terrestrial Mammals such as *Castor, Hystrix, Elephas, Mastodon, Equus, Hipparion, Hipparitherium, Rhinoceros, Cervus, Amphicyon, Hyænarctos*, and *Machairodus*, are common to the Miocene formations of the two areas, and have as yet been found (except perhaps *Hipparitherium*) in no deposit of earlier age. Whether this connection took place by the east, or by the west, or by both sides of the old world, there is at present no certain evidence, and the question is immaterial to the present argument; but, as there are good grounds for the belief that the Australian province and the Indian and South African sub-provinces were separated by sea from the rest of Arctogæa before the Miocene epoch, so it has been rendered no less probable by the investigations of Mr. Carrick Moore and Prof. Duncan that Austro-Columbia was separated by sea from North America, during a large part of the Miocene epoch.

It is unfortunate that we have no knowledge of the Miocene Mammalian Fauna of the Australian and Austro-Columbian provinces. But seeing that not a trace of a Platyrhine ape, of a Procyonine carnivore, of a characteristically South American Rodent, of a Sloth, an Armadillo, or an Ant-eater, has yet been found in Miocene deposits of Arctogæa, I cannot doubt that they already existed in the Miocene Austro-Columbian province.

Nor is it less probable that the characteristic types of Australian Mammalia were already developed in that region in Miocene times.

But Austro-Columbia presents difficulties from which Australia is free—*Camelidæ* and *Tapiridæ* are now indigenous in South America as they are in Arctogæa, and among the Pliocene Austro-Columbian mammals, the Austro-Columbian genera *Equus, Mastodon*, and *Machairodus* are numbered. Are these post-Miocene immigrants, or præ-Miocene natives?

Still more perplexing are the strange and interesting forms *Toxodon, Macrauchenia*, and *Typotherium;* and a new Anoplotheriod mammal (*Omalodotherium*) which Dr. Cunningham sent over to me some time ago from Patagonia. I confess I am strongly inclined to surmise that these last, at any rate, are remnants of the population of Austro-Columbia before the Miocene epoch, and were not derived from Arctogæa by way of the north and east.

The fact that this immense Fauna of Miocene Arctogæa is now fully and richly represented only in India and South Africa, while it is shrunk and depauperised in North Asia, Europe, and North America, becomes at once intelligible, if we suppose that India and South Africa had but a scanty mammalian population before the Miocene immigration, while the conditions were highly favourable to the new comers. It is to be supposed that these new regions offered themselves to the Miocene Ungulates as South America and Australia offered themselves to the cattle, sheep, and horses of modern colonists. But after these great areas were thus peopled came the Glacial epoch, during which the excessive cold, to say nothing of depression and ice-covering, must have almost depopulated all the northern parts of Arctogæa, destroying all the higher mammalian forms except those which, like the elephant and rhinoceros, could adjust their coats to the altered condition. Even these must have been driven away from the greater part of the area. Only those Miocene mammals which had passed into Hindostan and into South Africa would escape decimation by these changes in the physical geography of Arctogæa. And when the northern hemisphere passed into its present condition, these lost tribes of the Miocene Fauna were hemmed by the Himalayas, the Sahara, the Red Sea, and the Arabian deserts, within their present boundaries.

Now, on the hypothesis of evolution, there is no sort of difficulty in admitting that the differences between the Miocene forms of the Mammalian Fauna and those which exist now, are the results of gradual modification; and since such differences in distribution as obtain are readily explained by the changes which have taken place in the physical geography of the world since the Miocene epoch, it is clear that the result of the comparison of the Miocene and present Faunæ is distinctly in favour of evolution. Indeed, I may go further. I may say that the hypothesis of evolution explains the facts of Miocene, Pliocene, and Recent distribution; and that no other supposition even pretends to account for them. It is, indeed, a conceivable supposition that every species of Rhinoceros and every species of Hyæna, in the long succession of forms between the Miocene and the present species, was separately constructed out of dust, or out of nothing, by supernatural power. But until I receive distinct evidence of the fact, I refuse to run the risk of insulting any sane man by supposing that he seriously holds such a notion.

Let us now take a step further back in time, and inquire into the relations between the Miocene Fauna and its predecessor of the upper Eocene formation.

Here it is to be regretted that our materials for forming a judgment are nothing to be compared in point of extent, or variety, with those which are yielded by the Miocene strata. However, what we do know of this upper Eocene Fauna of Europe, gives sufficient positive information to enable us to draw some tolerably safe inferences. It has yielded representatives of *Insectivora*, of *Cheiroptera*, of *Rodentia*, of *Carnivora*, of Artiodactyle, and Perissodactyle *Ungulata* and of opossum-like Marsupials. No Australian type of marsupial has been discovered in the upper Eocene, nor any Edentate mammal. The genera (except in the case perhaps of some of the *Insectivora*, *Cheiroptera*, and *Rodentia*) are different from those of the Miocene epoch, but present remarkable general similarity to the Miocene and recent genera. In several cases, as I have already shown, it has now been clearly made out that the relation between the Eocene and Miocene forms is such that the Eocene form is the least specialised; while its Miocene ally is more so, and the specialisation reaches its maximum in the recent forms of the same type.

So far as the Upper Eocene and the Miocene Mammalian Faunæ are comparable, their relations are such as in no way to oppose the hypothesis that the older are the progenitors of the more recent forms, while, in some cases, they distinctly favour that hypothesis. The period in time and the changes in physical geography, represented by the nummulitic deposits, are undoubtedly very great, while the remains of middle Eocene and older Eocene Mammals are comparatively few. The general facies of the middle Eocene Fauna, however, is quite that of the upper.

The older Eocene, pre-nummulitic mammalian Fauna, contains Bats, two genera of *Carnivora*, three genera of *Ungulata* (probably all perissodactyle), and a didelphid marsupial. All these forms, except perhaps the Bat and the Opossum, belong to genera which are not known to occur out of the lower Eocene. The *Coryphodon*, however, appears to have been allied to the Miocene and later Tapirs; while *Phiolophus*, in its skull and dentition, curiously partakes of both artiodactyle and perissodactyle characters. The third trochanter upon its femur, and its three-toed hind foot, however, appear definitely to fix its position in the latter division.

There is nothing, then, in what is known of the older Eocene mammals of the Arctogæal province to forbid the supposition that they stood in an ancestral relation to those of the Calcaire Grossier and the Gypsum of the Paris basin; and that our present fauna, therefore, is directly derived from that which already existed in Arctogæa at the commencement of the Tertiary period. But if we now cross the frontier between the Cainozoic and the Mesozoic Faunæ, as they are preserved within the Arctogæal area, we meet with an astounding change, and what appears to be a complete and unmistakeable break in the line of biological continuity.

Among the twelve or fourteen species of Mammalia which are said to have been found in the Purbecks, not one is a member of the orders *Cheiroptera*, *Rodentia*, *Ungulata*, or *Carnivora*, which are so well represented in the Tertiaries. No *Insectivora* are certainly known, nor any opossum-like Marsupials. Thus there is a vast negative difference between the Cainozoic and the Mesozoic mammalian Faunæ of Europe. But there is a still more important positive difference, inasmuch as all these Mammalia appear to be Marsupials belonging to Australian groups; and thus appertaining to a different distributional province from the Eocene and Miocene marsupials, which are Austro-Columbian. So far as the imperfect materials which exist enable a judgment to be formed, the same law appear to have held good for all the earlier mesozoic Mammalia. Of the Stonesfield slate mammals, one, *Amphitherium*, has a definitely Australian character; one, *Phascolotherium*, may be either Dasyurid or Didelphine; of a third, *Stereognathus*, nothing can at present be said. The two mammals of the Trias, also, appear to belong to Australian groups.

Everyone is aware of the many curious points of resemblance between the marine Fauna of the European Mesozoic rocks and that which now exists in Australia. But if there was this Australian facies about both the terrestrial and the marine Faunæ of Mesozoic Europe, and if there is this unaccountable and immense break between the Fauna of Mesozoic and that of Tertiary Europe, is it not a very obvious suggestion that, in the Mesozoic epoch, the Australian province included Europe, and that the Arctogæal province was contained within other limits? The Arctogæal province is at present enormous, while the Australian is relatively small. Why should not these proportions have been different during the Mesozoic epoch?

Thus, I am led to think that by far the simplest and most rational mode of accounting for the great change which took place in the living inhabitants of the European area at the end of the Mesozoic epoch, is the supposition that it arose from a great change in the physical geography of the globe, whereby an area long tenanted by Cainozoic forms was brought into such relations with the European area, that migration from the one to the other became possible, and took place on a great scale.

This supposition relieves us, at once, from the difficulty in which we were left, some time ago, by the arguments which I used to demonstrate the necessity of the existence of all the great types of the Eocene epoch in some antecedent period.

It is this Mesozoic continent (which may well have lain in the neighbourhood of what are now the shores of the North Pacific Ocean), which I suppose to have been occupied by the Mesozoic *Monodelphia*; and it is in this region that I conceive they must have gone through the long series of changes by which they were specialised into the forms which we refer to different orders. I think it very probable that what is now South America may have received the characteristic elements of its Mammalian Fauna during the Mesozoic epoch; and there can be little doubt that the general nature of the change which took place at the end of the Mesozoic epoch in Europe, was the upheaval of the eastern and northern regions of the Mesozoic sea bottom into a westward extension of the Mesozoic continent, over which the Mammalian Fauna, by which it was already peopled, gradually spread. This invasion of the land was prefaced by a previous invasion of the Cretaceous sea by modern forms of mollusca and fish.

It is easy to imagine how an analogous change might come about in the existing world. There is, at present, a great difference between the Fauna of the Polynesian Islands and that of the west coast of America. The animals which are leaving their spoils in the deposits now forming in these localites are widely different. Hence, if a gradual shifting of the deep sea, which at present bars migration, between the easternmost of these islands and America took place to the westward, while the American side of the sea-bottom was gradually upheaved, the palæontologist of the future would find, over the Pacific area, exactly such a change as I am supposing to have occurred in the North Atlantic area at the close of the Mesozoic period. An Australian Fauna would be found underlying an American Fauna, and the transition from the one to the other would be as abrupt as that between the Chalk and lower Tertiaries. And as the drainage area of the newly-formed extension of the American continent gave rise to rivers and lakes, the mammals mired in their mud would differ from those of like deposits on the Australian side just as the Eocene mammals differ from those of the Purbecks.

How do similar reasonings apply to the other great change of life—that which took place at the end of the Palæozoic period?

In the Triassic epoch, the distribution of the dry land and of terrestrial vertebrate life appears to have been, generally, similar to that which existed in the Miocene epoch; so that the Triassic continents and their Faunæ seem to be related to the Mesozoic lands and their Faunæ, just as those of the Miocene epoch are related to those of the present day.

In fact, as I have recently endeavoured to prove to the Society, there was an Arctogæal continent and an Arctogæal province of distribution in Triassic times as there is now. And the *Sauropsida* and *Marsupialia* which constituted that fauna were, I doubt not, the progenitors of the *Sauropsida* and *Marsupialia* of the whole Mesozoic epoch.

Looking at the present terrestrial fauna of Australia, it appears to me to be very probable that it is essentially a remnant of the Fauna of the Triassic, or even of an earlier, age; in which case Australia must at that time have been in continuity with the Arctogæal continent.

But now comes the further inquiry, Where was the highly-differentiated Sauropsidan Fauna of the Trias in Palæozoic times? The supposition that the Dinosaurian, Crocodilian, Dicynodontian, and Plesiosaurian types were suddenly created at the end of the Permian epoch may be dismissed, without further consideration, as a monstrous and unwarranted assumption. The supposition that all the types were rapidly differentiated out of *Lacertilia*, in the time represented by the passage from the

Palæozoic to the Mesozoic formation, appears to me to be hardly more credible; to say nothing of the indications of the existence of Dinosaurian forms in the Permian rocks, which have already been obtained.

For my part I entertain no sort of doubt that the reptiles, birds, and mammals of the Trias are the direct descendants of reptiles, birds, and mammals which existed in the latter part of the Palæozoic epoch, but not in any area of the present dry land which has yet been explored by the geologist.

This may seem a bold assumption, but it will not appear unwarrantable to those who reflect upon the very small extent of the earth surface which has hitherto exhibited the remains of the great Mammalian Fauna of the Eocene times. In this respect the Permian land vertebrate Fauna appears to me to be related to the Triassic, much as the Eocene is to the Miocene. Terrestrial reptiles have been found in Permian rocks only in three localities: in some spots of France and recently of England, and over a more extensive area in Germany. Who can suppose that the few fossils yet found in these regions give any sufficient representation of the Permian Fauna?

It may be said that the Carboniferous formations demonstrate the existence of a vast extent of dry land in the present dry land area; and that the supposed terrestrial Palæozoic vertebrate Fauna ought to have left its remains in the coal measures, especially as there is now reason to believe that much of the coal was formed on dry land. But if we consider the matter more closely, I think that this apparent objection loses its force. It is clear that during the Carboniferous epoch, the vast area of land which is now covered by coal measures must have been undergoing a gradual depression. The dry land thus depressed must, therefore, have existed, as such, before the Carboniferous epoch—in other words, the Devonian times—and its terrestrial population may never have been other than such as existed during the Devonian, or some previous epoch, although much higher forms may have been developed elsewhere.

Again, let me say that I am making no gratuitous assumption of inconceivable changes. It is clear that the enormous area of Polynesia is, on the whole, an area over which depression has taken place to an immense extent. Consequently a great continent, or assemblage of sub-continental masses of land, must have existed at some former time, and that at a recent period, geologically speaking, in the area of the Pacific. But if that continent had contained mammals, some of them must have remained to tell the tale; and as it is well known that these islands have no indigenous *Mammalia*, it is safe to assume that none existed. Thus, midway between Australia and South America, each of which possesses an abundant and diversified Mammalian Fauna, a mass of land, which may have been as large as both put together, must have existed without a Mammalian inhabitant. Suppose that the shores of this great land were fringed, as those of tropical Australia are now, with belts of mangroves which would extend landwards on the one side, and be buried beneath littoral deposits on the other side, as depression went on; and great beds of mangrove lignite might accumulate over the sinking land. Let upheaval of the whole now take place, in such a manner as to bring the newly emerging land into continuity with the South American, or Australian, continent; and, in course of time, it would be peopled by an extension of the Fauna of one of these two regions—just as I imagine the European Permian dry land to have been peopled.

I see nothing whatever against the supposition that distributional provinces of terrestrial life existed in the Devonian epoch, inasmuch as M. Barrande has proved that they existed, much earlier. I am aware of no reason for doubting that, as regards the grades of terrestrial life contained in them, one of these may have been related to another as New Zealand is to Australia, or as Australia is to India, at present. Analogy seems to me to be rather in favour of, than against, the supposition that while only Ganoid fishes inhabited the fresh waters of our Devonian land, *Amphibia* and *Reptilia*, or even higher forms, may have existed, though we have not yet found them. The earliest Carboniferous *Amphibia* now known, such as *Anthracosaurus*, are so highly specialised, that I can by no means conceive that they have been developed out of piscine forms in the interval between the Devonian and the Carboniferous periods, considerable as that is. And I take refuge in one of two alternatives. Either they existed in our own area during the Devonian epoch and we have simply not yet found them; or, they formed part of the population of some other distributional province of that day; and only entered our area by migration, at the end of the Devonian epoch. Whether *Reptilia* and *Mammalia* existed along with them is to me, at present, a perfectly open question, which is just as likely to receive an affirmative, as a negative, answer from future inquirers.

Let me now gather together the threads of my argumentation into the form of a connected hypothetical view of the manner in which the distribution of living and extinct animals has been brought about.

I conceive that distinct provinces of the distribution of terrestrial life have existed since the earliest period at which that life is recorded, and, possibly, much earlier; and I suppose, with Mr. Darwin, that the progress of modification of terrestrial forms is more rapid in areas of elevation than in areas of depression. I take it to be certain that Labyrinthodont *Amphibia* existed in the distributional province which included the dry land depressed during the Carboniferous epoch: and I conceive that, in some other distributional provinces of that day, which remained in the condition of stationary, or of increasing dry land, the various types of the terrestrial *Sauropsida* and of the *Mammalia* were gradually developing.

The Permian epoch marks the commencement of a new movement of upheaval in our area, which attained its maximum in the Triassic epoch when dry land existed in North America, Europe, Asia, and Africa as it does now. Into this great new continental area the mammals, birds, and reptiles, developed during the Palæozoic epoch, spread, and formed the great Triassic Arctogæal province. But, at the end of the Triassic period, the movement of depression recommenced in our area, though it was doubtless balanced by elevation elsewhere; modification and development, checked in the one province, went on in that elsewhere; and the chief forms of mammals, birds, and reptiles, as we now know them, were evolved, and peopled the Mesozoic continent, from which I conceive Australia to have become separated as early as the end of the Triassic epoch, or not much later. This Mesozoic continent must, I conceive, have lain to the east, about the shores of the North Pacific and Indian Oceans; and I am inclined to believe that it continued along the eastern side of the Pacific area to what is now the province of Austro-Columbia, the characteristic Fauna of which is probably a remnant of the population of the latter part of this period.

Towards the latter part of the Mesozoic period, the movement of upheaval around the shores of the Atlantic once more recommenced, and was very probably accompanied by a depression around those of the Pacific. The Vertebrate Fauna elaborated in the Mesozoic continent, moved westward and took possession of the new lands which gradually increased in extent up to, and in some directions after, the Miocene epoch.

It is in favour of this hypothesis, I think, that it is consistent with the persistence of a general uniformity of the directions of the great masses of land and water. From the Devonian period, or earlier, to the present day, the four great oceans, Atlantic, Pacific, Arctic, and Antarctic, may have occupied their present positions, and only their coasts and channels of communication have undergone an incessant alteration. And, finally, the hypothesis I have put before you requires no supposition that the rate of change in organic life has been either greater, or less, in ancient times than it is now; nor any assumption, either physical or biological, which has not its justification in analogous phenomena of existing nature.

I have now only to discharge the last duty of my office, which is to thank you, not only for the patient attention with which you have listened to me so long to-day; but also for the uniform kindness with which, for the past two years, you have rendered my endeavours to perform the important, and often laborious, functions of your President, a pleasure, instead of a burden. T. H. HUXLEY

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Feb. 17.—The following papers were read: "Account of the Great Melbourne Telescope from April 1868, to its commencement of operations in Australia in 1869." By Albert le Sueur. The author stated that the building in which the telescope is placed is rectangular, 80 feet long meridionally by 25 wide, with walls 11 feet high. Of the meridional length, the telescope-room occupies the north 40 feet; the next 12 feet are appropriated to the polishing machine, crane, and engine; the remaining 28 feet are divided into two rooms, one of which is at present used as an office, the other, 25 by 14, is intended for a laboratory. The moveable roof is 40 feet long, and runs on rails laid the whole length of the walls; the telescope room may therefore be completely covered in, and as completely uncovered when required, the roof in the latter case resting on the south building, which on that account has a very low permanent roof. The telescope, when housed, lies meridionally on the east side of the pier, and nearly in a horizontal direction, provision having been made to prevent the tube being lowered beyond a certain small inclination. Some trouble was experienced in removing the varnish from the specula, and they would require repolishing. Of work done, the author could not yet speak with any satisfaction since it became at all practicable to use the telescope; the history which he had to relate was a long chapter of weary heart-breaking watchings, with an occasional half hour's work. η Argûs was the first object observed for purpose of delineation; after the first night's work little (and that by snatches) was done towards it; a new inroad of workmen and a long course of extremely unfavourable weather having carried the nebula out of convenient reach. The search, which was reluctantly given up, will, however, be again soon resumed. The horseshoe nebula is a grand object, conspicuous and with shape even in the finder. It appears, however, to present no marked difference (with perhaps one exception) which may not be accounted for by the difference of aperture used. This exception is the presence of a small but conspicuous double star at the s p angle of the knot which lies between the ☋ and the bright streak; the experiment has not been tried of cutting down the aperture to approximate to an 18-inch Herschelian, but the intrinsic brightness of the principal star, and the presence in the C G H of stars not more bright (No. 3 of Herschel's catalogue is certainly less bright) go far to show, without this experiment, that the star did not exist as such with its present brilliancy at the time of the C G H and P T 33 observations. The important position of the star, and the careful scrutiny which the knot and its neighbourhood must have repeatedly undergone, forbid the assumption that it was simply overlooked by Sir John Herschel. The star β is conspicuously and beautifully double, the companion of considerable brilliancy, about 15 mag.; with its present brilliancy and elongation, the author thinks, it should be within reach of an 18-inch. The appearance of the knot is sparkling, though no discrete stars can be seen, except perhaps a second faint one, which is suspected at the s f angle; part of the streak near to the knot is also sparkling, but not in so marked a manner; the other portions appear of the ordinary milky nebulosity. The fainter nebulosity (S) of the bright streak pretty well marks out the borders of the almost vacuous lane which leads up to and past the knot; on receding from the lane it becomes very faint; nor is this faintness uniform, but the appearances are so fugitive that, after repeated and painful effort, they could not be caught. The borders, however, stretching to the stars are occasionally pretty well seen. On one or two occasions the author suspected the existence of a link between the nebulosity about the star No. 10 and the lower portion of the ☋; this, however, requires verification. At the f end, the upper and smaller semicircle is plainly marked, the lower and larger very faintly; its exact figure is, therefore, uncertain. 3570 is a small but beautiful spiral. The two brighter knots are resolvable. Of work out of the regular course, amongst other things, Neptune has been observed on some five or six occasions for figure and a second satellite, with only negative results. In the absence of a photographic apparatus to be used at the uninterrupted focus of large mirror, attempts have been made to utilise the second or Cassegrain image; an average exposure of near ten minutes on an eight-day moon produced pictures which (by no means good) were of sufficient promise to make it worth while to resume the attempt under more favourable conditions. The time of exposure is somewhat surprising, and would seem to indicate a great loss of chemical rays by a second perpendicular reflexion; but perhaps the inactivity was mainly due to absorption at the surface of the large mirror, which was then very yellow. The spectroscope arrived some time ago, but has not been much used; it is thought that for *star* work of any value some modification will be required, principally the exchange of the present collimator for one of longer focal length; a greater dispersion, moreover, seems desirable. The spectroscope was mainly designed for nebula work, is handy and compact, and will be of much service. For spectroscopic work on objects having a sensible diameter, the great telescope itself labours under some disadvantages; the enormous focal length and consequent magnification of the image is a serious inconvenience in the case of faint objects, and may be only partially remedied by a suitable condenser. This magnifying of the image may, however, in some cases be advantageous, from the possibility thereby afforded of viewing small definite portions of moderately bright objects, though unfortunately that will be seldom. Of nebulæ, Orion has been examined for purpose of practice; the three lines are plainly and conspicuously seen; the hydrogen line is comparatively much fainter than was anticipated, disappearing in the fainter portions of the nebula. 30 Doradûs shows the nitrogen line with facility, the second line certainly, but not in all positions, and always with difficulty; the hydrogen line is suspected only. No trace of a continuous spectrum could be seen. η Argûs has been observed on only one unfavourable morning; the nitrogen line was seen over a considerable space; the presence or absence of others, or of a continuous spectrum, could not be stated with certainty. With respect to future operations, it is intended that at first the routine work shall consist of a detailed delineation of the objects figured by Sir John Herschel, or any others which may prove interesting; this will take some time; for even without the impediment of cloudy weather, the delineation with any degree of satisfactory correctness, of a moderately large nebula, requires a considerable amount of work with careful and frequent scrutiny. It is hoped, however, that this work will by practice be found less painfully difficult than it is at present. The spectroscope will be used as much as possible, the moon photographed, and attempts made to photograph the nebulæ, when a photographic apparatus has beenpr ocured, and staging, photographic room, &c., added to the building. It is moreover hoped that before long a refractor, of some nine inches aperture, may be procured, to be mounted with the reflector, or, preferably, as a separate instrument. This telescope, besides being of much general use, will find much and valuable employment in determining micrometrically the chief points in the nebulæ under examination with the reflector, with more expedition and accuracy than at present; for spectroscopic work this telescope would be a valuable adjunct, especially if it be constructed of such comparatively short focal length as seems now to be practicable.

"On a distinct form of Transient Hemiopsia," by Hubert Airy. From a comparison of the different accounts of "Hemiopsia," "Half-vision," or "Half-blindness," by Wollaston, M. Arago, Brewster, the Astronomer Royal, Dufour, Sir John Herschel, Sir Charles Wheatstone, and Mr. Tyrrell, the author considers that, irrespective of the wide primary distinction between the transient and permanent forms of Hemiopsia, there are different forms of transient Hemiopsia which have all been included under the same name; Wollaston, Arago, Brewster, and Tyrrell, describing one form of the transient affection, while Sir John Herschel, Sir Charles Wheatstone, the Astronomer Royal, Professor Dufour, and the author agree in describing another. As to the actual seat of the visual derangement, the author considers that the exact agreement of the two eyes in the nature, extent, and degree of their affection, proves (assuming the semi-decussation of the optic nerves at the chiasma) the seat of the affection to be at some point behind the chiasma of these nerves. All the causes that are found to lead to transient half-blindness, point to the brain as the seat of disturbance. Still clearer is the evidence given by the loss of speech and of memory, the derangement of hearing, and the partial paralysis which sometimes follow an attack of teichopsia. Such cases as Sir John Herschel's, where the cloud passed over the whole field from left to right, can only be explained by supposing the disturbance to lie in some region of the brain where the opposite halves are in contact. The mischief may possibly be seated in the corpora quadrigemina or geniculata, or even in the cerebellum itself. The phenomena are so definite and so localised, and their course is so regular, that we can hardly avoid the conviction that their cause is equally definite and equally localised; and it is difficult to admit so vague an agent as nervous sympathy with gastric derangement, except as acting through the medium of some secondary local manifestation in the brain.

Chemical Society, February 17.—Prof. Williamson, F.R.S., president, in the chair. The following gentlemen were elected fellows:—R. T. Atcherley, T. W. Axe, A. H. Bateman, E. Francis, A. Prangley, W. Pritchard, L. B. Ross, T. G.

Rylands, T. Wills, and P. Wright. An account was given by Prof. Tyndall of his researches on "the action of light on gases and vapours," illustrated by a series of beautiful experiments. Dr. Tyndall began by remarking that it had, for the last ten years, been his endeavour to make radiant heat a means of getting an insight into the working of the atomic forces, or, in other words, into the state which is called chemical combination. Whilst pursuing his experiments with luminous waves on matter in a finely divided state, he was forced to imagine molecules and atoms; in fact, his belief in the existence of atoms is founded more upon those physical evidences than upon the considerations which are current in the chemical world. If he had to give up the notion of atoms, and to replace that conception by the abstract idea of multiple proportions, he would feel completely at a loss how to account for changes in the physical properties of matter. After these introductory remarks, the lecturer proceeded to the main subject. The apparatus which served to illustrate the statements, consisted of a glass tube about 3 feet in length, and 3 inches internal diameter, closed at each end by glass discs. This tube, after having been exhausted by an air-pump, was partially filled with dry air which had been permitted to bubble through the liquid whose vapours were to be examined. The condensed beam of an electric lamp was caused to pass through the tube from end to end. Since the aim of these experiments is to render visible the chemical action of light upon vapours, substances have been chosen, one at least of whose products of decomposion by light has so high a boiling point that as soon as it is formed it is precipitated. Nitrous oxide gas, the vapours of Alleylic Iodide, Amylic Nitrite, Benzole, &c., mixed with some air which had passed through hydric nitrate or hydric chloride, were found well suited for this purpose. In all cases, no matter what the nature of the vapours was, if it was only employed in a sufficiently attenuated state, the visible action commenced with the formation of a blue cloud, which in some instances was of the deepest azure tinge, rivalling the colour of the purest Italian sky. When a cell containing some of the liquid whose vapours are to be examined was inserted between the lamp and the tube, no clouds were formed within the tube; the luminous waves traversing the liquid had been deprived of their acting power. When polarised light was sent through the tube the blue cloud was visible only in one direction—the direction varying according to the position of the Nicol's prison; when the short diagonal of the Nicol was vertical, the blue cloud was seen when the specator's eye looked horizontally upon the tube, not otherwise; as soon as the prism was turned round its axis, the blue cloud was only seen when the line of vision fell vertically upon the experimental tube.

After concluding his account of this highly interesting subject, Prof. Tyndall showed some of the experiments bearing on his researches upon Dust, quite recently communicated at the Royal Institution.

Anthropological Society, February 15.—Dr. Berthold Seemann, V. P., in the chair. C. W. Eddy, Esq., M.A., and E. Schiemann, Esq., were elected Fellows. The following papers were read:—No. 1. "On the Aborigines of the Chatham Islands," by Dr. Barnard Davis and Mr. E. A. Welch. Mr. Welch, after discussing the history and discovery of those islands, described their conquest by the Maories and the ultimate fate of the Aborigines. Dr. Barnard Davis gave the results of a particular examination of the characters presented by the skulls and skeletons of many of the inhabitants. In three cases the cephalic indices of the skulls were stated to be ·74, ·74 and ·87. The stature of the Moriories, or Chatham Islanders, appeared to indicate a race shorter and stouter than the inhabitants of New Zealand. "On polygamy: its influence in determining the sex of our race and its effects on the growth of population." By Dr. J. Campbell. The author, who had been many years resident in Siam, gave minute details of the relative proportions of female to male births in the harems of the King and other important Siamese dignitaries. The result seemed to be that the proportions of males and females born were, as in the case of Monogamist marriages, entirely equal.—Mr. Ralph Tate described an inscribed rock on the banks of the Iguana, a tributary of the Orinoco. This presented an incised marking which the author considered to be more ancient than the present inhabitants of the district.

Royal Microscopical Society, February 9.—Annual meeting; the Rev. J. B. Reade, president, in the chair. The following gentlemen were elected officers for the ensuring year:—President, Rev. J. B. Reade; Vice-Presidents, Charles Brooke, L. S. Beale, James Glaisher, F. H. Wenham; Treasurer, Richard Mestayer; Secretaries, H. J. Slack, Jabez Hogg. The president read an address and announced his intention of presenting to the Society a copy of the Philosophical Transactions —60 vols. *in extenso*, from 1665 to 1812, and the parts from 1813 to the present time, as issued by the Royal Society.—Mrs. Holland presented the silver medal of the Society of Arts, with certificates awarded to her late husband for his "Microscopic Triplet," 1832. A micrometer ruled on silver by Mr. Barton, with some specimens of beads and bead lenses made by the late Mr. Holland, &c.—A vote of thanks was given to the president and Mrs. Holland for their presents.

Institution of Civil Engineers, February 1.—Mr. Charles B. Vignoles, F.R.S., president, in the chair. "On the statistics of railway expenditure and income, and their bearing on future railway policy and management." Mr. John Thornhill Harrison, M. Inst. C.E. From returns now made to the Board of Trade supplying definite information on most points of interest, the author had prepared a synopsis of this information for twenty of the principal railways in England and Scotland, representing about 85 per cent. of the entire capital expended in the United Kingdom. The original cost of railways, the working expenses, revenue, &c., were described, and it was shown that while the National Debt, amounting to 750 millions sterling, with a return of 26½ millions per annum, or 3½ per cent., was a burden on the industry and capital of the country, the capital expended on railways, amounting to 500 millions sterling, gave a return of 20 millions, or 4 per cent. per annum; whilst a sum nearly equal to the interest on the National Debt was annually expended in labour and materials.

PARIS

Academy of Sciences, February 14.—The greater part of the proceedings at this meeting had reference to subjects connected with mathematics and mechanics. M. de Saint-Venant presented a second part of his memoir on the determination of the pressure of incoherent soils upon walls; M. Morin an elaborate report upon a memoir by M. Tresca on the effects of punching and stamping, and on the mechanical theory of the deformation of solid bodies; M. de Saint-Venant appended to the latter a theoretical proof of the equality of the two coefficients of resistance to cutting with shears and to extension or compression in the continuous movement of deformation of ductile solids beyond the limits of their elasticity; and a report on five memoirs by M. F. Lucas, entitled investigations upon the mechanics of atoms.—M. C. Jordan communicated a paper on a new combination of the twenty-seven right lines of a surface of the third order; M. Pellet a note on the functions irreducible by means of one module, and one modular function, and M.A. Ribacour a note on the deformation of surfaces.—An extract from a letter of M. De la Rire to M. Jamin was read, referring to the observations of M. Trève on the action of magnetism upon rarefied gases.—M. Zaliwski read a note on a battery with three liquids regarded by him as superior to Bunsen's battery. The battery consists of an inner porous vessel, containing nitric acid and a plate of carbon, and an outer porous vessel containing sulphuric acid, the whole placed in a vessel containing a solution of hydroclorate of ammonia and a plate of zinc.—In a short note M. J. M. Séguin communicated some interesting observations on the accidental images of white objects.—M. A. Demoget described a new electro-magnetic apparatus, which, by an increase in the number of coils and alteration in their shape, can be made to produce a greater evolution of electricity, with less rapid revolution, than Siemens' apparatus.—M. P. Volpicelli communicated a paper containing an account of a photographic barometer, and some historical details upon lunar radiation. He noticed some modifications which he has introduced into the construction of a barometer for the Observatory at Rome, and with regard to the second subject, after citing several old writers, such as Aristotle, Thomas Aquinas, Pico della Mirandola, and Cardan as having admitted the production of calorific effects by the lunar radiation, maintains that the first experimental and incontestable demonstration of the phenomenon was given by Melloni in 1843.—A short note, illustrated with a figure, upon two solar spots now visible with the naked eye, by M. Tremeschini, was presented. The penumbras of these spots measure 0° 3′ 45″ and 0° 4′ 50″ in their greatest diameter; one of them contains a nucleus measuring 0° 0′ 45″11 in its greatest diameter.—M. J. Girard presented a note upon double crystals of snow, the formation of which he ascribes to the splitting of a drop of water too large to form a single crystal; the twin crystals are united by a small stay of a hexagonal prismatic form, having each of its edges corresponding exactly to the origin of one of the six regular branches of the two crystals.—A note by M. P. Bert on the influence of green light on the Sensitive plant, was presented by M. Claude Bernard. The author placed several young Sensitive plants in lanterns filled with variously coloured glass, and found that those exposed to green light lost their sensibility and died almost as quickly as those placed in perfect darkness.—M. A. Milne-Edwards communicated a note on some Mammalia from Eastern Thibet, which notwithstanding the rigour of the climate, is inhabited by two species of monkeys, a *Macacus* and a *Semnopithecus*.—The author noticed two forms of Insectivorous mammals forming new genera—one, which he calls *Nectogale elegans*, being intermediate between the Desmans and the Shrews; the other very nearly related to the latter, and called *Anourosorex* on account of the rudimentary state of its tail.—A singular animal, resembling a bear in general appearance, was noticed as forming a new genus, *Ailuropoda*, allied to the pandas and raccoons.—A long-snouted mole and a new flying squirrel were also mentioned.—The following notes and memoirs were communicated, but no particulars of their contents are given.—On the statistics of the therapeutical properties of the mineral waters of Baréges, Amélie-les-Bains, Vichy, and Bourbonne, by M. Champouillon; on some questions which may be referred to the theory of permanent isothermal lines, by M. E. Combescure; on staphyloraphic, and on the action of hydrate of chloral, by Mr. Lawson Tait; on the cause of the oscillatory movement of molecular granules by M. Lerique de Mouchy; on an accumulation of heat by the concentration of radiant heat through convex lenses of rock salt and the application of this heat to the production of a current of air giving rise to a continuous movement, by M. Vernier; on the production of the electric light by induction coils, by M. Delaurier; and a note on the trisection of the angle, by M. L. Vezzia.

Berlin

German Chemical Society, February 14.—A. W. Hofmann gave a new instance of the aid science derives from industry. The manufacture of chloral yields as a secondary product chloride of ethyle mixed with other chlorinated liquids. By treating this mixture with alcoholic ammonia in Frankland's digester, large quantities of the chlorides of ethylated ammonia bases are formed, while sal-ammoniac separates. This appears now to be the most reasonable method for producing ethyl-amines. The chlorinated compounds mixed with the chloride of ethyl are not acted upon by NH_3. They remain behind. These liquids commence to boil at 30° C., and seem to consist partly of dichlorinated marsh gas.—O. Liebreich reported on Suewern's disinfecting process. The bulk of the substance employed consists of lime disguised by the presence of chloride of magnesium and tar. Its utility proved to be very limited. Amongst the details given by Mr. Liebreich he mentioned that the canal water operated upon contained nitrogenous matter in extremely variable quantities according to the temperature of the air. For 59 parts of N. found in it during warm days, it contained 2 parts only while the weather was cold.—V. Meyer described a new and ingenious synthetical method for producing organic acids. This method is founded on the observation that formiate of sodium, when heated, splits into H and the group COO Na. Thus, when heated alone, the formiate yields oxalate of sodium and H_2. When heated with the potassium salt of a sulpho-organic acid such as phenyl-sulphurous acid $HKSO_3$, acid sulphate of potassium separates and COO Na takes the place occupied by the group KSO_3. In the instance mentioned benzoate of sodium is formed. Sulphobenzoate of potassium similarly treated yields isophtalic acid. The same chemist made some interesting remarks on the constitution of camphor and of camphoric acid.—Mr. Franck, the discoverer of potassium salts in Stassfurth, and the originator of the important industry founded on this occurrence, gave some details of the manufacture of bromine from the mother liquors. After describing an apparatus for pouring bromine from one vessel to another, he described his process for purifying this substance by re-distillation. This he effects by allowing the vapour to pass through a solution of bromide of iron before it passes into the condenser. The chlorine mixed with the bromine is thus retained in the shape of chloride of iron. Bromide of iron is the best material for the production of potassium. It is also well suited for transport; and a large quantity of the bromine shipped to America, goes there in the form of dry bromide of iron. Parchment-paper and clay mixed with colza oil, serve to unite the vessels used in the distilling process of bromine. The retorts are made of sandstone, and are lined with tar inside. The bromine acts on the tar, entailing the inevitable loss of sixty or eighty pounds of bromine in a new retort, and the production of brominated organic products, boiling between 60° and 400° C., but containing no bromoform. The bromine manufactured at Stassfurth contains no trace of iodine.

DIARY

THURSDAY, February 24.

Royal Society, at 8.30.—Note on Certain Lichens: Dr. Stenhouse.—Successive Action of Sodium and Iodide of Ethyle upon Acetic Ether: Dr. Frankland and Mr. Duppa.
Zoological Society,
Society of Antiquaries, at 8.30.—On the Guilds at Wymondham, Norfolk: Mr. G. A. Carthew.
Royal Institution, at 3.—Chemistry: Prof. Odling.
London Institution, at 7.30.

FRIDAY, February 25.

Quekett Microscopical Club, at 8.
Royal Institution, at 9.—On the Results of the Ordnance Survey of Sinai: Captain Wilson.

SATURDAY, February 26.

Royal Institution, at 3—Science of Religion: Prof. Max Müller.
Royal Botanic Society, at 3.45.

MONDAY, February 28.

Geographical Society, at 8.30.
Institue of British Architects, at 8.
Institute of Actuaries, at 7.—On the Proper Method of Loading the Premiums required for the Grant of Life Annuities and Assurances: Mr. W. M. Makeham.
London Institution, at 4.

TUESDAY, March 1.

Medical and Chirurgical Society, at 8.30.
Anthropological Society, at 8.—On the Circassian Slaves and the Sultan's Harem: Major F. Millingen.
Institution of Civil Engineers, at 8.—Discussion upon The Mhow-Ke-Mullee Viaduct, and The Pennair Bridge.—The Wolf Rock Lighthouse: Mr. J. N. Douglass.
Syro-Egyptian Society, at 7.30.
Royal Institution, at 3.—Plant Life: Dr. Masters.

WEDNESDAY, March 2.

Obstetrical Society, at 8.—Anniversary.
Horticultural Society, at 1 30.
Society of Arts, at 8.

THURSDAY, March 3.

Royal Institution, at 3.—Chemistry: Prof. Odling.
Royal Society, at
Linnean Society, at 8.—On Hybridism among Cinchonæ: Mr. J. Broughton.

CONTENTS

Errata.—Page 409, first column sixth line: for "Fern Deal," read "Ferndene."—Page 410, first column, fourth line: for "29," read "19."—Page 410, second column, fortieth line: for "50," read "40."—Page 406, second column, twenty-fourth line: for "x," read "ϕ."

Professor Jevons requests us to state that the subject of the paper read by him at the Manchester Philosophical Society, though similar to that read a the Royal Society, was not the same as was inadvertently stated in our repor at p. 393.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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NATURAL SCIENCE AT THE UNIVERSITY OF CAMBRIDGE

IN endeavouring to give a brief sketch of the aids and encouragements to the student of Natural Science in this University, it will simplify matters to arrange our materials under three heads: (1) Instruction, (2) Appliances, (3) Inducements.

(1) INSTRUCTION.—This may be subdivided into (*a*) University, (*b*) Collegiate. As the relation between the University and the Colleges is often not understood by outsiders, it may be well to preface this part of our subject by a word of explanation. As it would clearly be impossible in most branches of learning for one, or even several, professors to teach the large number of students now resident in the University, the greater part of the work has to be done by the staff of tutors and lecturers in the various Colleges. Hence, in practice, a system of division of labour has grown up. The Colleges look after the general education of their students, and do the heavy work, undertaking almost the whole instruction of the rank and file in the Arts and Sciences; while the professor is held to be the representative of his particular department, whose duty is to do his best to advance its study, and be the organ by which the latest advances in it are communicated to the University at large. His work, therefore, is to fine-polish the tools which the Colleges have prepared. Hence, in one of the more frequented branches of study,—say, for example, that of mathematics,—the great mass of students never attend a professor's lecture at all; for them the instruction provided by the Colleges amply suffices; his class therefore consists of only a few of the ablest students, and he confines his instructions to those very difficult branches of mathematics on which perhaps few men besides himself can speak with much authority. In the case, however, of a branch of study followed by only a small number—say Sanscrit—the care of all the students may fall on the professor; but then, as the class cannot be a large one, this is not too heavy a burden. When, therefore, the demand for instruction in any such branch increases, the Colleges, either singly in the larger or by combination in the smaller Colleges, appoint lecturers to relieve the professor by taking charge of the average students, and by preparing the more able to attend his classes. This last is exactly the position of the Natural Sciences at the present time.

(*a*) To return, then, after this digression to the University Instruction in the Natural Sciences. At the present time, without reckoning the two purely Medical Professors, there are six Professorships in the University: that of

	Founded in	At present held by
Anatomy*	1707	Dr. Humphry.
Botany	1724	Prof. C. C. Babington.
Chemistry	1702	Prof. Liveing.
Geology	1727	Prof. Sedgwick.
Mineralogy	1808	Prof. W. H. Miller.
Zoology	1866	Prof. A. Newton.

The number of lectures given varies considerably, depending mainly on the requirements of the students; the smallest being one course of four days a week in one term, while the largest is two courses each of three days a week in every term.

(*b*) Collegiate. Trinity College has one lecturer in the Natural Sciences; St. John's College has two; and the present lecturers have made arrangements by which the lectures are common to the two Colleges: the subjects thus covered being Physics, Chemistry, Geology, and Elementary Botany. Sidney Sussex College has one lecturer in the Natural Sciences, and Downing two "in Medicine and Natural Science." We believe that these lecturers also admit to their lectures students from the neighbouring Colleges.

(2) APPLIANCES.—The University possesses various collections, &c., accessible to students. These are: the Museum of Human Anatomy and Pathology, which is strong in the latter department, but not so well supplied in the former. The Botanical Museum, containing the collections formed by the late Professor Henslow with the herbaria of Drs. Lehmann and Lindley, and considerable additions that have been made from time to time. These for many years could not be properly exhibited owing to want of space, but they have been recently established in a suite of rooms in the New Museums and Lecture Rooms Buildings, and provided with convenient cases in which they are being rapidly arranged. There is also a large Botanic Garden, with hothouses, &c. The Professor of Chemistry has a small Museum of Chemical Preparations, with Laboratories that will accommodate about forty students at once. The Geological Museum, which occupies the ground-floor rooms under a part of the Public Library, had for its nucleus the collection of Dr. Woodward, the first professor. Since then it has been constantly augmented by many valuable gifts, and by the energy and liberality of the present occupant of the chair, the venerable Professor Sedgwick. It is peculiarly rich in Palæozoic, Cretaceous, and Eocene fossils; containing, among others, collections from the Cretaceous rocks by Mr. Image and by Dr. Forbes Young, of Saurians from the Lias by Mr. Hawkins, of Dudley fossils by Captain Fletcher. There is, we believe, no Museum where the palæontology of East England can be better studied. It also contains some good sets of Continental fossils, and a remarkably fine series of rock specimens collected by the present professor. On the whole it is a collection of which the University may justly be proud. The Mineralogical Museum now occupies a suite of rooms above that of Botany, and its arrangement is almost completed. It originated in the collection formed by Dr. E. D. Clarke; but has since been greatly augmented, having received the entire collections of Mr. H. Warburton, Dr. Forbes Young, Lord Lilford, Viscount Alford, and Mr. H. J. Brooke, besides large donations from Dr. Whewell and others. Rooms for purposes of study are attached to the Museum. The Museum of Comparative Anatomy contains the nucleus of a fine collection in Comparative Osteology, numbering more than 2,000 specimens, with a collection of Invertebrata and a Physiological series. It owes much to the energy and liberality of the late Professor of Anatomy, Dr. Clark, and of his son, Mr. J. W. Clark, the present superintendent of this and the Zoological Museum. The latter Museum, now in process of arrangement, contains some good collections of birds

* The University also provides a demonstrator in Anatomy to assist the professor.

and fishes. In the Colleges, there are laboratories at St. John's, Sidney Sussex, and Downing; and we believe that Trinity College contemplates establishing one.

(3) INDUCEMENTS.—The degree of B.A. may be obtained in Natural Sciences. An examination in Honours was instituted in 1851; in 1861 the regulations were revised, and the successful candidates were declared entitled to a degree. Ninety-five students have passed this examination in the nine years since the alteration. A candidate for an ordinary degree may also select for the subject of his third or final examination one of the following subjects: Chemistry, Physics, Geology, Botany, Zoology. In the Colleges: Clare gives annually a scholarship, value 50*l.*; Caius two, value not stated, one for Chemistry, the other for Anatomy; Christ's has lately offered scholarships, from one to four in number, and from 30*l.* to 70*l.* in value, according to the merit of the candidates; St. Peter's gives annually one of the value of 60*l.*; St. John's gives annually an exhibition of 50*l.* for three years to students commencing residence; this College has also just instituted an annual examination in the Natural Sciences for its resident students, for proficiency in which prizes in books and pecuniary rewards will be given, as in the other College examinations; Trinity gives annually one foundation scholarship, tenable till the holder is of M.A. standing; Sidney Sussex, two scholarships annually, value 40*l.*, with opportunity of promotion, for Mathematics or Natural Science; Downing gives annually at least one scholarship, value 40*l.* A fuller description of these will be found in No. 6 of this periodical, p. 169.

In looking through the lists of the Natural Sciences Tripos, fourteen persons will be found to have been elected fellows, but in most cases the candidate has been not without distinction in other branches of study. In several, however, proficiency in Natural Science was the declared cause of the election.

These statements are made upon the authority of the last volume of the Cambridge Calendar, supplemented in some instances by personal knowledge.

Thus much has been done: of what remains to do it is perhaps better that one, who is a resident and engaged to some extent in the work, should refrain from speaking. On this point only I may venture to express my conviction, that the coldness and even dislike with which the study of Natural Science was once regarded here is rapidly passing away, that the number of earnest students in the various branches is annually increasing, and that the University is fully alive to the wants of the age; so that, while she can never neglect or forget those old paths of Classics and Mathematics in which many of her sons have won an almost world-wide reputation, she will heartily welcome, and will regard with no less pride, all who are among the followers of sciences of a more recent date.

T. G. BONNEY

THE MEASUREMENT OF GEOLOGICAL TIME

II.

WE have now to consider an entirely distinct set of facts which have an important bearing on the probable time elapsed since the last glacial epoch. Messrs. A. Tylor, Croll, and Geikie have shown that the amount of denudation now taking place is much greater than has generally been supposed. The quantity of water discharged by several rivers and the quantity of sediment carried down by those rivers have been measured with tolerable accuracy, and allowing for the difference of specific gravity between sediment and rock, it can be easily calculated, from the known area of each river basin, what average thickness has been removed from its whole surface in a year, since all the matter brought down by the river must evidently have come from some part of its basin. In this way it is found that the Mississippi has its basin lowered $\frac{1}{6000}$ of a foot per annum; the Ganges, $\frac{1}{2358}$; the Rhone, $\frac{1}{1528}$; the Hoang-Ho, $\frac{1}{1464}$; the Po, $\frac{1}{729}$.

But it is evident that this amount will be distributed very unequally over different parts of the basin, according as the surface is flat or sloping, whether the slopes are of loose soil or of rock, whether the rock is solid or friable. The perfectly flat alluvial plains that form a considerable part of many river basins, will not only suffer no denudation, but will generally receive deposits of sediment during floods, and all such flat lands should therefore be deducted from the area of the river. Slightly undulating lands, especially if well covered with forest, will also suffer scarcely any denudation, as is well seen in the case of the Rio Negro branch of the Amazon and other black water rivers of South America, which hardly carry down any perceptible sediment even when in full flood. Again, wherever lakes occur, they receive all the sediment from the basin above them, which portion should therefore be treated by itself, since it contributes no sediment to the main river. If we look at a physical map of North America we see that a large extent of the Mississippi basin consists of alluvial flats and slightly undulating prairie, sufficiently explaining its small proportionate denudation. Even the Rhone, which has a high rate of denudation, flows through a great extent of low lands and perfectly flat meadows, while the upper portion of its valley which produces most sediment is cut off by the Lake of Geneva. In order, therefore, to arrive at any fair estimate of the amount of denudation in the upland and mountainous portions of the Rhone valley (which is what we require for our purpose) we have considerably to reduce the area of its basin by taking away the flat lands in all its valleys, and considerably to increase the amount of sediment by adding all that is now poured into the Lake of Geneva. We shall probably not be far wrong in adding one third to its denuding powers on these grounds, which will lead us to the startling fact that the Rhone basin is being lowered at the rate of a foot in a thousand years; but even this is considerably less than in the case of the Po. Mr. Croll takes the Mississippi denudation of a foot in six thousand years as a measure for that of Europe; but for reasons above stated I conceive this to be quite out of the question, and I maintain, that if we are to use his measure of denudation for any practical purpose, we must apply that of European rivers to European phenomena, that of Alpine rivers to Alpine phenomena, and must further make the necessary corrections for alluvial flats and intercepting lakes.

Mr. Croll and Sir Charles Lyell were at first both inclined to adopt the period of high excentricity which occurred from 750,000 to 950,000 years ago as that of the glacial epoch, but Mr. Croll, in consideration of the proofs of rapid denudation above given, now believes that the period beginning about 240,000 and ending about 80,000 years ago, is the more likely one. Even this, however, offers difficulties. Denudation in Wales and Scotland must probably have gone on as rapidly as the average rate of the Rhone valley, especially during the period when the old glaciers were disappearing; and eighty thousand years will therefore imply eighty feet of average denudation over the whole surface of the country, if less in one part then correspondingly more in another; but how is this consistent with the preservation of ice-ground rock-surfaces and glacial furrows in so many situations, as well as numberless heaps of loose matter, the moraines of ancient glaciers, apparently just as they were left by the ice? There are, it is true, a few considerations that go to diminish though not to remove the difficulty. The amount of denudation is now abnormally large, because the large quantities of glacial drift left over the surface of the country, supply much of the sediment carried down by the streams of Alpine countries. Many glacial markings were at first covered up and preserved by drift or alluvium, and have been since exposed by denudation: those earliest exposed are obliterated, but new surfaces are being continually uncovered. The amount of denudation of a solid rock-surface may not be a tenth part of that which now obtains in glaciated districts; a fact which can only be ascertained by determining the amount of sediment brought down by streams the basins of which are *free from drift or gravel*, and consist almost wholly of *compact rock surfaces*. We still have to deal with the difficulty of the moraines, whose form and aspect are often so fresh that we can hardly believe them to have been much changed since the ice left them, although it is impossible to understand how they have escaped the denudation which has lowered the whole surface of the country eighty, or even a much smaller number of feet.

It is true Mr. Geikie, in his paper on Modern Denudation,* suggests that all the effects of ice-action, now visible, are merely the few examples which have been preserved owing to a concurrence of favourable conditions, while a much larger number have been destroyed; and I learn from him that there are in Scotland moraines in all stages of decay. If this be the true explanation of the difficulty, it follows that denudation must be extremely unequal, and that if one valley or hill-side has remained unaltered during 80,000 years, another must have been denuded to double the average amount.

Having thus shown the difficulty there is in accepting even the shorter period of 80,000 years for the date of the end of the glacial epoch in Europe, let us see what other modes of measurement are available. In Sir Charles Lyell's "Antiquity of Man," 2nd ed., p. 28, we have three different calculations of the age of the bronze and stone periods in Switzerland, which would place the latter at about from 5,000 to 7,000 years ago. At page 321 of the same work, we have an estimate of the age of the upper delta of the Tinière by M. Morlot. The lower delta (by the presence of Roman remains in one of the upper strata) is calculated with tolerable certainty to be 10,000 years old, while the upper delta, 150 ft. above the lake, is ten times as large as the lower one, and is therefore supposed to be 100,000 years old. From its fossil remains it is believed to be post-glacial; but it is evident that, during the melting of the ice, the torrent might have been more powerful, and have accumulated a delta much more rapidly than now. The peat mosses of Denmark, indicating that the present beech-tree vegetation of that country, which was also characteristic of it in the Roman period, was in the Bronze age replaced by oaks, and in the still earlier Stone age by fir-trees, imply a very long lapse of time; yet this only takes us back to the Neolithic age, when all the shells and all the mammalia were of existing species. The 8,000 or 10,000 years of the Swiss Stone age may, however, have sufficed for this change. There seems to be no doubt, that the time which elapsed from the close of the glacial epoch (when man used the rudest flint weapons, and was coeval with many extinct animals, when, moreover, the climate and physical features of the country were considerably different from what they are now) up to the Neolithic age, was much greater than from the latter date to the present day, but how much greater it is impossible to determine. The position of many of the tool-bearing gravels shows that rivers then flowed at much higher levels, but from the known rate of denudation, a valley might be deepened even 50 or 100 ft. in as little as 50,000 years, since it is in valleys that the effects of denudation would be greatest; and the extinction of the various animals might certainly take place in an equal time under such conditions as are not unlikely to have occurred at a period of great climatic change.

* Transactions of the Geological Society of Glasgow, vol. iii. p. 153.

It does not appear, therefore, that any of the estimates of time founded on an actual basis of observed change in a known period, require us to assume more than 80,000 years since the close of the glacial epoch, while the measurement of the existing rate of denudation renders it almost certain that it was less rather than more. We may fairly assume, that even if a large excentricity has been an essential condition of a glacial epoch, the ice would maintain itself into a period of less excentricity than would be required to bring one on. Now 74,000 years ago the excentricity was about double what it is now, and the winter of the northern hemisphere then occurred in *aphelion*, so that the glacial epoch would at that time probably have been in full force, and we may assume that it might continue 3,000 or 4,000 years longer. But when we come to 65,000 years back, we find the excentricity scarcely more than it is at present, and winter nearly in *perihelion;* so that we must conclude, if excentricity has anything to do with it, that the last glacial period came to an end not less than 70,000 years ago.

Now it is most important to observe that, for the last 60,000 years, the excentricity has been very small—for three-fourths of the time less than it is now. During this time the opposite phases of precession, each lasting 10,500 years, will have produced scarcely any effect on climate, which in every part of the earth will have been *nearly uniform for that long period.* But this is quite an exceptional state of things; for the curve of excentricity shows us that, during almost the whole of the last three million years, the excentricity has been high—almost always twice, and sometimes three and four times as much as it is now. If, therefore, Mr. Croll's theory be correct, there will have been a change each 10,500 years during this vast period (in all the extra-tropical regions at least) from a very cold to a very mild climate. This will necessarily have caused much migration both of plants and animals, which would inevitably result in much extinction and comparatively rapid modification. Allied races would be continually brought into competition, altered physical conditions would induce variation, and thus we should have all the elements for natural selection and the struggle for life, to work upon and develop new races. High excentricity would therefore lead to a rapid change of species, low excentricity to a persistence of the same forms; and, as we are now, and have been for 60,000 years, in a period of low excentricity, *the rate of change of species during that time may be no measure of the rate that has generally obtained in past geological epochs.* Thus we should have explained the extraordinary persistence of organic forms during the historical period as well as during the preceding Neolithic age, although slight changes of climate and of physical geography have undoubtedly taken place; and it would prove to be not so much the *usually* slow rate of organic change, as the fact of our living in the midst of an *exceptionally uniform climatic epoch*, that has hitherto prevented us from obtaining a measure of the average duration of species.

These considerations have an important bearing on our estimate of the duration of the glacial epoch itself, and on our calculation of geological time from the change of species since its commencement. If it terminated 70,000 years ago, and if each 10,500 years before that date, there was alternately a warm period and a glacial epoch, there would necessarily occur a series of northern and southern migrations of animals and plants, and thus deposits formed at times not geologically remote, might contain very distinct groups of animals. These might even meet and be confounded in the same strata, and thus lead to that extraordinary mixture of northern and southern forms which occurs in some of the more recent formations, like the hippopotamus and mammoth in the Norfolk crag and the lower brick-earths.

Geologists seem hardly to have attached sufficient importance to the great gap that intervenes between the Palæolithic and Pre-historic ages. Mr. Boyd Dawkins has shown, from a careful study of their mammalian remains, that the whole of the post-glacial river deposits and cave-beds of this country (148 in number) are of the same age, being characterised by about twenty species of extinct or arctic mammalia, and this was the age of Palæolithic man. In the Pre-historic or Neolithic age all these have disappeared, while the sheep, goat, dog, and *Bos longifrons* are first met with. Now, on the theory that this Palæolithic age was entirely post-glacial, and that the climate and physical geography of Britain have been since slowly approaching their present condition, how is this great gap to be accounted for? The large number of places where remains have been found, shows that the conditions requisite for preserving them very frequently occurred, and there must therefore have been some special cause which has prevented any record being left of the long period during which they were becoming extinct. Mr. J. Scott Moore* maintains that they were all pre-glacial, and that the gap was the glacial epoch itself. He adduces in corroboration the striking fact that none of the supposed post-glacial gravels ever rest on the boulder clay, but always on an older rock, which could hardly have been the case in every instance were they all post-glacial. Again, Mr. Boyd Dawkins tells us that the identity of such a large proportion of the species of pre-glacial and post-glacial mammals "forbids the idea of the existence of any gap or lacuna which would warrant the classification of the one as tertiary and the other as quaternary." But if we admit the occurrence, during the last glacial epoch, not only of one or two, but of a series of alternate cold and warm periods, we may make the Palæolithic age *inter-glacial*, and suppose it to have occupied several of these alternations of climate. If we further place the last submergence which separated Britain from the Continent, during one of the later phases of extreme cold, when most of the extinct mammalia, as well as man, had migrated southwards, we shall sufficiently account for the great gap that intervenes between the Palæolithic and Pre-historic ages.

* Pre-glacial Man and Geological Chronology. Dublin, 1868.

In the "Principles of Geology," 10th ed., vol. i. p. 300, Sir C. Lyell has given an estimate of the duration of geological epochs, from the proportionate change in the species of marine mollusca, taking as a basis a million years since the beginning of the glacial epoch. Of the marine shells then living, six per cent. have become extinct, while at the close of the glacial epoch they were all of existing species, but this does not necessarily imply that the former are many times older than the latter. The glacial period itself may have been the cause of their extinction independently of mere time; so that the Bridlington beds, where the above-mentioned proportion of extinct species occurs, need not on this account be more than twice as old as those glacial or post-glacial drifts which contain only living species, or, according to our previous estimate, about 140,000 years. The Norfolk crag, which contains eleven per cent. of extinct shells, may be from 40,000 to 60,000 years older; this will allow for two or three alternations of warm and cold periods, which, at a time of such high excentricity, must have been strongly contrasted, and have led to a correspondingly rapid change of species. From these considerations it becomes evident that the time, measured by the occurrence of five per cent. of extinct species of marine shells, is not necessarily the whole number of years which has elapsed since they existed, but only that number *minus* the last 60,000 years of uniform climate and specific immobility; and we may be even too lavish of time if we allow so much as 100,000 years for this amount of change under the influence of those repeated alternations of climate which have characterised the last three million years and which have probably more or less characterised all past geological time. If now we take this number as our datum instead of a million years, all Sir Charles Lyell's figures will be reduced to a tenth, and will stand thus: the time elapsed since the beginning of the—

Lower Miocene . . .	2,000,000	years.
Eocene	6,000,000	,,
Cretaceous	10,000,000	,,
Triassic	14,000,000	,,
Permian	16,000,000	,,
Carboniferous	18,000,000	,,
Devonian	20,000,000	,,
Silurian	22,000,000	,,
Cambrian	24,000,000	,,

These figures will seem very small to some geologists who have been accustomed to speak of "millions" as small matters; but I hope I have shown that, so far as we have any means at present of measuring geological time, they may be amply sufficient. Taking Sir William Thomson's allowance of a hundred million years for the time during which the earth can have been fit for life, it yet allows Mr. Darwin, for the process of development from the primordial germ, three times as many years anterior to the Cambrian epoch as have elapsed since that date, an amount of time which, I believe, will fully satisfy him, by whatever scale we may measure it.

The evidence of the rapidity of denudation would indeed tend to the still further shortening of the estimate here given; and it is not impossible that a concurrence of geographical conditions might have brought down the glacial epoch into a period when the excentricity was no greater, or even less, than it is now. This, however, is hardly probable, and I am inclined to think that the considerations already alluded to will, to a considerable extent, explain how it is that so many signs of glacial action still remain, in spite of such denudation. The only argument I consider new in this paper, is that derived from the uniformity of climate during the last 60,000 years, and the alternations of heat and cold for a long time previously, leading to a slower change of species since the glacial epoch than at any former period, thus allowing us to suppose change of form in the organic world to go on more rapidly than we had before thought possible. If this be a sound deduction, it will, I believe, more than anything else, enable us to bring the period required for the development of the whole organic world within that which modern natural philosophy assigns as the age of the habitable earth.

Much of the force of my argument appears to depend upon the accuracy of Mr. Croll's view, that, during a time of great excentricity, there will be in each hemisphere alternately a glacial epoch for about 10,500 years, and a perpetual spring or summer for about an equal period. But Sir Charles Lyell argues, with great force, for the opposite view, that the cold of one period would be continued through the other, and that during the whole continuance of a phase of high excentricity both hemispheres would be in a state of glaciation. Supposing this view to be the true one, it will not very materially affect my argument, for the diagram shows many comparatively rapid alternations from a very high to a very low excentricity, which would also be from a glacial to a temperate climate and would certainly tend to comparative rapidity of specific change; while in each 10,500 years there would, no doubt, be some retreat and advance of the snow line, followed by a less amount of migration, competition, and variation. During the last 60,000 years, on the other hand, the change of excentricity has been hardly perceptible, and the change of organic forms may be supposed to have been far below the average.

ALFRED R. WALLACE

FRESHWATER CRUSTACEA OF NORWAY

Histoire Naturelle des Crustacés d'eau douce de Norvège; by George Ossian Sars. Part I. Malacostraca. With 10 plates. (Christiania, 1867.)

SOME few years ago, much interest was excited amongst naturalists by the announcement of the occurrence, in the great Swedish lakes Venner and Vetter, of certain Crustacea, heretofore known only as marine species inhabiting the Arctic and Baltic Seas. The author of this discovery was Professor Lovèn; and the explanation of it appeared to be, that the gradual elevation of the Scandinavian peninsula had cut off these originally marine creatures from their natural habitat, and that they had been able to accommodate themselves successfully to altered conditions of life.

In the volume now under notice, we have an elaborate —we may say almost an exhaustive—contribution to the natural history of these and other fresh-water crustacea of Norway. The species here treated are *Mysis oculata*, var. *relicta; Gammarus neglectus; Pallasia cancelloides*, var. *quadrispinosa; Gammaracanthus loricatus*, var. *lacustris; Pontoporeia affinis*; and *Asellus aquaticus.* One notices with surprise the absence of the most abundant freshwater Amphipod of our own country, *Gammarus pulex*, and its replacement by the very closely allied *G. neglectus.* The well-shrimps (*Niphargus*) seem also to be unnoticed as yet in Norway; neither do we find any mention of another group, inhabiting chiefly brackish water, but in some districts of England reaching into situations which, though affected more or less by tides, are yet of quite fresh-water character; e.g. *Palæmon varians* and *Mysis vulgaris.*

The anatomy and physiology of all these animals, and their points of variation from the typical marine forms, are most carefully and elaborately worked out. The following interesting remarks occur respecting *Pontoporeia affinis.* The males of this species are numerous, having their antennæ either imperfectly developed or presenting a very peculiar form, except in some individuals, where, towards the end of autumn, the antennæ take on their fully developed form; in both cases, the animals being perfectly fertile. This phenomenon is analogous to some already observed in the Cumacea and Tanaidæ. The great likeness between this and the Greenland species, *P. femorata*, led the author at one time to consider the two as presenting only varietal differences, the Norwegian species exhibiting a permanent arrest of development such as he shows to be the case with the variety *relicta* of *Mysis oculata.* This supposition, however, he was compelled to dismiss; one important fact tending to a contrary opinion being that the secondary appendage of the superior antenna contains in *P. affinis* a larger number of joints than in *P. femorata.*

We would commend the dredging of our deeper lakes to the attention of English naturalists. Nothing in that direction has, so far as we know, been done in this country; and it is worthy of remark, that only in the very greatest depths of the Scandinavian lakes were the abnormal species found. That this field is not unlikely to prove a productive one near our own doors we fully believe, inasmuch as we have ourselves found, and elsewhere published, some interesting instances of the occurrence of truly marine microscopic crustacea in fresh water in the west of Ireland.

It should be added, that the plates illustrating M. Sars' work are admirable specimens of the engraver's art, and leave nothing to be desired as to copiousness and accuracy. The work is altogether well produced; the expenses, which we fear are scarcely likely to be repaid, having been generously borne by the publisher, M. le Réviseur d'Etat Johnsen.

G. S. B.

THE THREE KINGDOMS OF NATURE

The Three Kingdoms of Nature, briefly described. By the Rev. S. Haughton, F.R.S., M.D. Dubl., D.C.L. Oxon, &c. (London: Cassell, Petter, and Galpin.)

THIS little work resembles a modern novel in one particular: it is written with an idea.

The learned author, in his preface, lays down the law that "the faculties of our mind are developed in succession as we advance in age, each of them reaching its maximum and then gradually diminishing. In childhood the senses acquire their greatest development; in boyhood and youth, the memory and imagination; in early manhood, the purely reasoning faculties; and in adult life, the judgment." He accordingly draws the conclusion that "the child should be instructed mainly through his sensations; the boy should learn languages, ancient and modern, and natural history, so far as it depends on observation; the youth should cultivate mathematics and logic; while studies such as ethics, physiology, and politics should be reserved for the more mature period of life:" and offers this work as a text-book on Natural History.

We must confess that the above law seems to us to be barely a half-truth. We admit that the senses are relatively strongest in childhood, but not absolutely. So far from their attaining their maximum development at that age, and then gradually diminishing, we believe that the senses of the truly fashioned man are at their height when he is in the prime of life; and that in the properly trained man, memory, imagination, reason, and judgment, all flourish at the same time.

We are apt to forget into what a wretchedly cramped and artificial condition so many generations of schoolmasters have bred us. Each of us, generation after generation, has very early been made to put Chinese shoes on most of the feet of his mind.

We all see the sportive, elastic, quick, sharp, unwearying work of the senses of a little child. We do not all of us bear in mind to how fearful an extent those senses are bruised and deadened by the pedantry of our pedagogues. Men who cultivate those sciences in which success is inseparable from agile sense, know at what cost and labour, in later life, sometimes even in their full prime, they have had to go back and undo all that their schoolmasters have done, have had to become little children again for the sake of a sharper eye and a quicker ear. To ourselves, there is nothing more disheartening than to study a little boy, of eight or ten years of age, who has never been to school, tracing out in his mind with ease nascent scientific capabilities; then to know the same little boy after he has enjoyed for two or three years the great advantages of a grammar or a commercial school, or a private academy, and to find his mind as blank and as deadened as his moral nature.

We do not feel inclined, then, to accept the physiological law laid down by Dr. Haughton, but we are not thereby prevented from agreeing with him that "Natural History (as a school study) is inferior to no other study, not even language, as a means of cultivating the memory and observation," or from accepting his brief description of the three kingdoms as a capital instrument of teaching.

The first part contains, besides an introductory and extremely lucid chapter on Crystallography, a detailed but succinct description of the various minerals found in Nature; the chemical composition, physical characters, crystalline forms, geological and geographical distribution of each being briefly given.

The second part treats of the Vegetable kingdom; dealing somewhat fully with the anatomy, more briefly with the physiology, of plants, and devoting only some dozen pages or so to classification.

The third part, comprising nearly half the volume, describes the Animal kingdom, beginning with mammalia and working down to protozoans. In each subdivision a brief anatomical history precedes the classification, which is given pretty fully. Formal definitions in italics, of classes and orders, are relieved by popular descriptions of the habits and features of species and individuals; and the whole work is largely illustrated by many excellent woodcuts.

Although so large a field is gone over, the matter is on the whole eminently exact and truthful; and the author has probably given an indication of the judgment of the mature period, by hesitating to place in a dogmatic text-book views on various points which are certainly recent, and may turn out to be raw. We may congratulate Dr. Haughton on having compressed a vast amount of information into a small compass. But is only right to add one more observation: the book is very formal, even to exceeding toughness. Though quotations from the poets, Aristotle, and Scripture appear here and there, the general reader would, we fear, find it very dry. As a text-book in the hands of a teacher, it will commend itself to every one; we doubt if any but very strong-minded persons would choose it for self-instruction, except with the fear of an examination before them. M. F.

OUR BOOK SHELF

Baillon's Cæsalpineæ.—*Histoire des Plantes:—Monographie des Legumineuses Cæsalpinées.* Par H. Baillon. (Paris: Hachette, 1869. London: Williams and Norgate.)

WE have so recently reviewed the first volume of Baillon's "History of Plants" (see NATURE, No 2, p. 52) and discussed his mode of treating the subject, that we need scarcely more than mention the publication of his monograph of the important order or sub-order of *Cæsalpineæ*. The boundary-line between this sub-order and the *Papilionaceæ* is very difficult to be accurately laid down. M. Baillon describes the *Cæsalpineæ* to be, in general terms, those *Leguminosæ* which have a straight embryo and the æstivation not vexillary in the bud; but neither of these diagnostics can be relied on as absolutely constant. All the other characters dependent on the regularity or irregularity of the corolla, the cohesion of the stamens, the number of seeds, the presence or absence of albumen, &c., are still more uncertain. There are even species so far removed from the normal type of the order as to have undivided leaves, indefinite stamens, diclinous flowers, and herbaceous stems. A. W. B.

Ueber die Fortpflanzungs-Geschwindigkeit des Schalles in Rohren. Von Adolf Seebeck. (Göttingen, 1869.)

IN this inaugural dissertation, Herr A. Seebeck, the inheritor of a name famous in physical science, gives an account of his experiments on the velocity of the propagation of sound in pipes. The results are extremely interesting and important.

In 1867, Professor Kundt, of Zurich, proved that the velocity of sound in pipes depends on their cross section, and attributed the result to the loss of heat in the friction of the gases on the enclosing wall. Kirchhoff deduced the consequences of this theory mathematically, and pointed out that the diminution of velocity must vary inversely as the square root of the number of vibrations in the sound propagated; that is to say, that the velocity of sound could not be uniform for different notes. Seebeck shows that the loss is inversely as the cube of the square root of the number of vibrations; so that we can scarcely attribute the result entirely to the loss of heat by friction of the enclosed gas on the walls of the tube. On the other hand, his results completely establish the fact of a difference in the speed with which different notes of music are propagated in tubes.

The magnificent and laborious work of M. Regnault on the velocity of sound in pipes, appeared while Seebeck was occupied in these investigations. He points out, that since the sounds which Regnault studied, such as explosions of gunpowder and so on, are due to violent and complicated disturbances, however important it may be to study them in a practical view, they are not likely to give us accurate and delicately differenced results. Where the sound contains a mass of irregular notes, no effect due to difference of note can be observed. The method of generation compels the air to move at first in all directions in the tube. Such sounds fall into the sea of air like a mass of stone dropped from a great height into the water. The waves which they generate can only reduce themselves to regularity at some distance from the disturbance and their propagation must be irregular till that distance is reached. On the other hand, a regular pulsation, such as would be produced by the timed advance and retrogression of a piston at the end of the cylinder, gives waves which are regular and regularly propagated from the beginning. It is in consequence of this delicacy in the character of his experiments that Seebeck has attained his results.

He makes one of König's tuning-forks sound at the open mouth of a cylindrical pipe, the other end of which is stopped by a moveable piston. A short distance from the mouth of this pipe there is an opening, connected with an indiarubber tube which can be carried to the ear. If, by the motion of the moveable piston, this opening be made to correspond exactly to a "ventre" in the standing wave which is generated in the air of the tube, it is easy to measure, with great accuracy, the length of that standing wave, which corresponds to the precise number of vibrations of the tuning-fork. The extreme difference in fifty experiments for the same note, appears to have been about one five-hundredth of the whole amount.

The results are the following, the velocities being reduced from the experiments to those at 0° C.:

	Diameter of pipe in millimetres.	Velocities reduced to 0°, in metres per second.				Number of vibrations per second in note sounded.
1.	3·4	322·90	318·86	317·26	——	512, 384, 320, 256
2.	9·0	328·44	327·68	327·22	325·63	
3.	17·5	330·92	329·86	329·24	327·82	
4.	29·0	326·10	326·72	325·36	324·54	

If we compare these numbers with that for the speed of propagation in free space, as given by Schröder von der Kolk, which is 332·77, we see (1) that they are *uniformly* and considerably *less*; (2) the divergence *is greatest in narrow tubes*, with the exception of that where the tube was 29 millimetres in diameter, which was in all probability too wide to have the mass of air at its end uniformly affected by the vibrating tuning-fork; (3) the notes which travel slowest are the *low notes*. This difference is by far the greatest in the case of the narrow tube of an eighth of an inch in diameter, amounting to nearly 1 in 60 of the whole amount for the notes e and c_2.

The author discusses the further question, whether the nature of the enclosing tube produces any effect. In a tube, the inside of which is sheet copper, which has nearly 17 mm. diameter, the velocity is as low as it is in a glass tube of 9 mm. Where the friction is raised to a maximum by coating the inside wall of the tube with flannel, the velocity is reduced to 293·7 metres per second in a tube of 13 mm. diameter.

The same subject is treated fully by Herr Schneebeli, in a series of experiments published in Poggendorff's *Annalen* in February of last year; but those which we have described appear to us to have conducted their author to more valuable and interesting results.

WILLIAM JACK

An Introduction to the Study of Chymistry. Written for the People by Cuthbert C. Grundy. Pp. 108. (London: Simpkin, Marshall, and Co.)

WE remember when at school being called upon to admire the beauties of Schiller's *Wilhelm Tell.* Our impressions of that play were then by no means complimentary to some of the principal personages: so far as we could see Melcthal, Stauffacher and the rest of the members of the three Cantons apparently did nothing but meet clandestinely (when the weather was favourable) to talk much treason and fine sentiment, generously leaving most of the hard work to be performed by Tell (who being lowly-born was perhaps not so free of speech). All this was doubtless wrong and absurd; but we are reminded of these early impressions by the character of much of what is being said and done in reference to the education of the masses in the present movements. There is a wonderful disparity in the proportion of Tells to our ideal Melcthals and Stauffachers. Possibly, if certain noisy persons would but show their earnestness in the practical manner of Mr. Grundy, the wheels of progress would not drag so heavily.

In a modest little preface, Mr. Grundy informs us that his book is mainly intended for those among the great body of the people who desire knowledge, but have little time and only limited means for acquiring it. Occasionally, for example, when defining and illustrating the phenomena of latent heat, the author lays himself open to the charge of sacrificing precision of knowledge to clearness of statement. This fault is not unfrequently met with in manuals of this character: surely the two are not incompatible. Why does Mr. Grundy prefer the more antiquated form of styling the science? The generally accepted word is undoubtedly more correct: Kopp has satisfactorily shown this in his recently published "Beiträge zur Geschichte der Chemie."

On the whole, however, we can congratulate Mr. Grundy on having succeeded in explaining in clear and simple language the fundamental principles of chemical philosophy.

T. E. T.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

On Professor Tyndall's Exposition of Helmholtz's Theory of Musical Consonance

IN the course of a re-perusal of Helmholtz's "Ton-empfindungen," it occurred to me to compare the theory of consonance and dissonance, there propounded, with the exposition of that theory presented in the Lectures on Sound of Professor Tyndall. The result of the comparison is the present paper, in which I shall endeavour to show that Professor Tyndall's version of the theory is radically different from the original, and erroneous.

Helmholtz determines the consonances of two *simple* tones by reference to their combination-tones. That of the first order suffices for the *octave;* those of the first and second order determine the *fifth* and *fourth*. The remaining consonances—*major and minor sixth* and *major and minor third*, do not, according to him, admit of determination from two simple tones and their combination-tones, but require the addition of a third primary simple tone.

* "Ton-empfindungen," pp. 301-303, 306-307. I shall in the following references use "H." to denote this work, and "T." for Prof. Tyndall's lectures.

Professor Tyndall * undertakes to determine the consonances of the *octave, fifth, fourth*, and *major third* for two simple tones, without employing combination-tones. He writes as follows :—

"Bearing in mind that the beats and the dissonance vanish when the difference of the two rates of vibration is 0; that the dissonance is at its maximum when the beats number thirty-three per second; that it lessens gradually afterwards and entirely disappears when the beats amount to 132 per second—we will analyse the sounds of our forks,† beginning with the *octave*. Here our rates of vibration are—

512 – 256; difference = 256.

It is plain that in this case we can have no beats, the difference being too high to admit of them.

"Let us now take the *fifth*. Here the rates of vibration are—

384 – 256; difference = 128.

This difference is barely under the number 132, at which the beats vanish; consequently the roughness must be very slight indeed.

"Taking the *fourths*, the numbers are—

384 – 288; difference = 96.

Here we are clearly within the limit where the beats vanish, the consequent roughness being quite sensible.

"Taking the *major-third*, the numbers are—

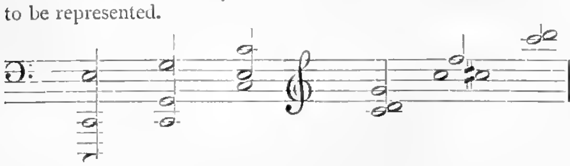
320 – 256: difference = 64.

Here we are still further within the limit, and accordingly the roughness is more perceptible. Thus we see that the deportment of our four tuning-forks is entirely in accordance with the explanation which assigns the dissonance to beats." ‡

It will not be difficult to test the value of the above reasoning. Starting from the rate of 256 vibrations per second selected by Prof. Tyndall, all that can be deduced from his definition of beats and dissonance at the head of the extract is that the maximum of dissonance will fall on the interval 256 : 256 + 33, *i.e.* 256 : 289; and that all intervals larger than 256 : 256 + 132, *i.e.* 256 : 388, will be free from dissonance. These numbers indicate almost exactly a whole tone and a *fifth* respectively. Each of these results is contrary to experience: the dissonance of a whole tone is less harsh than that of a half tone; and intervals greater than a fifth are by no means equally free from dissonance. Moreover, it follows that the determination of the octave by this reasoning is delusive, for the process would bring out, as perfect consonances, a *seventh* or a *flat ninth*, which are extreme discords, just as readily as an octave. If we apply the same method to other parts of the scale than that to which Prof. Tyndall has restricted himself, the results are even more remarkable. Thus starting from the higher octave of 256, viz. 512, the maximum roughness falls on 545, a half-tone, and dissonance ceases after 644, which lies between a *major third* and a *fourth*. For the next octave, *i.e.* starting from 1,024, dissonance ceases before we reach the interval of a whole tone. If we take lower positions on the scale we obtain opposite results. With 128 as our fundamental note, the maximum dissonance falls on 161, slightly above a *major third*, while roughness extends to 260, just beyond an *octave*.

With 64 the worst discord is at 97, just above the *fifth*, and roughness reaches 196, another *octave* higher. Starting from 32 the worst dissonance 65 is just above the *octave*, and roughness is not got rid of until 164, *two octaves and a major third* from the fundamental note.

The following octave exhibits at one view the results we have reached. The lowest note of each triad represents the fundamental note, the middle one the position of maximum dissonance, and the highest the limit of roughness. The middle note necessarily falls out of the last triad, as it lies too near the fundamental note to be represented.



Prof. Tyndall's method leads to the following conclusions :—The interval of an *octave* from the 16-foot C is the harshest possible dissonance; so is that of a *fifth* from the 8-foot C; so is that of a *major-third* from the lower C of a baritone voice. On the octave above the high C of a soprano voice, all the intervals beyond D are perfect consonances, while in the 16-foot octave there are no perfect consonances at all.

* T. p. 296.
† Tuning-forks produce, of course, *simple* tones.
‡ T. pp. 296, 297.

These conclusions are so utterly at variance with facts, that the method by which they have been obtained must be pronounced erroneous. In fact, Prof. Tyndall is himself a witness that this is so; for, in speaking of the *octave*, he remarks that if this interval be slightly impure, *beats of the fundamental tone are heard*.* Now this does not square with his own theory; for suppose two simple tones with 513 and 256 vibrations per second, which would form an impure octave: the difference is 257, which is as much "too high" as 256 was in the case of the pure octave. This interval should, therefore, give no beats, and an impure octave be as harmonious as a pure one. But according to Helmholtz's view, the first combination-tone of 513 and 256, viz. 257, will produce one beat per second *with the fundamental tone*, as stated, but not satisfactorily explained † by Professor Tyndall. This amounts to a practical admission by him that the beats of two simple primaries are not adequate for the determination of their consonances, and that recourse must be had for this purpose to combination-tones.

I claim to have shown that the method by which Prof. Tyndall appears to determine the consonances of simple tones is erroneous, and the determinations themselves fallacious. I proceed to point out the defect which vitiates his reasoning. He enunciates but one condition for the production of audible beats, that their number should not exceed 132 per second. Helmholtz lays down a second, quite as important—that the tones producing them should not differ too much in pitch. "These beats," he writes, "are *powerful when their interval amounts to a half-tone or a whole tone, but weak and audible only in the lower portions of the scale, when it is equal to a third, and they diminish in distinctness as the interval increases*." ‡ Here we see at once the reason why it is futile to attempt to determine consonances of a fifth or octave by the beats of two simple primaries—viz. that for these wide intervals the beats are imperceptible.

Let us now proceed to Prof. Tyndall's theory of consonance for *composite* sounds. Taking the octave C′, C″ or 264 : 528, he writes :—"With regard to the octave C′, C″, its two fundamental tones and their over-tones answer respectively to the following rates of vibration :—

		1	:	2	
Fundamental tone		264		528	Fundamental tone
Over-tones . .	1.	528		1056	
	2.	793		1584	
	3.	1056		2112	
	4.	1320		2640	
	5.	1584		3168	
	6.	1845		3696	
	7.	2112		4224	
	8.	2376		4752	
	9.	2660		5280	

"Comparing these tones together in couples, it is impossible to find, within the two series, a pair whose difference is less than 264. Hence, as the beats cease to be heard as dissonance when they reach 132, dissonance must be entirely absent from the combination. This octave, therefore, is an absolutely perfect consonance." § The same process is then applied to other intervals. For the *fifth* 264 : 396, the lowest difference between any two overtones being 132, the interval is "all but perfectly free from dissonance." For the *fourth*, 264 : 352, the least difference, 88, makes it "clearly inferior to the fifth." Similarly the *major third*, 264 : 330, with least difference 66, is "less perfect as a consonance than the *fourth*, and the *minor third* 264 : 316·8, with least difference 53, "inferior as a consonance" to all the previous intervals.‖ In each case the "least difference" is precisely equal to the difference between the vibration-rates of the fundamental tones; so that, in spite of the array of figures, *nothing is added by this process to that employed by Prof. Tyndall to fix the consonances for simple tones*. Inasmuch, therefore, as that method has been proved erroneous, these determinations cease to have any validity.

Here, again, the neglect of the second condition for the production of audible beats is at the root of the error. Helmholtz

* T. p. 297.
† Professor Tyndall's attempted explanation depending on *difference of phase* between the two primaries is at once refuted by the general principle that *difference of phase in partial-tones has no effect on quality*. See H. p. 193. A note and the octave above may obviously be treated as the groundtone and first overtone of a composite sound.
‡ H. p. 302. § T. p. 299. ‖ T. p. 299—301.

does not only consider the differences of the vibration-rates of pairs of over-tones, but inquires also whether they are *within beating distance* of each other. In the former case alone can they become a source of dissonance. The interval of an *octave* is a perfect consonance, because every partial-tone of the higher sound coincides with one of those of the lower; and thus any slight deviation in pitch will produce beats between each adjacent pair.

The interval of a *fourth* is less consonant than that of a *fifth* —not, as Prof. Tyndall represents it, on account of its 66 beats which, but a single octave below that in which he has placed it, ought to become the worst possible dissonance—but because the second partial-tone of the higher sound comes within beating distance (a whole tone) of the third partial-tone of the lower, as shown on the stave—

when the fundamental tones are written in minims, and the over-tones in crotchets.

I may as well notice that a diagram given by Helmholtz * to illustrate various degrees of dissonance, and copied by Prof. Tyndall, † is accompanied by the latter with an explanation giving a wrong idea of its meaning. The diagram, as explained by its author, is intended to represent to the eye the degrees of roughness attaching to intervals greater than one octave, and not exceeding two. Prof. Tyndall having evidently missed the remark of Helmholtz ‡ that C′, *not its octave* C″, "is to be the constant fundamental tone of all the intervals," has represented the diagram as "beginning with the unison C″—C″" and going up to the octave intead of beginning with the octave C′—C″ and going up to the double octave C′—C‴. The diagram as it stands in Prof. Tyndall's lecture is calculated to convey an impression as unlike its author's meaning as it is contrary to fact.

Trinity College, Cambridge, Feb. 26. SEDLEY TAYLOR

* The second on page 292. † Page 203. ‡ Page 291.

The Valuation of Liquid Town Sewage

THOUGH I consider it highly unbecoming for one member of a committee, charged with an important inquiry, to criticise publicly and in a controversial manner, views expressed by another member of that committee in regard to the subject it has to investigate, still some of the remarks made by Mr. Hope at the Society of Arts last Wednesday seem so unmistakeably to refer to the article which appeared in NATURE on the 23rd December last, that I feel constrained, as the writer of that article, to reply to them. The statement objected to by Mr. Hope was an expression, not of individual opinion, but of the fact—long accepted as beyond question—that the practical value of liquid town sewage as manure, that is to say, its value to the farmer, cannot be computed *solely* from the amount of manure material it may contain, and that, in forming such an estimate, the positive element afforded by chemical analysis must be controlled by the negative element introduced by extreme dilution, and varying under different local circumstances. This fact has been recognised by authorities too numerous to name, and so decisively, that Mr. Hope's assertion as to the value of the ammonia in sewage being affected only in a very minor degree by the amount of water mixed with it, seems to have no other merit than that of being "sensational." I am at a loss to conceive what ground Mr. Hope could have for objecting to the statement that "it is a great mistake, and likely to prove a very ruinous one," to estimate the value of dilute sewage by calculation solely from the amount of manure material it may contain. Yet this is what Mr. Hope characterises as a "strange paradox." Why it has puzzled him, as he admits, I will not stop to inquire; but I must protest against his representing "the obligation of applying water to crops at all times of the year, whether they want it or not," as having been one of the reasons given for the statement he objects to. In doing that he has at least fallen into a great error, and he has at the same time evaded the point to which attention was directed in the article, viz., the agricultural difficulty attending the "continuous daily application of sewage to land." That is a difficulty not to be disposed of *ex cathedra*—it would obtain whether the land destined to receive sewage were under crops or lying fallow. In the one case the application of sewage might be inadmissible during great part of the year; in the other case the land under fallow would be unproductive meanwhile. Indeed the need for applying sewage to fallow land, which Mr. Hope seems to suggest, would enhance the difficulty of disposing of sewage by irrigation, since it would involve the want of a still larger area of land for its reception, day by day throughout the year. Such a mode of application might well necessitate an area of twenty-five acres for every 100 persons, and that necessity, if it existed, would be, I imagine, a very serious matterin the case of many towns.

I will not attempt to occupy your space by considering the question whether leaving land under fallow is to be regarded as a feature of progress in agriculture; nor will I venture an opinion as to whether water be the "best dung-cart," further than to express my surprise that, in regard to this question, Mr. Hope should have recourse to a chemist's opinion while declaring that its decision is not within the province of the chemists.

The case put by Mr. Hope, with an air of anticipatory triumph, of a man who applies to his land an excessive and useless amount of manure, seems to me an exact parallel to the use of liquid sewage in many instances, for whether it be the fancy or the folly of the farmer, or some other circumstance, which impels him to use manure in such a way that the possible effect cannot come up to the amount of manure applied, I should imagine it to be obvious that, to the user, the value of the manure must be gauged by the practical effect likely to be realised. I should expect this view to be appreciated even by the bucolic intellect which Mr. Hope seems disposed to contemn.

As stated by the chairman at the Society of Arts meeting, the views held by Mr. Hope on the general subject of town refuse are clear and precise. There is no doubt what those views are, but it is not my intention to enter upon any discussion of them. At the same time, as a member of the British Association Committee, and having individually entertained the expectation that Mr. Hope's co-operation would be of material service in the inquiry it has to make, I cannot avoid expressing my regret that he declares himself a partisan of one particular solution of the town-refuse problem. There are, probably, few questions of the day which demand more careful and impartial consideration than this one—few that less admit of being dealt with for the promotion of a project at any price. For my own part, therefore, I deem it a misfortune that the value of Mr. Hope's well-known ability and extensive knowledge of this subject should be limited by his avowal of a foregone conclusion.

February 28. BENJAMIN H. PAUL

Weeds in Newly Turned Ground

FROM a recent address of Mr. Bentham, the President of the Linnæan Society, it would appear to be still uncertain whether the weeds which appear spontaneously on ground which has been newly turned over, spring from seeds hidden in the ground, or from seeds accidentally carried on to the new surface. Could not this question be decided by a simple experiment, namely, by turning over some suitable ground and covering parts of it by gardener's glass frames, so as to prevent the importation of any seeds? So far as the weeds are the same both within and without the frames, it is certain that they must spring from seeds previously contained in the earth. It is true that there will be a difference of temperature beneath the glass and in the open air, but it would not prevent us from learning what seeds are really contained in the earth. A frame covered with fine muslin would serve instead of glass if the muslin be fine enough to prevent the passage of any seeds.

J.

Skeleton Lectures on Science

I HOPE you will allow me, through your valuable pages, to suggest what I have no doubt would be a most powerful and successful means for promoting scientific knowledge throughout the length and breadth of the land. There are hundreds of persons with the desire and a sufficient taste and general knowledge of science, who now devote themselves to penny readings, who would be too glad to give popular lectures on scientific subjects, if they could only be aided by *skeleton lectures*, and the loan, on moderate terms, of simple apparatus, diagrams, &c., to illustrate the same. It certainly would well remunerate any scientific instrument maker to loan out apparatus for such lectures.

Skeleton sermons are enormously in request, why not skeleton lectures on science? W. L.

ANCIENT BRITISH LONG BARROWS

I.

THERE are many hopeful signs that the number of persons to whom all knowledge of nature is dear for its own sake is steadily on the increase ; but it is, unfortunately, true that science still requires some adventitious aid to secure the attention of the general public. We must, therefore, look upon it as a matter of congratulation that even the Irish Question has been found to have a scientific aspect, and has recently awakened some general interest in so obscure a subject as that of the ethnology of England and Ireland.

It is not our present intention to enter upon the long-standing controversy as to the physical characters of the so-called Kelts, as we think that the materials for a satisfactory solution of the various questions involved are still very insufficient, notwithstanding the large amount of really trustworthy evidence collected of late years by Broca, Pruner Bey, and others in France, and by Barnard Davis, Thurnam, Beddoe, and Wilson in our own country. Few persons have any idea of the time, skill, and patience necessary for any satisfactory investigation either of the ethnic composition of existing populations, or of the characters and affinities of the earlier races whose works and remains have come down to us. It may seem surprising that we should be long in doubt on matters apparently so easily settled as the average stature, prevailing head-form, and distribution of colour of hair and eyes, in various districts of our own and neighbouring countries ; but it must be remembered that the number of persons interested in this branch of inquiry is extremely small, and that the collection of anthropological statistics by inaccurate or improperly instructed observers is very much to be deprecated. If the scientific study of existing populations is surrounded with difficulties and can reckon but few votaries, still more is this the case with the investigation of the character and affinities of the races inhabiting Western Europe at the dawn of history and in pre-historic times. We have had innumerable riflers of grave-mounds and endless discussion of the scraps of information handed down by Greek and Roman authors ; but of thorough and extended investigation of pre-historic monuments of any one class or of any given district, with a view to elucidating the ethnography and early history of the country rather than with the object of collecting specimens for the museum, we have all too little to show.

The late Mr. Bateman devoted considerable attention to the pre-historic archæology of Derbyshire and the adjoining counties, but his extensive investigations do not appear to have been conducted with the care or described with the accuracy necessary for scientific purposes. The important researches for remains of our early ancestors, made by Sir Richard Hoare and Mr. Cunnington in the richest district in all England, were undertaken so long ago as the beginning of the century ; and although the explorations are recorded in full detail in Sir Richard's great work, "Ancient Wiltshire," the general results have not hitherto been fully and satisfactorily worked out. This want has, however, at length been supplied in a memoir* recently communicated to the Society of Antiquaries by Dr. John Thurnam, a gentleman who possesses the rarely combined qualifications of classical scholarship, antiquarian knowledge, and familiarity with scientific method, and who is well known as one of the authors of the "Crania Britannica," undoubtedly the most valuable contribution to the ethnology of this country which has yet been published. The memoir in question is not a mere analysis of the labours of the Wiltshire baronet and his coadjutor; it is to a large extent a record of original explorations, more especially of a class of monuments somewhat neglected by Sir Richard Hoare, but to which the greatest interest attaches now that the advances in certain departments of anatomical knowledge enable us to turn to due account the evidence afforded by human remains.

Fig. 1.—A Long Barrow (after Sir Rd. Hoare)

Fig. 2.—Vessel with Primary Interment. Norton Bavant, Long Barrow (scale 2/8 linear)

* On ancient British Barrows, especially those of Wiltshire and the adjoining counties. Part I. Long Barrows. From the "Archæologia," vol. xlii. 1869

The monuments to which we refer are the huge grave-mounds known as Long Barrows, and chiefly occurring in Wiltshire and the adjoining counties.

Only the first part of Dr. Thurnam's memoir has as yet been published—that, namely, relating specially to the Long Barrows; but this part is of sufficient importance to demand separate notice at our hands.

The chief result of the examination of the Ancient British barrows of the south-west of England is their division into two great classes—(1) the Long Barrows, the primary interments of which have yielded implements of stone and bone only, and which are, therefore, confidently assigned to the Stone Age; and (2) the Round Barrows, affording implements of bronze as well as of stone, and occasionally, though rarely, of iron. The round barrows vary considerably in form, and Dr. Thurnam thinks that these variations are not to be attributed to the individual fancy of the builders. He recognises three primary forms of round barrow—the bowl-shaped, the bell-shaped, and the disc-shaped; each of these three having again its three modifications. The long barrows are of two kinds—the simple barrows of South Wilts and Dorset, consisting merely of earth, chalk, and flints; and the barrows of North Wiltshire, Gloucestershire, and Somersetshire, containing chambers or cists built of large stones.

Wiltshire is, *par excellence*, the county of long barrows, one district consisting of about 150 square miles, containing, on an average, one of these huge mounds in every six miles. The distribution of these monuments is a point of great interest. Unlike the round barrows, which usually occur in clusters, they are almost without exception solitary—generally two or three miles apart—and situated in some prominent position, usually the highest points of the hills, commanding extensive views over the downs. The immense size of the mounds of the South Wilts and Dorsetshire long barrows, and the imposing stone structures of those of North Wilts, Gloucestershire, and Somersetshire, would alone be sufficient, notwithstanding the rude character of the implements contained in them, to lead one to conclude that we have here the graves of the chieftains of the primitive people of these districts. The situations chosen for the grave-mounds, and the evidence, hereafter to be alluded to, of the immolation of slaves, and perhaps wives and children, seem strongly to confirm this supposition.

It will be convenient in the remainder of our notice to treat separately of the unchambered and chambered barrows; that arrangement having been followed in the memoir in the "Archæologia." The following is Dr. Thurnam's account of the external form of the simple or unchambered barrows:—"The long barrows are for the most part immense mounds, varying in size from one or two hundred to three and even nearly four hundred feet in length, from thirty to fifty feet in breadth or upwards, and from three to ten or even twelve feet in elevation. (See Fig. 1.) Along each side of the whole length of the tumulus is a somewhat deep and wide trench or ditch, from which trenches no doubt a great part, or sometimes even the whole, of the material of the mound was dug, but which it is very remarkable are not continued round the ends of the barrow. . . . . In by far the greater proportion of long barrows the mound is placed east and west, or nearly so, with the east end somewhat higher and broader than the other. Under this more prominent and elevated extremity the sepulchral deposit is usually found at or near the natural level of the ground." The great infrequency of manufactured objects in these barrows and their rude character is very remarkable. Some "delicate

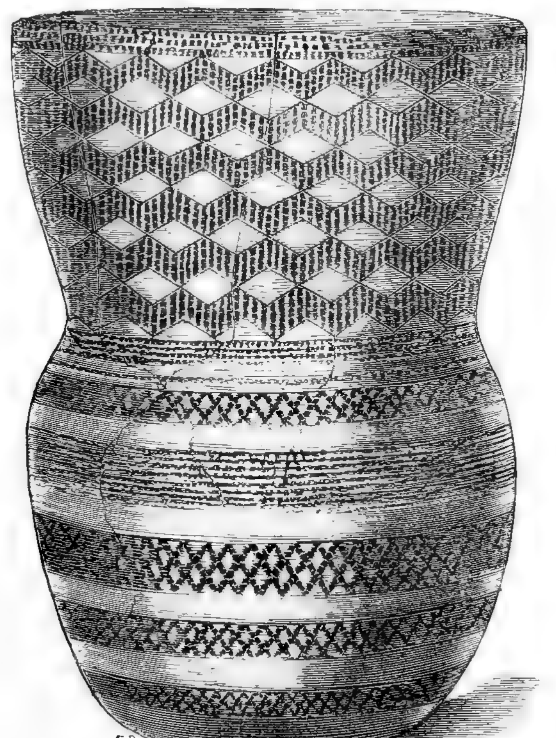


Fig. 3.—Drinking Cup with Secondary Interment. Figheldean, Long Barrow (scale ½ linear)

and beautifully-chipped leaf-shaped arrow-heads" have been found in one or two instances, and this type of arrow-head, which is unbarbed, is the only one yet discovered. In no case has any trace of metal been found with the primary interments. Fragments of a coarse black pottery are occasionally met with, and in one barrow, that of Norton Bavant, Dr. Thurnam was fortunate enough to discover a tolerably perfect vessel of extremely rude construction, and utterly devoid of the ornamentation usually found in the pottery from the round barrows. Thanks to the courtesy of the Society of Antiquaries, we are enabled to reproduce Dr. Thurnam's drawing of this vessel. We are likewise indebted to the same Society for the other figures which illustrate this paper.

Remains of oxen of the ancient small species, *Bos longifrons* or *Bos brachyceros*, are often found in long barrows not far from the human remains; antlers and bones of the red deer are still more frequent. Tusks and bones of swine have also been discovered. It would appear that oxen were slaughtered at the funeral feasts, and that the heads and feet (the bones of which parts are more frequently found), not being used for food, were buried in the barrow, perhaps as offerings to the gods or to the spirits of the dead.

Secondary interments in the upper portion of long barrows are not infrequent, and afford valuable evidence of the antiquity of these tumuli. Some of these interments are assigned without hesitation to the Anglo-Saxon period; others, again, undoubtedly belong to the Ancient Britons of the bronze age, being sometimes burials after cremation, sometimes interments of entire skeletons in the contracted posture characteristic of the round barrows. In the latter case the remains are frequently associated with pottery undoubtedly of the round-barrow period. In order to show the difference between this pottery found with secondary interments in long barrows, and part of the long-barrow period itself, we reproduce (Fig. 3) an elegantly ornamented drinking-cup found at Figheldean, and now in possession of Dr. Thurnam.

In the present article we have only touched upon some of the most interesting of Dr. Thurnam's researches. It still remains for us to notice the chambered long barrows, and the most important evidence of all, that derived from the skeletons disinterred in both chambered and unchambered barrows. We have been able from the archæological evidence to gain some idea of the state of barbarism in which these primitive people lived; but still further information is to be obtained even on this point from the very bones of the people themselves; and from these sad relics alone can we obtain any ray of light as to the relation of these most ancient Britons to the population of more civilised times.

HOW LARGE SEEMS THE MOON?

IN a communication addressed to the Association Scientifique, M. Viguier remarks on the linear dimensions which ordinary observers employ to define the size of celestial objects. They seem to imagine that they are really pointing out the size of a meteor, for instance, when they state that it was a yard in diameter, or the like Of course, such a statement is absolutely without meaning to the astronomer; while the seemingly less precise mode of speaking which compares the size of a meteor to that of the moon, is in reality much more valuable. It is true that when an observer says a meteor was as large as the moon, he makes a wider error than when he says it was a yard in diameter; but the astronomer knows what one statement means, whereas he can form no real estimate even of the meteor's apparent size from the other.

If every observer formed the same estimate of the linear dimensions of a celestial object, one might indeed interpret a statement of the linear dimensions of a meteor. But this is not the case. As M. Viguier justly remarks, the short-sighted or the far-sighted person each forms his own estimate of the moon's real size, the position of the moon affects the judgment, nay, even the state of the weather influences our instinctive estimate.

But it is interesting to consider what is really implied by such a statement as that the moon is a foot in diameter. This is a size often assigned to the moon, I may remark, though many judge her to look larger. The moon subtends an angle of about half a degree, so that this estimate makes half a degree of the celestial sphere one foot in length. Thus the circumference becomes about 720 feet, and the radius about 115 feet. This, at any rate, is the distance which the estimate assigns to the moon. And this last view is the more correct, since the varying estimates made of the moon's dimensions according to her position, suffice to show that the mind instinctively assigns to the celestial vault a somewhat flattened figure, the part overhead seeming nearest to us. In fact, a common opinion that the moon's diameter looks about twice as large when she is on the horizon as when she is nearly overhead, would assign to the celestial dome the figure of a segment of a sphere, less than a fifth of the sphere's surface being above the horizon.

It is worth noticing, though M. Viguier does not consider the point, that we can conclude from the estimated size of the moon *as compared with the intervals separating certain stars*, that the mind intuitively assigns to the moon a distance considerably greater than that of the fixed stars. For example, I find that if, when the moon is below the horizon, an observer be asked whether the distance separating the three stars in Orion's belt (ζ from ϵ, or ϵ from δ, I mean) be greater or less than the moon's diameter, the answer is that it is about equal to that dimension. In reality, the moon's apparent diameter is but about one-third of the distance between these stars. It follows that the mind estimates the distance between the stars on a scale one-third only even of the small scale according to which it measures the moon; in other words, that it regards the distance of the fixed stars as about one-third that of the moon.

It may be, however, that the result of this comparison merely indicates that the mind assigns to the celestial sphere as seen on a moonless night a distance equal to only one-third of that which separates us from the faintly seen stars of a night on which the moon is full.

RICHD. A. PROCTOR

NOTES

WE are informed that her Majesty's Government has determined to issue a Royal Commission to inquire into the present state of Science in England. This step will be hailed with the liveliest satisfaction on all sides, and much good will certainly follow from such an inquiry, especially at a time when the arrangements for the prosecution of Science in this country are acknowledged on all hands not only to be "chaotic," but positively detrimental to the national interest. We learn that some of the commissioners have already been designated, but as their number is not yet complete, we withhold the names.

WE have been favoured with a copy of the report just issued by the Rivers Pollution Commissioners on the Mersey and Ribble basins. We hope to return to this subject shortly.

THE first Royal Society's Soirée of this Session will take place on Saturday evening next.

MR. E. RAY LANKESTER has been elected by examination to the Radcliffe Travelling Fellowship at Oxford.

WE have received the third part of Vol. I. of the Transactions of the Edinburgh Geological Society, containing the communications made to that body during its session 1868-1869. These are numerous, and testify to the activity of the members of the society. The most important are Mr. Powrie's description of the fish remains of the Old Red sandstone rocks of Forfarshire; Mr. Robert Brown's paper "On the geographical distribution and physical characteristics of the coal-fields of the North Pacific coast;" and Mr. Croll's notice of two river channels buried under drift. Mr. Powrie's paper is illustrated with five plates of roughly executed, but tolerably characteristic figures. The part also contains a biographical notice of the late Prof. J. D. Forbes.

The American Gaslight Journal and Chemical Repertory states that Professor Loomis, who claims to have discovered a way to transmit messages by electrical air currents without the aid of wires, wants to be appointed Consul to some European port, that he may experiment on the summit of Mont Blanc.

FOR many years it has been a query whether the electric current might not be brought so far under man's control as to take the place of steam as a motor for machinery, and success has at last crowned the persevering efforts of scientists. At the last exhibition of the American Institute, there was seen an elliptic lock-stitch sewing machine, driven by a small electric engine which might easily be put into a common hat box. A series of eight magnets are set on the periphery of a circle, and around these revolves an armature of steel, which is continuously propelled by the magnetic action, and thus operates the machinery that moves the needle. Connection with this motor is had by means of a small slide within easy reach of the operator, at whose will the current may be cut off entirely, or the speed of the needle graduated as may be desired. The use of this motor, if it becomes general, cannot fail to prove of the utmost benefit to ladies, especially to machine operators, as it does away entirely with the necessity for using the feet, as is now the case, and must be highly conducive to the health of females, who suffer from many diseases that are generated by the constant strain on the pedal and limb muscles. The inventor of the engine in question is Charles Gaume.

A LARGE chemical laboratory is projected at Harvard. The library building is also to be greatly enlarged.

WE regret to learn that a wing of the Emperor's Palace in Pekin has been burned, containing the Imperial printing-office, with large stores of books and block-types. The books printed at the Imperial cost for the last two centuries have issued from this printing office.

Prof. W. H. Miller, of Cambridge, has been elected a correspondent of the French Academy of Sciences, in place of Prof. Fournet, of Lyons. The other candidates were MM. Abich; G. Bischoff; A. Boué; Dana; v. Dechen; Domeyko; J. Hall; v. Hauer; v. Helmersen; C. T. Jackson Kjerulf; v. Kokscharow; F. Romer; Scacchi; A. Sismonda; Studer, and Sir W. Logan.

THE Cleveland correspondent of the *Engineer* states that operations are in progress for working upon a large scale the salt deposits underlying Middlesborough.

WHATEVER may be the case in our own country, it is gratifying to see that there exists in France considerable sympathy between scientific and literary men. Professor Sars, the late eminent zoölogist at Christiansen, left a large family in very impoverished circumstances; and an appeal for their relief was made in our columns by Mr. Gwyn Jeffreys, from his personal knowledge of the case, to the naturalists and geologists of Great Britain. This appeal was seconded in France by M. Alglave, in his *Revue des Cours Scientifiques;* and the result has been highly successful in both countries. It must tend to foster and increase the sentiment allied to that of freemasonry which animates men of science everywhere without regard to nationality. But in France this charitable movement has not been confined to scientific men. M. Emile Girardin, in *La Liberté*, has advocated it with his usual ability and energy; and in the list of French subscribers to the fund are the names of his Excellency M. Segris, the Minister of Public Instruction, M. Villemessant, the Chief Editor of *Figaro*, Alexandre Dumas, fils, the Society "des amis des lettres" at Paris, the Stanislaus Literary Society at Nancy, Clery the painter, *L'Echo de la Sarbonne*, and many others of a similar kind. Let us hope that science, arts, and letters may be associated here also on the same friendly footing, each promoting the objects of the other, and all working together although placed in different grooves of the machine.

AT the annual general meeting of University College, London, Mr. George Grote presided, and the following students of the College, who had "passed distinguished examinations for University degrees," some at London alone, others at Cambridge as well as at London, were admitted Fellows of the College on the nomination of the Council:—in Arts, Mr. Numa Edward Hartog, Mr. Alfred Slater West, Dr. Richard Francis Weymouth, and Mr. Augustus Samuel Wilkins; in Medicine or Science, Dr. Henry Charlton Bastian, Mr. Marcus Beck, Dr. Frederick George Finch, and Dr. Edward Lloyd Harries Fox.

DR. J. H. GLADSTONE will bring the subject of "Indices of Refraction" before the next meeting of the Chemical Society.

THE Board of Trinity College, Dublin, has nominated the Rev. T. Leslie, F.T.C.D., to the Professorship of Natural Philosophy in Trinity College.

THE President, vice-Presidents, and Committee of the Quekett Microscopical Club have issued cards for a conversazione on Friday evening the 11th, at eight o'clock.

WE learn with much regret that the celebrated botanist, Prof. Fr. Unger, died suddenly on February 13th, at Gratz.

WE hear that the number of candidates for the place of Assistant-Registrar about to be created at the University of London is very great. Among them are men of high position and attainments, who are perhaps desirous to obtain a footing in London. They will know their fate ere long, for the choice of the Senate is to be made in the course of this month.

WE hear that the "Ladybirds" which excited so much curiosity last autumn, have reappeared in large numbers in the neighbourhood of New Wandsworth. So early an appearance will surprise most of us who have been wont to regard these visitors as summer guests.

WE learn from the *Athenæum* that the Société de Géographie has awarded the Empress's new prize of 10,000 francs to M. de Lesseps, and that he has given the money as a contribution to the Society's projected expedition into equatorial Africa.

THE *Pall Mall Gazette* reports that all the medical men connected with the case of the Welsh fasting girl were to appear last Monday before the justices at Llandyssil, to answer the charge of "wilfully killing and slaying" Sarah Jacobs, the prosecution being instituted by the Government.

NOTICE is given that at the annual election of fellows to be held in October next at the University of Cambridge, one fellowship will be given for proficiency in the natural sciences. The examination will be held in the latter half of the month of September, on days hereafter to be fixed. The subjects for examination will be those appointed for the natural sciences tripos. The competition for this fellowship will be open to any member of the University who shall have attained the degree of B.A., B.L., or M.B., and whose standing after such degree shall not exceed three years.

WE have received from the Canadian Government Emigration Office the Year Book and Almanac of Canada for 1870, containing statistics and other useful information relating to British North America, and a map showing the railways and their principal connections.

THE current number of the *Revue des Cours Scientifiques* contains a translation of Mr. Carruthers' lecture at the Royal

Institution, on the Cryptogamic forests of the coal period, and a continuation of the report on the Anthropological Congress at Copenhagen.

Cosmos states that the cavern of Montesquieu-Avantès (Ariége) has been recently explored by M. F. Regnault, of Toulouse, who discovered, on the surface of a hearth covered with stalagmite, bones of ruminants and human bones, the latter consisting of fragments of skulls, leg and arm bones. The whole were sent to M. F. Garigou, who declares that both kinds of bones are broken in the same manner, and each bears indications of a smashing instrument and of a sharp tool that has scratched them. These bones are said to be exactly similar to those which were regarded as furnishing decided proof of cannibalism, at the Anthropological Congress in 1867. M. Garigou writes that he has no hesitation in agreeing with MM. Spring, Dupont, Schaffausen, Broca, Carl Vogt, Steenstrup, &c., that primitive man was, like modern savages, anthropophagous.

Les Mondes also reports that Prof. Capellini of Bologna, has discovered remains of man and of animals in a cavern in the island Galmeria, the access to which is difficult and dangerous. In excavating he found many implements of flint and stone, the working of which showed that they belonged to the most remote stone age. Besides objects referrible to the hand of man, he found many which had been carried there by the human inhabitants of the cave, and a considerable quantity of animal bones, mixed with the human bones. The condition of the latter indicated that the cave had been inhabited by cannibals. At the centre of the cave were traces of a hearth.

DR. BERTHOLLE has communicated to the Société Médico-Chirurgicale the particulars of what he believes to be a case of spontaneous combustion, which recently came under his notice, the subject being a woman who was an habitual spirit drinker frequently suffering from *delirium tremens.*

THE *Siècle* states that M. Combes has declined to act on the commission charged with the temporary direction of the Paris Observatory, and that his place has been filled by M. St. Claire Deville.

WE have received the prospectus of a new series of the "Zeitschrift für die gesammten Naturwissenschaften," edited by Dr. C. G. Giebel and Dr. M. Siewert, of Halle. One of the main features of the journal is to be the publication of monthly reports of the progress of astronomy and meteorology, physics and chemistry, geology, mineralogy, palæontology, botany, and zoology.

Cosmos reports the death of M. Florent Prevost, assistant-naturalist at the Museum of Natural History, and known for his useful work in connection with the agronomic applications of zoology.

WE have received from the Chairman of the Technological Commission of Victoria, a report on the promotion of technical and industrial instruction, by lectures and otherwise, among the working classes of Victoria.

THE Food Committee of the Society of Arts had recently before them a specimen of meat treated by Professor Gamgee's process. A joint of mutton—stated to be part of a sheep slain on December 28th, and to have been, since the treatment, simply hung up in Professor Gamgee's premises—was roasted and tasted by the Committee, who pronounced it very satisfactory; but the Committee considered that a test over a longer time and at a warmer period of the year, was necessary before any decided opinion as to its success could be given. Another joint—from a sheep slain on the 22nd December—was ordered to be placed in charge of the Secretary, to be tested at a future time. Mr. Tallerman also exhibited specimens of meat imported from Australia, and showed it both cooked and uncooked. He explained the plan he had adopted, by means of which cheap dinners were prepared from it for the use of the people. Specimens of raw meat from Australia, preserved in tins by Manning's process, were brought before the Committee. The meat consisted of beef steaks, which were cooked and tasted by the Committee. The meat, though sound, was not considered satisfactory in flavour.

Cosmos reports the death of M. Foucou at New York, shortly after establishing himself at Oil Creek, where he intended to carry on the working of petroleum, to the industrial application of which he had given much attention.

MR. HARTNUP, astronomer at Liverpool, has published his annual report to the Marine Committee Mersey Docks and Harbour Board, and is no doubt not a little gratified at dating it from a new Observatory. The old building having been swept away by dock improvements, a new site was found on the left bank of the river, on the top of Bidston Hill, about a mile to the rear of Birkenhead Docks, and two hundred feet above the mean sea-level. The new building occupies about five hundred square yards in an acre of land set apart for the use of the Observatory. Underground rooms, with arrangements for elevating the temperature at pleasure, are provided for the testing of nautical instruments. In each hot-air chamber one hundred chronometers can be placed at once for examination. Two octagonal, domed rooms, twenty feet in diameter, rise at opposite angles of the building, one being occupied by the transit, the other by the equatorial instrument. In the words of the report, "The site is remarkably favourable for astronomical and meteorological observations." We may, therefore, hope to hear of much good work being accomplished at the Liverpool Observatory. To facilitate comparison of chronometers without the trouble of carrying them to the Observatory, a time-gun has been placed on the river brink near the landing-stage at Birkenhead. This gun is fired every day at one o'clock by a galvanic current sent from the standard clock on Bridston Hill, and masters of vessels lying in the port thus get the true time. Besides the observations of transits required for the service of the establishment, the usual meteorological observations have been taken, comprising daily and hourly readings of the barometer, the velocity and direction of the wind, the amount and duration of windfall, and the mean daily temperature of evaporation. All these results, collected into tables, are published at the end of the report, and thereby add to its utility. The site of the old Observatory was in latitude 53° 24′ 48″ N., and longitude 3° 0′ 1″ W. from Greenwich: the new Observatory is 17·04 seconds farther to the west.

ACCORDING to the Sydney Correspondent of the *Times* the production of sugar in Australia appears to be progressing rapidly and successfully.

WE learn from the *Society of Arts Journal*, that at a recent meeting held at the Town Hall, Reading, it was decided to accept the offer made by the Hon. Auberon Herbert, and to establish a free library.

FOR many years past the French physician, M. Burg, has been engaged in investigating the effect of copper as a preservative and curative agent in cholera. In support of his theory, M. Burg instances the immunity enjoyed by workers in this metal from cholera. He has obtained from the Prefect of the Paris police, certain statistics which go to prove that this immunity in the case of copper-workers has a real existence. In the instances of jewellers, engravers on metal and clockmakers, out of a population of 11,500, there were 16 cases of cholera, or 1 in 719. Engravers in copper, makers of metal eyelet-holes, jewellers working with copper, had, in a population of 6,000, 6 cases, or 1 in 1,000. Founders, tap-makers, chisellers, turners in bronze, lamp-makers, and workers in counterfeit gold, had, in a population of 14,000, 7 cases, or 1 in 2,000. Opticians using copper, mathematical instrument makers, musical instrument makers, stampers, metal polishers, &c., out of a population of 5,650, had not a single case of cholera.

BOTANY

Movements of Chlorophyll

ACCORDING to observations recently made by the French botanists, MM. Prillieux and Roze, the grains of chlorophyll in the leaves of plants assume different positions according as they are exposed to light (either natural or artificial) or to darkness. In darkness these grains, together with protoplasmic threads to which they are attached, are in contact with the walls which divide the cells from one another; under the influence of light they gradually change their position from these to the upper or under walls which form the surfaces of the leaf. M. Roze believes that this motion originates in the protoplasmic threads, which are the vital and animating part of the cell. (*Comptes Rendus.*)

Dependence of the Distribution of Plants on that of Animals

PROF. HILDEBRAND continues in the *Botanische Zeitung* his account of Delpino's investigations on the Dependence of the Geographical Distribution of Plants on that of Animals (see NATURE, No. 9, p. 246). In passing from the tropics to the temperate regions, we observe a general falling off in the number of species of native plants, caused by the disappearance of those animals which are needful for their fertilisation. Thus a large number are lost whose impregnation depends upon humming-birds. Roses and pæonies disappear where the larger Coleoptera are no longer found. The greater number of *Sileneæ*, and especially the night-flowering species of *Silene* and *Lychnis*, find their limits where nocturnal Lepidoptera cease. In the Arctic zone those plants only can be found which are fertilised by the agency of Hymenoptera, Diptera, or the wind. This law is illustrated by the flora of Nova Zembla lying between 71° and 76° N. lat., and Spitzbergen, between 76° and 80° N. lat. Out of 124 species of flowering plants constituting the phænogamous flora of Nova Zembla, six belong to the tribe *Pedicularineæ*, which are neither self-fertilised, nor by the agency of the wind, but entirely by the help of Hymenopterous insects. The inference is drawn that, notwithstanding the severity of the climate (the mean temperature of August, the hottest month in the year, not rising above 5° C. or 41° F.), some insect of this class must find its home there. Accordingly Spören records observing a single beetle and a ground-bee, with a few flies and midges. The insect described as the ground-bee is probably the widely-diffused *Bombus terrestris*, one of the most active of insects in the fertilisation of plants. Prof. Delpino thus classifies the 124 flowering plants of Nova Zembla: 16 dichogamous, fertilised by Hymenoptera; 84 dichogamous or homogamous by Hymenoptera or Diptera; 24 dichogamous by the wind. Out of 91 flowering plants found in Spitzbergen, 2 may be described as fertilised by Hymenoptera, 63 dichogamous or homogamous by Hymenoptera or Diptera, and 26 by the wind. In neither country are there any plants dependent on Lepidoptera for their fertilisation.

A. W. B.

M. JOSE DI CANTO has successfully introduced, on an experimental scale, the cultivation of *Cinchona officinalis* into the Azores.

SCIENTIFIC SERIALS

The last number of Poggendorff's *Annalen der Physik und Chemie* (vol. cxxxviii. part 4), contains the following papers:—(1.) "Thermo-chemical Investigations, Part iii." by Julius Thomsen (pp. 497 to 514). This communication relates to the calorimetric behaviour of the acids of sulphur and selenium when neutralised with bases. The author's numerical results differ considerably from those of Favre and Silbermann. This difference is ascribed by him to the use, by those investigators, of the mercurial calorimeter, which he considers to be "altogether inapplicable for accurate determinations." (2.) "Mineralogical Communications" (ninth part), by G. vom Rath (pp. 515 to 550). (3.) An addition to a previous communication "On the crystalline forms of salts of certain sulpho-acids derived from phenol," by the same author (pp. 550 to 553). (4.) "Experiments on Irradiation," by Wilhelm von Bezold (pp. 554 to 560). This paper contains a description of experiments whereby the imperfect achromatism of the eye is made strikingly evident, and also of a method of producing analogous effects objectively upon a screen by means of a simple unachromatised convex lens. (5.) "On the vibrations of a plate of air corresponding with those of a solid plate," by E. H. Vierth (pp. 560 to 563). Two Chladnis plates were fixed by means of a clamp parallel to each other, and one about a millimeter above the other, a disk of cork being placed at the centre to prevent them touching. The upper plate being thrown into vibration by means of a fiddle bow, the distribution of nodes and loops in it and in the stratum of air between the plates, was ascertained by strewing sand upon each plate. The sand figures formed, respectively, upon the upper plate by its own vibrations and upon the lower plate by the vibration of the stratum of air, were markedly different, but, nevertheless showed a distinct correspondence. (6.) "On the corrosion-figures and asterism of Iceland spar," by Heinrich Baumhauer (pp. 563 to 565). (7.) "Reply to the critical remarks of Mr. L. Boltzmann," by R. Most (pp. 566 to 570). In this paper, which is entirely mathematical, the author maintains the accuracy of a demonstration of the second fundamental theorem of the mechanical theory of heat communicated by him to a previous number of the *Annalen*. (8.) "Experimental investigation into the influence of temperature on electromotive force," by L. Bleekrode (pp. 571 to 604). Solutions of salts of various metals were placed between precisely similar electrodes of the same metal in each case as that contained in the salt employed, and the electrodes were connected by a metallic circuit of great resistance, containing a delicate reflecting galvanometer. When the liquid in contact with one of the electrodes was heated, a current was obtained in most cases of such a strength as to indicate a change of electromotive force between the metal and liquid approximately proportioned to the change of temperature. The experiments seem to show that the currents observed were of the nature of thermo-currents, but they are not quite conclusive on this point. (9.) "On new Sulpho-salts" (third communication), by R. Schneider (pp. 604 to 628). (10.) "Experiments on combinations of Mica" (from the Proceedings of the Berlin Academy, July 1869), by E. Reusch (pp. 628 to 638). If a number of thin plates of biaxal mica are superposed, so that the principal section of each makes an angle of 60° with that of the preceding one, the combination has the optical properties of a uniaxal crystal causing rotation of the plane of polarisation to the right or left, according to the direction in which each plate of mica is turned relatively to the preceding one. (11.) "On the separate perception of an Over-tone simultaneously with the Fundamental tone," by C. B. Greiss (pp. 638 to 640). This paper contains nothing new, except that it ascribes to Prof. Tyndall a well-known experiment of Helmholtz's. (12.) "Reply to Dr. Mohr," by A. Von Lasaulx (pp. 640 to 642), respecting the formation of basalt. (13.) "On the motion of the light of the negative inductive discharge in rarefied air," by J. C. Poggendorff (pp. 642 to 644). When the discharge of an induction coil is allowed to pass between two fine platinum wires, the ends of which are within one millimetre of each other, the well-known negative glow recedes from the end of the negative wire, in proportion as the air in which the discharge is taken is more and more rarefied; and at the same time the position of the greatest evolution of heat by the negative discharge recedes similarly.

The Ibis, a quarterly journal of Ornithology, New Series, No. 21, January 1870. (Van Voorst.) The papers contained in this number are—(1.) "Notes on the Birds of the Peninsula of Sinai," by C. W. Wyatt. (2.) "On the Sun-birds of the Indian and Australian regions," by Lord Walden—an article showing an extraordinary acquaintance with the literature of the subject. (3.) "On a fourth collection of birds from the Fantee country," by R. B. Sharpe. (4.) "A list of the birds of Turkey," by Captain Elwes and Mr. T. E. Buckley—the first attempt at a compilation of all the available information respecting the ornithology of one of the least known European countries, including that acquired by the authors during a tour through various parts of the Turkish dominions. (5.) "On the Ornithology of Hainan," by Consul Swinhoe, hitherto well known by his successful researches in the sister island of Formosa—an article containing results quite as remarkable as those furnished by the writer's former explorations. (6.) "Notes on the birds of the Island of St. Helena," by J. C. Melliss. (7.) "Additional notes on Mr. Lawrence's list of Costa-Rican birds," by O. Salvin. (8.) "Notices of recent Ornithological publications," English, German, Finnish, Italian, Portuguese, and Australasian, wherein more than thirty works are briefly reviewed; and (9.) "Letters from Mr. Allen Hume, Drs. Jerdon and Malmgren, Captain Shelley, Messrs. Gurney, Harting, and Sharpe, Dr. Salvadori and Mr. Swinhoe." The number also contains four well-drawn and coloured lithographic plates, by Mr. Keulemans, representing seven species of birds, all but one hitherto unfigured.

STAR-DRIFT

WITH reference to the accompanying account of my paper on this subject, recently communicated to the Royal Society, it is to be remarked that the interest, if any, attaching to my results must be founded on the way in which they bear on received theories respecting the distribution of the fixed stars. It is quite evident that according to the views usually accepted, the stars which appear in any part of the heavens must be regarded as situated at very different distances from the eye; the faintest nine or ten times farther from us, at the very least, than the brightest, and the different stars altogether too far apart to exert any influence on each other. Indeed, whatever theory we may hold respecting stellar distribution, regarded generally, we must be prepared to recognise in the stars seen towards any part of the sky, objects which lie at very different distances. And regarding these objects as severally in motion, we must be prepared to find in general the utmost diversity, not only as respects the direction of the apparent motions of the stars, but also as respects the magnitude of these motions. It is only when one has adopted the theory that the stars are grouped according to special laws of aggregation, that one would be led to anticipate that here and there, almost as by accident, so to speak, some indications of their grouping might be discoverable in the characteristics of the stellar proper motions. Although I had become firmly convinced that the stars are not distributed throughout space with any approach to that general uniformity insisted on by many astronomers, I had very little hope that a suggestion I threw out a year ago in the pages of the *Student*, that the stellar proper motions if examined carefully might afford evidence in favour of my views, would be confirmed in any very distinct manner if the method I had pointed out should ever be applied. I knew that a certain community of motion in the constellation Taurus had led Mädler to important, but as I judged incorrect conclusions as to the nature of the stellar motions; but I also knew that that community of motion was one which could only be appreciated by the few who had convinced themselves of what was to be *expected* if the stars were uniformly distributed. I had an impression at that time that Mädler had examined the stellar proper motions over the whole of the northern hemisphere, and that it was the exceptional community of proper motion in Taurus which had led him to form his well-known theory respecting a central sun. It was only when I was reminded that he had in fact examined the stellar proper motions in the neighbourhood of Taurus alone, having been led by independent considerations to regard that neighbourhood as that within which a central sun was to be looked for, that I was encouraged to map down all the recognised proper motions. To my surprise I found that in Gemini, Cancer, and Leo, a community of motion far more striking than that noticed by Mädler in Taurus was to be recognised; and further, that though in other directions, as I had expected, stellar motions belonging to different depths in space were intermixed, it was yet possible to trace out laws of association indicating the existence of drifting star-groups in these directions also.

I lay very little stress on the indications which have led me to name the great double cluster in Perseus as more likely to be an important centre of motion than the Pleiades. But it is worthy of mention that Mädler required a star on the Milky Way as the centre of the galaxy, and Alcyone does *not* lie on the Milky Way; he required his centre to lie ninety degrees from the apex of the solar motion, and Alcyone does *not* lie ninety degrees from the mean of the last determinations of that point. The great cluster in Perseus fulfils both conditions in the most perfect manner.

RICHARD A. PROCTOR

A careful examination of the proper motions of all the fixed stars in the catalogues published by Messrs. Main and Stone (Memoirs of the Royal Astronomical Society, vols. xxviii. and xxxiii.) has led Mr. Proctor to the conclusion that in parts of the heavens the stars exhibit a well-marked tendency to drift in a definite direction. "In the catalogues of proper motions, owing to the way in which the stars are arranged, this tendency is masked; but when the proper motions are indicated in maps, by affixing to each star a small arrow whose length and direction indicate the magnitude and direction of the star's proper motion, the star-drift (as the phenomenon may be termed) becomes very evident. It is worthy of notice that Mädler, having been led by certain considerations to examine the neighbourhood of the Pleiades for traces of a community of proper motion, founded on the drift he actually found in Taurus his well-known theory that Alcyone (the *lucida* of the Pleiades) is the common centre around which the sidereal system is moving. But in reality the community of motion in Taurus is only a single instance, and not the most striking that might be pointed out, of a characteristic which may be recognized in many regions of the heavens. In Gemini and Cancer there is a much more striking drift towards the south-east, the drift in Taurus being towards the south-west. In the constellation Leo there is also a well-marked drift, in this case towards Cancer.

"These particular instances of star-drift are not the less remarkable, that the stars are drifting almost exactly in the direction due to the proper motion which has been assigned to the sun, because the recent researches of the Astronomer Royal have abundantly proved that the apparent proper motions of the stars are not to be recognised as principally due to the sun's motion. Mr. Stone has shown even that we must assign to the stars a larger proper motion, on the average, than that which the sun possesses. Looking, therefore, on the stars as severally in motion, with velocities exceeding the sun's on the average, it cannot but be looked upon as highly significant that in any large region of the heavens there should be a community of motion such as I have described. We seem compelled to look upon the stars which exhibit such community of motion as forming a distinct system, the members of which are associated indeed with the galactic system, but are much more intimately related to each other. In other parts of the heavens, however, there are instances of a star-drift opposed to the direction due to the solar motion. A remarkable instance may be recognised among the seven bright stars of Ursa Major. Of these, the stars β, γ, δ, ϵ, and ζ are all drifting in the same direction, and almost exactly at the same rate towards the "apex of the solar motion," that is, the point *from* which all the motions due to the sun's translation in space should be directed. If these five stars, indeed, form a system (and I can see no other reasonable explanation of so singular a community of motion), the mind is lost in contemplating the immensity of the periods which the revolutions of the components of the system must occupy. Mädler had already assigned to the revolution of Alcor around Mizar (ζ Ursæ) a period of more than 7000 years. But if these stars, which appear so close to the naked eye, have a period of such length, what must be the cyclic periods of stars which cover a range of several degrees upon the heavens? In like manner the stars α, β, and γ Arietis appear to form a single system, though the motion of α is not absolutely coincident either in magnitude or direction with that of β and γ, which are moving on absolutely parallel lines with equal velocity. There are many other interesting cases of the same kind." The author hopes soon to be able to lay before the Royal Society a pair of maps in which all the well-recognised proper motions in both hemispheres are exhibited on the stereographic projection. In the same maps also the effects due to the solar motion are exhibited by means of great circles through the apex of the solar motion, and small circles or parallels having that apex for a pole. The star-drift described by Mr. Proctor serves to explain several phenomena which had hitherto been thought very perplexing. In the first place, it accounts for the small effect which the correction due to the solar motion has been found to have in diminishing the sums of the squares of the stellar proper motions. Again, it explains the fact that many double stars which have a common proper motion, appear to have no motion of revolution around each other; for clearly two members of a drifting system might appear to form a close double, and yet be in reality far apart and travelling, not around each other, but around the centre of gravity of the much larger system they form part of. While mapping the proper motions of the stars, Mr. Proctor has been led to notice that the rich cluster around χ Persei falls almost exactly on the intersection of the Milky Way with the great circle which may be termed the equator of the solar motion; that is, the great circle having the apex of the sun's motion as a pole. This circumstance points to that remarkable cluster, rather than to the Pleiades, as the centre of the sidereal system, if indeed that system has a centre cognisable by us. When we remember that for every fixed star in the Pleiades there are hundreds in the great cluster in Perseus, the latter will seem the worthier region to be he centre of motion. The author is disposed, however, to regard the cluster in Perseus as the centre of a portion of the sidereal system, rather than as the common centre of the Galaxy.

SOCIETIES AND ACADEMIES

Royal Society, February 24.—The President in the chair. The following papers were read: "Note on certain Lichens." By John Stenhouse. Usnic acid extracted from *Usnea barbata* by dilute solution of carbonate of soda was found to have the formula $C_{18} H_{18} O_7$, and the sodium salt $C_{18} H_{17} Na O_7$. This result accords with that of Hesse and differs from that of Knop, Rochleder, and Heldt, whose analysis give the formula $C_{19} H_{18} O_7$. Usnic acid was also obtained from *Evernia prunastri* as well as evernic acid. Tetrabrom-evernic was got by the action of bromine on evernic acid. Its formula is $C_{18} H_{12} Br_4 O_7$. The acid extracted from *Cladonia rangiferina*, though possessing the same composition as usnic acid, was observed by Hesse to have a different melting-point (175° C.) from ordinary usnic acid (203° C.) He proposed, therefore, to call it β-usnic acid, as it so closely resembled ordinary usnic acid in its general character. The author has found that ordinary usnic acid, melting at 203° C., obtained from *Evernia prunastri*, *Ramalina calicaris*, and the various *Usneas*, does not yield a trace of β-orcin when distilled, whilst, on the contrary, the acid extracted from *Cladonia*, on being subjected to the same treatment, yields β-orcin; thus showing a marked difference in the products of its decomposition from ordinary usnic acid, as well as in its melting-point. Under these circumstances, therefore, he proposes to name the acid from *Cladonia rangiferina* "Cladonic Acid," instead of β-usnic acid, as proposed by Hesse. He intends to continue the study of this acid.

"On the successive action of Sodium and Iodide of Ethyl upon Acetic Ether." By Prof. Frankland and Mr. B. F. Duppa. The authors, referring to a paper by Mr. Wanklyn, wherein it is stated that their interpretation of the nature of the reaction between sodium and acetic acid must be erroneous because it involves the disengagement of hydrogen, remarked that Mr. Wanklyn's opinion is founded upon experiments which differ essentially from their own, and not warranting the conclusion which he has drawn from them. The authors allowed all evolved gas freely to escape, while Mr. Wanklyn operated in sealed tubes under great pressure. M. L. Cailletet has recently shown that the evolution of hydrogen from zinc and hydrochloric acid is gradually diminished and finally stopped under increasing pressure, while the evolution of hydrogen from sodium-amalgam and water is diminished and finally stopped in a sealed tube. Since pressure retards or even interrupts a reaction in which a permanent gas is evolved, whilst it is known to exercise little or no influence upon other chemical changes in which no evolution of gas takes place, the authors consider this influence of pressure affords an explanation of the difference between the results of Mr. Wanklyn's experiments and their own, as regards the evolution of hydrogen during the action of sodium upon acetic ether. They confirm his observation that sodium dissolves in valeric ether, under ordinary atmospheric pressure, without the evolution of any gas; adding that since a reaction, whatever its nature may be, which thus proceeds readily with ethylic valerate, can scarcely be impossible with its homologue, acetic ether, it is probable this reaction goes on side by side with those which they have described, but that when the pressure is moderate those changes chiefly take place which involve the disengagement of hydrogen, whilst under the great pressure arising in sealed tubes, those changes being more or less suppressed, the reaction observed by Mr. Wanklyn comes into prominence. The authors reserve their observations upon Mr. Wanklyn's views regarding the changes which take place when sodium acts upon acetic, butyric, and valeric ethers, until the publication of the experimental data upon which those views are founded.

Ethnological Society, February 22.—Prof. Huxley, president, in the chair. Mr. E. Backhouse was announced as a new member.—By the courtesy of Dr. Lockhart, a calva from China was exhibited by Prof. Busk, in illustration of a former paper on an ancient calvaria which had been assigned to Confucius. The skull is mounted in copper, and was formerly supported on a tripod and furnished with a lid.—"On discoveries of archæological interest in recent deposits in Yorkshire." By Mr. C. Monkman, of Malton. The author described the discovery of worked flints in the clay of Kelsea Hill, in the East Riding of Yorkshire. This was formerly regarded as belonging to the Hessle clay—a post-glacial deposit unconformable to the true boulder clay of Holderness—but it is probably only a derivative clay washed from the Hessle deposits on Kelsea Hill. It may, therefore, be of comparatively recent origin. Large finds of implements of Neolithic type are reported to have been made in the York sands. Many stone implements have also been found in the old river deposits in the Vale of Pickering, chiefly turned up in the prosecution of land-drainage works. The paper was illustrated by a fine collection of specimens.—"On the Natives of Naga, in Luzon, Philippine Islands." By Dr. Jagor. The author described in detail the manners and customs of the Bicol Indians who inhabit this locality. Dr. Campbell inquired whether there was any connection between the name of this place and the Sanskrit *naga*, a snake.

Entomological Society, February 21.—Mr. Alfred R. Wallace, president, in the chair. Professor Schiödte and Siebold were elected honorary members. Messrs. B. J. Lucas and G. T. Porritt were elected annual subscribers.—Mr. J. Hunter exhibited a moth captured in the New Forest, and supposed to be *Plusia ni*.—Mr. Albert Müller exhibited galls formed in the florets of the tansy by *Dipterous* larvæ.—Mr. Pascoe exhibited a beetle from King's George's Sound, the *Nepharis alata* of Castelman—*Hicketes thoracicus* of King, which latter name sinks.—Mr. A. G. Butler read a paper "On butterflies recently received by Mr. Swanzy from West Africa." Three new species were described of the genera, *Romalcosoma*, *Philognoma*, and *Mycalesis*.

London Mathematical Society, February 10.—Prof. Cayley, president, in the chair. Mr. A. Ramsay was elected a member. The president gave an account (second communication) of his paper on "Quartic Surfaces."—Mr. Walker made some further remarks on the subject of his paper on the "Equations of Centres and Foci, and conditions of certain Involutions," read at the January meeting of the society.—The condition that a quadric (v) should determine a pair of corresponding points in one of the three involutions given by a quartic (u) is the vanishing of the cubic invariant of $\overline{12}\, uv$. When u and v are the Jacobian and quadric covariants of two cubics the preceding condition expresses that the two cubics determine an involution. When one of the two cubics (v) is the cubic covariant of the other (u) the two determine four distinct involutions; and the Hessian of u determines the foci in one of the four—viz., that in which the points harmonically correspondent are also correspondent in the involution. The other three involutions are not analytically distinguishable one from another.—Mr. Clifford read a paper "On a case of Evaporation in the order of a Resultant." In it he established the two following theorems:—"Let it be required to eliminate x between two equations homogeneous in x, and certain other variables $y, z, \ldots$ in which equations, however, x only occurs in virtue of the occurrence of a quantity $w = x^{\alpha} y^{\beta} z^{\gamma}, \ldots$ where $\alpha + \beta + \gamma + \ldots = \mu$; let, also, m, n be the orders of the equations, and h, k the remainders after division of m and n respectively by μ; then the order of the resultant is

$$= \frac{m\, n - hk}{\mu}."$$

Theorem 2. "Let it be required to eliminate $\kappa - 1$ variables $x, y, \ldots$ from k equations homogeneous in these and certain other variables, in which equations, however, x, y, only occur in virtue of the occurrence of $k - 1$ quantities $u, v, \ldots$ all of the same order μ; let also $m_1, m_2, \ldots m_\kappa$ be the orders of the equations, and $m_i = p_i \mu + h_i$, $h_i < \mu$; then the order of the resultant is

$$\Pi p \left(\Sigma \frac{h}{p} + \mu\right)."$$

Mr. Perigal presented to the Society a copy of his "Geometric Maps and Contributions to Kinematics."

Meteorological Society, January 19.—Charles V. Walker, president, in the chair. The Rev. J. Crompton, Dr. C. Fox, and Mr. E. J. Sykes were elected Fellows. The following papers were read: "On the Temperature and Humidity of the Air at the Heights of 22 feet and 50 feet above the ground, in comparison with the Temperature and Humidity of the Air at the Height of 4 feet." By Mr. Glaisher. Our knowledge of the temperature and humidity of the air near the surface of the earth is almost entirely confined to within 4 or five feet above the earth. The theory that the temperature was always lower at higher elevations was proved not to be at all times true, and the theory of the decline of 1° of temperature in every increase of 300 feet of elevation, was proved to be erroneous. The author stated the results of his observations in the great Captive Balloon, at Ashburnham Park, Chelsea, which M. Giffard kindly placed at his disposal for the purpose. This balloon could ascend to the height of 200 feet on a calm day; its rate of ascension could be regulated at will; it could be kept stationary at any elevation, and experiments could be repeated several times in the day. From these results the author considered it to be evident that observations, even up to 50 feet, give more information than could be obtained by the use of either a free or captive balloon, as to the temperature and humidity of the air at moderate elevations. If carried through an entire year, this would give the seasonal as well as diurnal changes; such experiments are in progress at present, and several months' observations have already been made, the results of which will be placed before the Society at a future time.—"Rainfall at Jerusalem during the Rainy Season of 1868-69." Dr. T. Chaplin.

MANCHESTER

Literary and Philosophical Society, February 8.—Mr. J. P. Joule, president, in the chair. Mr. Binney, referring to his previous notice of stray boulders without traces of clay, high up the western slopes of the Pennine chain, about 1,000 feet above the level of the sea, said that Mr. A. H. Green and his colleagues had stated, in their valuable memoir on the carboniferous limestone, yoredale rocks, and millstone grit of North Derbyshire and adjoining parts of Yorkshire, just published by the Geological Survey, that they believed the eastern plain from Sheffield through Chesterfield down to Belper, to be in the main free from drift. Mr. Binney had often searched for boulders in the neighbourhood of Chesterfield. The only foreign rock which he met with in that district was a large block of greenstone several hundred pounds in weight, above the valley of the Hippei near Spring Bank and below the waterworks station, Chesterfield. The stone was well rounded and polished. He mentioned the fact to direct the attention of observers to this subject on both the eastern and western slopes of the Pennine chain. Probably they have only to be more diligently sought for in order to be found in greater abundance.

"On Convertent Functions." By Sir James Cockle. This was a supplement to the author's paper "On convertent functions." The convertent equation (3) contains in substance only one disposable arbitrary, and the sign of summation Σ does not increase, and may be expunged from it without diminishing, its generality. Consequently the process would fail to convert the Boolian integral for the cubic and lead only to illusory results. But a recognition of this failure had led him to another form of convertent equation. And first, if to the several dexters of (2) and (3) we add a term h, then the conversion will be possible, even though h be not a perfect differential co-efficient, provided only that $\int hdu$ be assignable within the limits of the integration.

Mr. Spence repeated the experiment he had made at the Exeter meeting of the British Association, showing that the temperature of saturated saline solutions could be raised to their boiling points by merely passing them through ordinary steam at a temperature of 212°. Thus, a solution of chloride of sodium was raised to a temperature of 221°, and one of chloride of calcium to 248°.

"On the Natural Ropes used in packing Cotton Bales in the Brazils." By Mr. Charles Bailey. Most of the cotton bales which reach this country from the Brazils are corded with the long stems of climbing plants growing in profusion in the forests bordering on the cotton districts. In their fresh state these stems are exceedingly pliant and of remarkable strength, so that they serve admirably for cordage purposes, but by the time that the cotton reaches the mills of Lancashire they become dry and rigid, and as no further use can be made of them, they are burned for firewood. Being very long, they are very troublesome to put on the boiler fires, and most millowners are glad to get rid of them. These objects are invested with singular interest when examined in regard to their structure, for although the external form of many of them is extremely curious, their chief interest centres in their remarkable internal organisation. Although they reach this country in immense quantities, they are not often to be met with in our museums or colleges, and the names of the plants which produce them are for the most part unknown. The *Bignoniaceæ* stands pre-eminent as the natural order most largely used for supplying lianas for packing purposes, both as regards the quantity of ropes, and the largest number of species. *Malpighiaceæ*, *Sapindaceæ*, *Leguminosæ*, *Aristolochiaceæ*, and *Ampelidæ* also yield these ropes. There are many other species found amongst these ropes which belong to other natural orders, such as the *Menispermaceæ*, *Gnetaceæ*, *Asclepiadaceæ*, &c., but our knowledge of them is too limited to assign them to their respective orders. Most of the author's specimens have come from bales of Santos cotton. The whole of these lianas furnish beautiful objects for the microscope.—Mr. Forrest suggested that useful dyes might be obtained from the plants described by Mr. Bailey.—In reply to a question from the Rev. Brooke Herford, Mr. Bailey stated that owing to a difference in the structure and general appearance of some of the stems in his possession, he had been led to suspect that they were aërial roots of some of the plants he had exhibited and described.

CAMBRIDGE

Philosophical Society, February 21.—The following papers were read:—"The antiquity of some of our familiar agricultural terms." By Mr. Paley (St. John's). After some general remarks upon the English language, and the fact that agricultural life was peculiarly favourable to the preservation of old words, Mr. Paley called attention to the fact that while in our language the generic names of animals are usually of Saxon origin, the words denoting their application are usually of classic origin. Words which are not generic, but particular and descriptive, are also generally of classic origin. He then proceeded to discuss the derivation of a large number of familiar agricultural terms in illustration of the above remarks.—"Proof that every rational equation has a root," and "The space theory of matter," both by Mr. Clifford (Trinity.)

GLASGOW

Natural History Society of Glasgow, January 25.—Prof. John Young, president, in the chair. "On the claims of Natural History as a branch of education" By J. W. Allan. The author advocated the teaching of zoology and other branches of natural history in schools, also that zoology should occupy a more important place in the curriculum in all universities. At its close Prof. Young made some remarks bearing on the different aspects of the question.—"On the introduction of the wild turkey (*Meleagris Gallopavo*) into Argyleshire." By John Gilmour. The author of this paper mentioned having received three specimens of this beautiful bird—a male and two females—from the southern extremity of Lake Huron, in Canada, in the summer of 1866, since which time various broods had been successfully reared in the neighbourhood of Ardlamont, where the birds had been allowed their full liberty in the woods. Mr. Gilmour concluded his paper with a description of the wild bird as compared with domestic breeds, remarking that it possessed greater symmetry with a more compact form, standing higher on its legs, and exhibiting other characters more like those of a game bird than one of the gallinaceous order. Mr. Gray mentioned that there are now supposed to be three different species of *Meleagris* besides the *M. ocellata* of Honduras and other parts of Central America, namely, *M. Americanus*, which is probably peculiar to the eastern half of North America; *M. Mexicana* of Gould, a species belonging to Mexico and extending along the table lands to the Rocky Mountains, the Gila and the Llano Estacado; also the *M. Gallopavo* of Linnæus, or domesticated bird. This last species was perhaps originally indigenous to one or more of the West India Islands, whence it was taken in a tamed state to various parts of North America, and thence to Europe about the year 1520. The domesticated bird differs from the nearly allied wild species in having a largely-developed dewlap extending from the base of the under mandible down the fore part of the neck to its base, and it cannot yet be said to be a settled question as to the precise original stock from which the valuable barn-yard breeds have descended.—"Notes on the genera of extinct fossil shells—*bellerophon* and *porcellia*; their classification amongst the mollusca, and their distribution in the silurian and carboniferous strata of the west of Scotland." By John Young. Mr. Young stated that at one time this interesting group of shells had been placed by palæontologists among the cephalopods, the highest division of the mollusca, and regarded as fossil representatives of the recent *argonautidæ*, which possess a symmetrically coiled shell as in *bellerophon* and *porcellia*, but, like them, not chambered as in the genus *nautilus*. In the more recent classification of the mollusca, *bellerophons* and *porcellia* are now placed amongst the gasteropods, and in that division termed the *neucleobranchiata*, which consist of entirely pelagic animals, some having shells, others none, and, according to Woodward, swimming at the surface instead of creeping on the bed of the sea. Prof. Owen believes, however, that it can scarcely be insisted all were necessarily floaters on account of their organisation. In recent seas the extinct genera are represented by the genus *Atlanta* and the sub-genus *oxygyrus*. In palæozoic times the genus *bellerophon* commenced its existence, so far as is known, in the lower Silurian, and became extinct in the carboniferous period.

NEWCASTLE-UPON-TYNE

Chemical Society, November 25, 1869.—I. Lowthian Bell, president, in the chair. "On the estimation of Peroxide of Manganese in Manganese Ores," by E. Sherer and G. Rumpf. The authors showed that the method of Fresenius and Will is open to the objection of giving results which do not always agree with those obtained in the practical use of manganese for producing chlorine. They recommended Bunsen's method of testing as better adapted for the valuation of manganese ore.

BRIGHTON

Brighton and Sussex Natural History Society, February 10. The president, Mr. T. H. Hennah, in the chair. The hon. sec., Mr. T. W. Wonfor, exhibited a collection of *galls*, found on British plants, made by Mr. W. H. Kidd, and read a description of each one of the insects producing them, drawn up by the same gentleman. The collection is intended for the Brighton Museum. Mr. Wonfor then read a paper on Seeds. Commencing with the first appearance of the ovule in the unexpanded flower-bud, as a pimple consisting of an aggregation of cells, its gradual development and the impregnation by the pollen, together with its coeval parts, were traced until the perfect seed, ready for dissemination and containing within it the embryo of the future plant, was fully formed. The various modes by which the seed is scattered, the numbers produced by some plants, the power possessed by some of resisting heat and cold, and the wonderful property possessed by others of preserving their vitality, under apparently very adverse circumstances, for long periods of years, were each discussed. On the subject of artificial selection, it was shown what has been done, notably by Mr. F. Hallett, of Brighton, with cereals in increasing both the size and number of grains in an ear; something similar might be done with other plants. Seeds, as objects for the microscope, were next discussed. From a long series of examinations of wild and cultivated seeds, spread over several years, while unwilling to lay down any law of classification by their microscopic appearance, yet often in the case of unknown seeds he had been able to determine the family to which they belonged from certain peculiarities common to many plants of the same family. Seeing how varied and beautiful they were, and how little preparation they required, he considered they were not attended to by microscopists so much as they deserved. The paper was illustrated by a large collection of seeds and microscopic preparations.

VIENNA

Imperial Academy of Sciences, January 7.—Memoirs were communicated "On some constituents of the fruit of *Cerasus acida*, Borkh.," by Professor H. Rochleder, and on a spiral valve in the portal vein of the Rodentia, by Professor J. Hyrtl. —Herr von Haidinger presented a note by Dr. S. Meunier on the victorite or enstatite of the meteoric iron of Deesa, in Chili, which was said to be perfectly colourless and transparent and to contain no trace of iron. He also made some remarks on the study of meteorites, regarding them as the last step in the development of our planetary system.—Professor F. Unger communicated a memoir on the occurrence of Typhaceous plants (*Typha* and *Sparganium*) in tertiary deposits.—Prof. E. Mach presented a preliminary communication on an apparatus constructed by him for the observation of sound-movements.—Dr. Samuel Kónya communicated an account of his investigation of the mineral water of Wielutza, near Jassy, in Roumania. He obtained about 0·9 per cent. of solid constituents, of which 0·574 was sulphate of soda, and nearly 0·18 sulphate of magnesia. The water also contained chloride and carbonate of magnesia.—A memoir by MM. J. Rumpf and F. Ullik, on the Ullmannite of Waldenstein in Carinthia, was presented by Professor Peters. —Professor Graber communicated an account of the Orthoptera of level districts among the Austrian Alps.

January 13.—A report was communicated from Dr. von Scherzer upon the proceedings of the scientific members of the East Asiatic Expedition. The following specimens were specially noticed:—Three Chinese and three Japanese skulls, a collection of freshwater fishes from Osaka in Japan, and a number of Chinese drugs.—A memoir "On nexus of curves," by Dr. Emil Weyr, was presented.—M. Haidinger communicated the contents of a series of letters from Professor W. H. Miller, relating to meteorites.—M. A. Waszmuth forwarded a memoir on a new method of determining the reduction-factor of a tangent compass. —Herr J. Effenberger announced that he had succeeded, upon scientific principles, in producing violins which in power of tone approached those of the old makers.—Professor Reuss presented a memoir on Upper Oligocene corals from Hungary, in which he described 16 species of corals from the beds in the neighbourhood of Gran, which contain abundance of *Nummulites Lucasana* and *perforata*, and were formerly regarded as of Eocene age: half the species are new; of the other half, seven have occurred in the beds of Castel-Gomberto and Oberburg.—A memoir by Dr. Leo Levschin, containing a description of the structure and vessels of the intestine of *Salamandra maculata*, was presented by Professor Langer.—Herr. F. Unferdinger communicated a memoir on the transformation and determination of a certain triple integral.—M. H. Obersteiner read a paper on some lymphatic spaces in the brain: and Dr. S. L. Schenk presented a memoir on the amount of nitrogen in the flesh of various mammals, in which he stated that this quantity is variable, ranging from 3·06 to 4·21 per cent.

PARIS

Academy of Sciences, February 21.—At this meeting M. Becquerel communicated a memoir on the production of electrocapillary currents in the bones, nerves, and brain.—M. de Saint Venant presented a report on a memoir by M. Boussinesq, relating to the theory of periodical liquid waves, and another on a supplement by M. Tresca to his memoir read on the 27th of November, 1864, on the flowing of solid malleable bodies pressed out of a cylindrical vase through a circular orifice.—The astronomical and physical communications were:—A notice of a direct and easy method of effecting the development of the perturbative function and of its differential coefficients, by Mr. S. Newcomb; and a note by M. A. Martin on the method adopted by Léon Foucault, to ascertain whether the surface of a mirror is strictly parabolic.—The following papers were read on chemical subjects:—A note on synthesis of aromatic acids, by M. A. Wurtz, in which the author described a series of acids produced by the action of amalgam of sodium upon mixtures of brominated toluene and chloride of benzyle, with chloroxycarbonic ether.—A paper containing facts relating to the stability as chemical species of normal propylic, butylic, and amylic alcohols, by MM. J. Pierre and E. Puchot. The authors described a series of observations made upon these substances under various conditions, from which they concluded that the three alcohols were specifically different. They remarked that amylic alcohol is the only one of the three which exerts any sensible action upon polarised light.—A memoir on the artificial digestion of feculent bodies by maltine, by M. L. Coutaret, in which he stated that the action of maltine or vegetable diastase upon cooked starchy matters is precisely analogous to that of the salivary diastase, and recommended the use of the former in cases of dyspepsia.—A note by M. A. Lamy on a new kind of thermometer, founded on the principle of "dissociation," that is to say, on the determination of the amount of gas given off by a solid body at different temperatures. The substance employed by the author is a double chloride of calcium and ammonia. The author regarded his method as particularly applicable to the determination of temperatures low down in the earth or in deep soundings. M. Becquerel remarked that for temperature-observations at various depths in the earth, he had several years ago proposed a method which gave good results.—A note by M. Reboul on combinations of the hydroacids with brominated ethylene and propylene.—A note by M. A. Colley on the action of the free haloids and of some chlorides upon glucose, in which he described a new compound obtained by the action of chloride of acetyle upon glucose, which he proposes to name *acetochlorhydrose* ($C^6H^7(C^2H^3O)^4Cl$).—A notice of a new phosphuretted compound by MM. Darmstädter and Henninger. This body, which the authors named *cyanethylphosphide*, was obtained by the action of an etherial solution of phosphuretted hydrogen upon chloride of cyanogen. And, lastly, a chemical and therapeutical investigation of the thermal water of the solfatara of Puzzoli, by M. S. De Luca; the water contains free sulphuric acid. The only purely mathematical communication was a memoir by M. Halphen on algebraical left curves.—General Morin presented a memoir by M. Goldenberg describing improvements introduced by him in the ventilation of the grinding and polishing works at Zorrhoff, near Saverne.—M. H. Sainte-Claire Deville communicated some further remarks by M. A. Schafarik, on the diamonds discovered at Dlaschkowitz in Bohemia, in which it was stated that fragments of the stone have been burnt, for the purpose of demonstrating its identity with diamonds from other localities.—A note from M. Liebreich on the use of strychnine as an antidote for chloral, was presented by M. Wurtz. The physiological action of these two substances was stated to be so antagonistic, that either of them may be employed with more or less effect as an antidote to the other.—M. Duchartre communicated a memoir by M. Prillieux on the formation of small masses of ice in the interior of plants. These masses, which occur in many plants, when exposed to severe frosts, were described by the author as composed of numerous prismatic needles closely applied to each other, and formed in lacunæ between the cells of the living tissues.—M. A. Chatin presented a second note on the causes of the dehiscence of anthers, in which he described the part taken in the production of this phenomenon by the second membrane or mesothecium.—M. F. Lenormant continued his notes on animals known to the ancient Egyptians, with an account of the domestication of some species of antelopes under the old empire, especially the fourth and fifth dynasties—Of the following communications no particulars are given. A memoir by M. Delaurier on a new general theory of the production of static and dynamic electricity,—an *electro-thermic theory*; a memoir on the pathology and therapeutics of cholera, by M. J. de Zycki of Wilna; a note by M. G. Adeline on the influence of copper as a preservative from cholera; a note by M. Allegret in continuation of his remarks on the geometrical representation of the elliptical function of the first kind with an arbitrary modulus, &c.; a note on the theory of magic squares, by M. Marie; a letter on the formation of ice, and a note on a case of catalepsy from Mr. Jackson Davis.

New Zealand

Wellington Philosophical Society, November 13, 1869.—Mr. W. L. Travers, F.L.S., in the chair.

Dr. Hector called attention to two live specimens of the mud fish from Hokitika, *Neochanna apoda* of Gunther. The specimens were swimming actively in clear water, and had perfect vision, although their eyes are small, so that the undeveloped state of the eye in the specimen previously received must have been exceptional. The Hon. Mr. Fox remarked that these mud fish were not peculiar to Hokitika. Five years ago he remembered seeing a fish dug up from a gravelly-clay ten feet below the surface at Rangitikei, and he believed that it was identical with the fish exhibited.

A remarkable meteor, observed in Wellington on the 8th inst. at 11.30 P.M., was described by the Rev. Mr. Stock. It was observed in E.S.E. and descended almost vertically with three distinct coruscations, attended by showers of sparks and bright prismatic colours. The brightness was equal to that of Venus. Mr. Kebbell and Mr. Gillon corroborated Mr. Stock's observations. A description of three additions to the New Zealand flora, with specimens, was laid on the table, and Dr. Hector gave a short abstract of a report by Mr. Kirk, of Auckland, on the botany of Cape Colville peninsular. This paper gave the results of a survey that had been made for the Geological Department for the purpose of obtaining an accurate record of the original vegetation, as it was undergoing rapid modification by the gold diggers. Several new species of plants were described, of which specimens were exhibited.

The next paper was a description of the mechanical apparatus employed in raising the *Taranaki*, by Mr. J. T. Stewart. Dr. Hector directed attention to a collection of the marine animals that were found on the vessel, among which are three species of *anomia*, two of *mytilus*, *ostrea*, *pecten*, *serpula*, *balanus*, and *teredo*. He remarked that some of these animals are usually confined to depths only slightly below low water. Their occurring so well-grown within a year at the depth of 100 feet, seemed to indicate that depth of water did not so much control their existence as a supply of nourishment, which was probably abundant near the wreck.

Mr. Skey showed that the temperature obtained by the common blowpipe, with proper precautions against conduction of heat, was at least 5,100° Fahr., as it is capable of fusing fine points of platinum, and described a new process to facilitate the analysis of supposed auriferous quartz, when sulphides were present in large quantities. Iodine or bromine is used as the solvent, and a rapid test is obtained by dipping filter paper in the solution and burning it with due care, when if gold be present a very characteristic purple hue is imparted to the ash. By this test the presence of gold in the proportion of one dwt. in the ton can be detected with great economy and certainty.

Dr. Hector described the bones of a fossil penguin recently discovered on the west coast of Nelson, and presented to the museum by Mr. Dingan. The discovery is interesting, as a fossil bone found by Mr. Mantell in the Oamaru limestone of Otago in 1849, was pronounced by Prof. Huxley to belong to a gigantic penguin five feet in height. The fossil bones found by Mr. Dingan, appeared to be those of a bird not larger than penguins that still exist in antarctic seas. The fossil shells sent from the same formation as the bones, indicate that they belong to a lower pliocene period.

Mr. Hamilton read a paper on the educational system.

DIARY

THURSDAY, March 3.

Royal Society, at 8.30.—Results of Monthly Observations of Dip and Horizontal Force made at Kew Observatory: Dr. Balfour Stewart.—Spectroscopic Observations made with the great Melbourne Telescope, Nebula in Argo, and the Spectrum of Jupiter: A. Le Sueur.
Chemical Society, at 8.—Indices of Refraction: Dr. Gladstone.
Linnean Society, at 8.—Hybridism among Cinchonæ; Mr. J. Broughton.
Pathological Society, at 8.
Royal Institution, at 3.—Chemistry of Vegetable Products: Prof. Odling.
Society of Antiquaries, at 8.30.—Monastic Inventories: Rev. M. S. C. Walcott.
London Institution, at 7.30.

FRIDAY, March 4.

Geologists' Association, at 8.
Philological Society, at 8.15.
Royal Institution, at 9.—Iron-built Ships: Mr. E. J. Reed, C.B.
Archæological Institute.

SATURDAY, March 5.

Royal Institution, at 3.—Science of Religion: Prof. Max Müller.

MONDAY, March 7.

London Institution, at 4.
Medical Society, at 8.
Entomological Society, at 7.
Society of Arts, at 8.—Cantor Lecture: Dr. Paul.
Royal Institution, at 2.—General Monthly Meeting.

TUESDAY, March 8.

Photographic Society, at 8.
Ethnological Society, at 8.—On the opening of a Cairn in North Wales: Col. A. Lane Fox.—On the Earliest Phases of Civilisation: Hodden M. Westropp.
Institution of Civil Engineers, at 8.—The San Paulo Railway, Brazil: Mr. D. M. Fox, M. Inst. C.E.
Medical and Chirurgical Society, at 8.30.
Royal Institution, at 3.—Plant Life: Dr. Masters.

WEDNESDAY, March 9.

Society of Arts, at 8.—Street Tramways: W. B. Adams.
Archæological Association, at 8.
Royal Microscopic Society, at 8.—1. On the Comparative Steadiness of the Ross and Lister Models under Trying Circumstances; 2. On the Shell Structure of Fusulina; 3. On the Microphyle of the Fish's Ovum; 4. On the Reparation of the Spines of Echini: Dr. W. B. Carpenter.
Geological Society, at 8.—On the Structure of a Fern-stem from the Lower Eocene of Herne Bay, and on its allies, recent and fossil: Mr. W. Carruthers, F.L.S., F.G.S.—On the Oolites of Northamptonshire: Mr. Samuel Sharp, F.G.S.—On the Geology of the district of Waipara River, New Zealand: Mr. T. H. C. Hood, F.G.S.

THURSDAY, March 10.

Royal Institution, at 3.—Chemistry: Prof. Odling.
Royal Society, at 8.30.
Mathematical Society, at 8.
Zoological Society, at 8.30.—On Dinornis: Professor Owen.—Description of a new species of *Ampullaria*: Dr. J. C. Cox.—On the Birds of Veragua: Mr. O. Salvin.—On new birds from the Yantze-kiang: Mr. R. Swinhoe.
London Institution, at 7.30.

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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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THURSDAY, MARCH 10, 1870

SCIENCE EDUCATION IN GERMANY

II. THE POLYTECHNIC SCHOOLS

THE "Polytechnicum" is an institution peculiar to Modern Germany. It has for its object the teaching of all branches of the sciences of experiment and observation, not only in their principles, but in their applications to the industrial arts; these applications not being merely treated as illustrations of science, but regarded as the main subjects for instruction, for the sake of the understanding of which systematic courses on theoretic science are given.

The Polytechnica are altogether independent of the science departments of the Universities, but like these latter the Polytechnica are State institutions, the Professors (ranking generally somewhat below those of the University) are Government servants, and the current expenses are defrayed by State grants.

As a type of this interesting class of Science schools I may cite the two celebrated schools of Carlsruhe and Zurich, beginning with the Carlsruhe school with its 600 students.

In the original programme the school was declared to consist of *one* general and *seven* special departments. The general department, called the *Mathematical*, furnished instruction in mathematics, in natural science, and in modern languages and literature. It was viewed as preparatory to the special schools, and also as adapted for those who proposed to become teachers of mathematics and natural science. The seven special schools were of (1) civil engineering; (2) mechanical engineering; (3) architecture; (4) forestry; (5) manufacturing chemistry; (6) commercial studies; (7) civil service (*Postschule*). This constitution is in the latest programme, so far modified that (1) the general department is no longer treated in form as introductory to the rest, though it still appears to be so virtually; (2) the last two of the special departments enumerated above are omitted, while an agricultural department is added. The schools are, therefore, now seven, viz.:—

	Duration of complete course.
1. Mathematics	2 years
2. Civil Engineering	2½ ,,
3. Mechanical Engineering	2 ,,
4. Architecture	4 ,,
5. Chemistry	— ,,
6. Forestry	3 ,,
7. Agriculture	2½ ,,

The teaching staff consists of twenty-four professors with sixteen assistant lecturers and laboratory assistants. The appliances comprise five laboratories, viz. chemical, physical, mineralogical, and one for forestry and agriculture; a library; and twelve different cabinets or collections. In the department of natural philosophy, as many as 120 students attended the lectures of Professor Wiedemann in the summer semester of 1868. The cabinets are large and well-arranged. In the physical laboratory there were in the above year fourteen students, who went through the course of instruction in groups of four; most of these become teachers of the subjects in *Real-Schulen*; some get important posts in large mechanical workshops.

In Zürich exist both a University and a Polytechnic School; and although the university is a cantonal, and the school a federal institution, they are so far allied that they share one magnificent building, and many students of the university are, at the same time, pupils in the school. The total expense to the State for the maintenance of the Polytechnic School is 12,000*l.* per annum, whilst the original cost of the stately building itself was 160,000*l.* The professors of the two institutions, moreover, work to a certain degree in concert. For instance, Dr. Bolley is Professor of Chemistry in the school, and Dr. Städler, Professor of the same subject in the university. They have each a laboratory; but Professor Städler's is an analytical, and Professor Bolley's a technical laboratory. About 40 students work in the former, and 50 in the latter on an average.

There is less freedom allowed to pupils of the school, as to the classes to be attended, than is customary at the university. Definite courses are laid down; but relaxations are freely granted.

The most important department of this Polytechnic School is that of mathematics and engineering; there are also departments of forestry and agriculture, and an important department for teachers—a sort of technological seminary.

The Professor of Technical or Applied Chemistry, Dr. Bolley, lectures three or four times weekly throughout the session. He makes four or five sub-divisions of his course; —thus he lectures on the Chemistry of Colour; of Heating and Lighting; of Materials of Nourishment; and of Agriculture. Before entering this class, the student is required to have attended a course of theoretical lectures on chemistry, and an elementary experimental course.

Dr. Zeuner, the Professor of Engineering, gives about fifty or sixty lectures yearly on the Mechanical Theory of Heat; and he lectures six times a week for two semesters, on the Theory of Machines. The character of his courses is very high and rigorous; he insists on a knowledge of the differential calculus as a condition of entering his classes, and he remarked to the writer on the generally inadequate mathematical preparation of English students of engineering, mentioning his conviction that Professor Rankine, for whose works he expressed an unbounded admiration, must find the sphere of his efficiency as a teacher seriously limited by reason of the want of due preparation on the part of his students.

The following extracts from the prospectus of the lectures in the engineering department of the Zürich school, show how much more complete is the scheme of instruction there than has at present been found possible in England.

B. *Department of Civil Engineering.* (Duration of course, 3½ years.)

1st year.—Differential and Integral Calculus. Descriptive Geometry. Principles of Construction. Practice in Construction. Drawing. Experimental Physics. Experimental Chemistry.

2nd year.—Differential Equations. Technical Mechanics. Geometry of three dimensions. Perspective. Technical Geology. Topography. Drawing. Descriptive Mechanical Construction. Surveying.

3rd year.—Theoretical Mechanical Construction. Astronomy. Geodesy. Construction of Iron Bridges, Railways, and Iron Roofs. Drawing.

In addition to these courses there are similarly extensive programmes for (A) the department of Architecture, and (C) the department of Mechanical Engineering. The number of regular students in the year 1867, was in these subjects (A) department of Architecture, 33; (B) department of Civil Engineering, 103; (C) department of Mechanical Engineering, 87.

That the Polytechnic system of science education finds favour, at any rate, with the German State Governments, and therefore probably also with the people, is apparent from the fact that large institutions of the kind have just been built in Prussia (at Aix-la-Chapelle), in Austria (at Vienna), and in Bavaria (at Munich). In this latter city no less a sum than 125,000*l.* has been expended on the building of the new Polytechnicum, erected in a very costly style of architecture, and covering five acres of ground, whilst distinguished men from all parts of Germany have been called to fill the newly-founded professorships. The cost of the buildings at both Vienna and Aix-la-Chapelle will probably not be far short of the above amount, and it must be remembered that labour and material are very much (probably one-half) lower in Germany than with us. The expenses of education at the Polytechnica are very small; at Carlsruhe attendance on the regular courses of lectures costs 5*l.* 10*s.* for the session of nine months; the fee for chemical laboratory practice for the same length of time is 3*l.* 15*s.* to regular students, and 5*l.* to occasional students. At Zürich the fees are even lower, as any of the regular courses of the distinct departments or schools can be attended for the payment of 109 francs, or about 4*l.* 4*s.* for the session of nine months.

The age for entrance into the Polytechnic Schools is one year younger than that for the German Universities, viz. seventeen: the duration for study is the same, three years. Here, too, evidence of fitness is vigorously exacted of those who propose to enter as *regular students*, in the shape of an adequate school certificate, either from a gymnasium, a real-gymnasium, or a *Real-Schule;* or, in default of that, an entrance examination must be passed. A much higher mathematical preparation is demanded than is needed for entering the University, a knowledge at least up to, and in some schools including, the differential calculus being required. Persons of all ages, however, and not possessing such qualification, are admitted freely and without examination, as *occasional* students in the several departments. Many of these occasional students are often poorly prepared; but it is considered that the gain to such auditors, and to society through them, is great; and that, whatever tendency might arise from this practice towards the lowering of the standard of instruction could be guarded against by rigidly keeping up the standard of admission for regular students.

To many of the Polytechnica is attached a preliminary school, in which those who are not ripe for the full studies of the Polytechnicum can supply their deficiencies. The age for entrance to this *Vorschule* is sixteen.

In all the Polytechnica with which the writer is acquainted, it is the schools of civil and mechanical engineering, building construction, and architecture which really flourish. These departments of applied science are not represented in the German university system, whereas the study of chemistry in its various divisions, and of mechanics and physics in their numerous branches, forms a portion of every university course. Indeed, as a rule, the lectures delivered in the Polytechnic Schools on chemistry and physics differ very slightly, if at all, in character and scope from those which the University professor delivers. The fact is that the teaching of special technical chemistry in the Polytechnica has been found to be impossible. All that can be done in any school is, in the first place, to teach the groundwork of the science without regard to its applications, and then to point out the scientific principles upon which certain technical processes depend. No system of theoretical school instruction will fit a man to be a dyer or a calico-printer, or even a chemical manufacturer. These arts can only be learnt by practice on the large basis of practical experience, and all that Polytechnic Schools can do is to prepare the ground for a proper reception of that practical experience by a sound training in scientific principles.* This scientific training is, however, just as much the special work of the University as of the Polytechnicum, and there appears to be no valid reason for the separate existence, often side by side in one town, of a University and a Polytechnic School. On many grounds the absorption of the Polytechnicum by the University appears advisable. In the first place there is room to fear that a due supply of thoroughly good teachers, especially in science—at least in the higher positions—cannot be secured for institutions perpetually growing in number, while, on the other hand, a great waste of power is caused where such institutions exist side by side, as many of the professorships, being common to Universities and Polytechnic Schools, are thus twice represented.

Again, serious harm must come from the tendency which this separation of the Polytechnic School from the University has to foster the narrow one-sidedness already so strong in the extreme partisans of the one and the other group of studies. The Universities would suffer by the weakening in them of those branches of pure and applied science which have always been and must continue to be studied there. The Polytechnic schools would suffer (and already do suffer) from the tendency, thus encouraged, to neglect the *educational* aspects of science in considering its practical applications. How great the gain has been to the branches of the liberal arts and sciences from their alliance in Universities, the history of Universities from their first foundation abundantly shows: and it is difficult to see any sufficient reason why the applied sciences, such as Engineering, in their professional aspect should not have their proper place in the organisation of the University, exactly as Theology, Law, and Medicine have long had their place, to the great advantage both of these studies themselves and of the non-professional studies with which they have been brought into contact.

Signs are already observable in Germany, according to the highest authorities, that the zeal for teaching science in its application to the practical arts is encroaching on the domain of science proper, and that science will be deteriorated without, at the same time, industry being advanced. The true work of institutions,

* This is clearly admitted in certain cases by the Polytechnic authorities themselves. Thus I find in the regulations of the Carlsruhe Agricultural School the following words printed in large type:—"This school is concerned with the cultivation of the mind of the student, not with learning the technical operations of agriculture."

founded with the special aim of fostering the industrial arts, should be to insist on teaching *principles* systematically, and not in their isolated applications. To treat of the applications of the science is, of course, necessary, even for the sake of science itself; and under certain circumstances, some of these applications may wisely be dwelt on more than others; but this is quite a different thing from pretending to teach as *science* detached *fragments* of science in their application to this or that art.

The following extract from a well-known essay by Liebig, written so long ago as 1840, clearly shows that his views on this question coincide with those above expressed:—

"The teaching of science in the laboratories of the Trade—and Polytechnic—Schools is, in most places (in Prussia), very deficient. A system of true scientific instruction should fit a student for each and every possible application of science; for these applications become easy, and follow as a matter of course, from a knowledge of scientific principles. Nothing is more deleterious or dangerous than when utilitarianism is made the foundation of a system of tuition in a school, or when institutions, whose true aim ought to be experimental instruction in scientific principles, are employed to convert mere children into soap-boilers, brandy-distillers, or sulphuric acid makers. All this entirely destroys the true purpose of the institution.

"I have found, in all those attending my laboratory who intended to pursue a technical course of study, a general predisposition to devote themselves to some branch of applied chemistry. It is only with feelings of fear and trepidation that they consent to follow my advice, and give up the time they thus waste on mere drudgery to making themselves acquainted with the methods by which pure scientific problems are soluble, and by which alone they can be solved. . . . . There are many of my pupils, now at the head of many departments of manufacturing industry, who, having had no previous acquaintance with the processes, were in half an hour perfectly *au fait* with all the details of the manufacture, whilst in a short time they saw and introduced all sorts of necessary reforms and improvements. This power they had gained by being accustomed in their laboratory work to obtain the most accurate and precise knowledge of all the substances which came into their hands in their work; they had to learn the conditions necessary for avoiding errors, they investigated the properties of the products of decomposition formed, and thus became acquainted with the sources of error, with the means of avoiding losses; they were able to improve their apparatus, and to amend their processes. All this can never be learnt when the work is conducted according to cut-and-dry methods."

There are, no doubt, certain obstacles in the way of the proposed amalgamation in Germany; but in the old English Universities, and in the science colleges which we hope soon to see established in various parts of England, the difficulty would not arise at all. Apart from questions of tradition and historical routine, there can be no reason why students of applied science, led by their probable destination to manufacturing industry, should not study systematic science in the same class-rooms with students of the same subject who may have other aims: and if such students require minute practical and experimental instruction, there is no reason why they should not obtain this in physical and mechanical, as they do already in chemical, laboratories. In such a technical department, future teachers of science and leaders of manufacturing industry would be trained in the application of science to the most important branches of art and manufacture—so far, that is, as these are fit subjects for academic treatment; so far as they are not, they must be left to the workshop.

H. E. ROSCOE

VON SCHLICHT ON FORAMINIFERA

Die Foraminiferen des Septarienthones von Pietzpuhl. By E. von Schlicht. 4to. With 38 lithographic plates. (Berlin, 1870. London: Williams and Norgate.)

SINCE the appearance of D'Orbigny's "Foraminifères Fossiles du Bassin Tertiaire de Vienne," no work has been issued on the Foraminifera in their geological or palæontological relations, with pretensions at all corresponding to those of the newly-published monograph, the title of which stands at the head of the present article. We do not use the word *pretensions* in an offensive sense, for the author is careful to apprise his readers of the limitations of the treatise; but rather to indicate the sort of impression produced by the dimensions of the book and its profuse illustration. A quarto volume containing, in addition to the letter-press, thirty-eight large plates devoted to the Foraminifera of a small division of the Tertiary system of North Germany, and confined to a very limited district, or, as we might put it, 1,192 drawings of microscopic shells from the clay of a single brickyard, ought to show in its results a very evident *raison d'être* to save it from the imputation of labour thrown away. We need not require the expression of new or startling philosophical views to bring such a work within the scope of things worth doing; but we may fairly expect from so large an expenditure of labour and cost, some real and definite addition to our scientific knowledge. Whilst a smaller book might pass unnoticed, or at least without critical examination, one like this cannot escape without an inquiry as to what it contains of novelty, either in observation or theory,—in facts or their arrangement; and on the reply dictated by a patient study of its contents, the verdict as to its value must depend. To frame an answer to these questions which will serve to give an idea of the work, it will be necessary to offer a few preliminary observations and to epitomise the labours of previous observers in the same field.

In the Tertiary system of Belgium, and Northern and Central Germany, there occurs a thick bed of clay, containing nodules of argillaceous limestone, with radiating cracks or fissures in their interior, which have become filled with calc-spar. These nodules are termed "septaria," and they are regarded as sufficiently characteristic of the deposit to give it a name, though possibly a somewhat indefinite one. As used by German authors, the term "Septarienthon" includes the Rupelian clays of Rupelmonde and Boom, near Antwerp, the brick-clays of the neighbourhood of Berlin, together with similar beds in the valleys of the Maine and Elbe, and in many other localities between the Baltic and the centre of Germany. These beds are of Lower Miocene or Upper Eocene age, and belong to a group of transition strata, associated by continental geologists under the name "Oligocene," which are scarcely represented in Great Britain. Possibly the fluvio-marine beds of the Isle of Wight are the nearest equivalent to be found in the Tertiaries of this country.*

The exact geological position of the Septaria-clay is of less consequence to our present purpose than the general fact that it was deposited some time during that earlier or middle Tertiary period in which the Foraminifera, as a zoological group, had their most conspicuous development. It is not surprising that so promising a field should have been diligently worked by German rhizopodists, and it may be questioned whether any single bed, or group of beds, has received so large an amount of attention in respect to its microzoa. The particular locality to which Herr von Schlicht's researches refer, is the estate or manor of Pietzpuhl, which lies at the highest point of a Tertiary ridge, commencing at the river Elbe, a little north of Magdeburg, and extending in an easterly direction above Möckern to Loburg,—a course of eighteen or twenty English miles. The clay-bed is worked at Pietzpuhl for bricks or some other economical purpose, and being open to-day, the investigation of its fossil fauna presents no preliminary difficulties.

Attention was first directed to the microzoa of the Septaria-clay just twenty years ago, in two letters from Herr Reuss (then of Bilin) to Herr Beyrich, on "Foraminifera in Clay, from Hermsdorf,"† which appeared in the Journal of the German Geological Society. These communications contained little beyond a list of the genera represented; but a year later, a third letter was published,‡ containing a good deal of supplementary information, and in 1851 Professor Reuss published a more elaborate paper "On the Fossil Foraminifera and Entomostraca of the Septaria-clays of the neighbourhood of Berlin,"§ containing the results of the examination of the beds described by Prof. Beyrich, together with a tabular comparison of the species obtained at Hermsdorf and Freienwalde with those of other well-known Tertiary deposits, such as the Miocene of the Vienna Basin and the sub-Appenine Pliocene clays. The table presents a series of sixty-five species, and of these, fifty-three are described and figured as "new." All except four of them were obtained from Hermsdorf. We will not enter into any analysis of the catalogue, else we might be tempted to exceed our bounds, in criticism on the new species.

Another letter from Prof. Reuss‖ gave similar particulars respecting two fresh localities, viz:—Gorzig near Köthen, and the excavations of Fort Leopold at Stettin. Shortly afterwards, appeared an elaborate paper by Dr. J. C. Bornemann of Leipsic on the "Microscopical Fauna of the Septaria-clay of Hermsdorf, near Berlin** containing much of novelty and interest, and adding forty-six more "new species" of Foraminifera to an already extensive list. The figures of many of these show curious modifications of the simpler types, those of the genus *Polymorphina* being especially instructive. In 1858 Prof. Reuss contributed a further instalment to the literature of the subject in his paper "On the Foraminifera of Pietzpuhl," †† and this concerns our present purpose more directly, as it is stated to be the first result of the author's examination of the specimens in Herr von Schlicht's collection. It is, however, little more than a catalogue, and introduces by name seventy-two more "new species," without either figures or descriptions.

Six years later Prof. Reuss published in the Reports of the Vienna Academy his researches "On the Foraminifera of the Septaria-clay of Offenbach"* near Frankfort, figuring therein forty-four more new species; and finally, in 1866, amongst the memoirs presented to the same scientific body appears an elaborate monograph by Prof. Reuss, entitled "The Foraminifera, Anthozoa, and Bryozoa of the German Septaria-beds,"† one of the most instructive, as well as one of the most beautifully illustrated of the author's many contributions to the history of the fossil Protozoa and Cœlenterata. This paper is not devoted, like its predecessors, to the description of new species, but is rather an epitome of the facts already known, with additional information as to distribution. It is supplemented by a comparative table of the geological and geographical relations of 228 reputed species, which is a sort of concentrated essence of the whole. Without compromising our radical objection to the system of sub-dividing and renaming, time after time, forms having the same essential characters, on account of minute and very variable peculiarities, or of regarding a slight difference in geological age as a reason for constituting a new species in cases where zoological characters fail to show ground of distinction, we may cheerfully yield to Prof. Reuss our tribute of admiration for his final summary of what was known of the microzoa of the Septaria-clay.

These bibliographical details have appeared necessary because the field of research to which they refer is one with which British palæontologists have little opportunity of becoming practically acquainted; and our object in respect to Herr von Schlicht's work is half accomplished now that we have indicated the amount of labour previously expended on the same subject.

Herr von Schlicht introduces his monograph by a preface of seven pages, comprising the readable matter of the volume. This introductory essay deals in generalities rather than new truths, and the apology of the author constitutes its chief novelty. After a few preliminary paragraphs he mourns the shortcomings of the work in respect to classification, nomenclature, and other important matters. Of the systems of classification, Prof. Reuss's, as last amended, is alone spoken of with much commendation; that of Prof. Max Schultze receives bare mention, as do also the views of British rhizopodists. "After all," asks the author, "do we know enough yet about the Foraminifera to invent any classification of them? Some people think not; and so, on the whole, although the early D'Orbignyan arrangement is the worst, it is pretty well known, and it will be the least trouble."

It may be that the systematic scheme laid down by Prof. Reuss is faulty: in this we should agree with Herr von Schlicht, though on different grounds; but it has a basis of natural relationship in its larger groups, wholly wanting in that of D'Orbigny. That a general harmony should exist between its sub-divisions and those indicated

* See a paper by Sir Charles Lyell, on the Belgian Tertiaries. *Quart. Journ Geol. Soc*. vol. viii. p. 299.
† *Zeitschrift d. deutsch. geol. Gesellsch.*, vol. i. p. 259.
‡ *Ib.* vol. ii. p. 49. § *Ib.* vol. iii. p. 309. ‖ *Ib.* vol. iv. p. 16.
** *Ib.* vol. vii. p. 307. †† *Ib.* vol. x.

* *Sitzungsberichte der k.k. Akademie der Wissenschaften*, vol. xlviii.
† *Denkschrift der math.-naturwissen. Cl. der k.k. Akad. Wissensch.* vol. xxv.

by the independent researches of Dr. Carpenter and his colleagues in this country, is surely strong evidence in its favour; and the fact of its having been used in the latest publications on the particular subject of the work, gave it a strong claim for introduction, in spite of the alleged possibility of subsequent modification.

The author further laments the imperfection caused by his omission of specific or trivial names. In the prospect of a new and better classification, with the possible employment of different criteria for the separation of genera and species, every new specific name would, he thinks, only serve to increase the present confusion in nomenclature, and to augment the difficulties of future observers; besides, hints the author shrewdly, "thereby I have spared to myself a notable piece of labour." So the honour of appending specific names is willingly bequeathed to the future systematist who shall investigate the new forms, and who, we agree with Herr von Schlicht, will not be overpaid for his trouble.

Thus we are warned at the outset that, so far as nomenclature is concerned, no advantage is taken of the mass of plates which occupies half the volume. And yet, oddly enough, the author does name *one* of his figures—an attenuated, slightly curved, costate Nodosarian, with broad, clear, somewhat irregular sutures and pointed ends. This he calls *Dentalina edelina n.s.*, a name that might very well have been spared.

Notwithstanding the absence of trivial names, *genera* are recognised, and detailed descriptions are given of the specimens figured, with references to the plates. Thirty-two genera are adopted (two of them new), and *numbers* from 1 to 556, are appended to the descriptions instead of *names*. Some of the old generic terms employed are already regarded as untenable by those who had been in the habit of using them, and the two new ones are certainly needless. One of them, "*Atractolina*," represents a mixed lot of forms, some of them possibly compact fusiform *Polymorphinæ*, the remainder doubtful *Nodosarinæ*. In the case of two generic types which inosculate in their feebler varieties, as these most certainly do, we are ready to admit the difficulty of determining to which group a number of the intermediate forms belong; but to make a fresh sub-division for them cuts the knot rather than unties it. The other new genus, "*Rostrolina*," has no better foundation, based as it is on the mere shape of the terminal orifice—a straight or curved slit in the mucronate terminal chamber, instead of the circular or radiate aperture usually found. Specimens with this peculiarity have long been known, but have been regarded as mere individual modifications, and no previous writer has thought it necessary to invent even a specific name for them.

A good deal of criticism might be expended on the subdivisions and their arrangement, but we content ourselves with the passing remark that Reuss's type *Chilostomella* is out of place amongst the *Polymorphinidæ*, and that *Bolivina* is far separated by the author from *Bulimina*, which is its nearest ally.

We may sum up in a few sentences. Notwithstanding the work falls far short of what it might have been in many important particulars, it is of considerable value. The omission of any attempt to simplify the nomenclature, with the opportunity the large number of plates offered for doing so excellent a service, is inexcusable. It may be doubted whether a single new specific name would have been needed, and the plates might have been made the basis of a large reduction in those already in use. The best point of all about the book is the completeness of many of the series represented,—the consecutive links in the chain between a number of reputed species being in many cases all figured. It more than once occurred to us in turning over the plates, there must be something of dry humour about an author who could suggest that anyone who named the new forms would deserve all the honour he could get out of them, and that the fasciculus of plates was intended to demonstrate that the system of species-splitting could not be carried further than it had been carried by some previous authors, short of naming every specimen. On the other hand, from the large number of drawings devoted to the illustration of the minute morphological variations of a few simple types, the work affords valuable testimony to the truth of the views enunciated by Mr. W. K. Parker in his earliest paper on the Miliolitidæ of the Indian Seas, as to the impossibility of sub-dividing these lowest classes of animals by hard lines corresponding to the specific limits of more highly organised creatures; that a long series of forms presenting an extraordinary range of morphological variation may be grouped round sub-types, several of which merging at their edges into each other, and without any perceptible lines of demarcation between them, find in their turn a common central type, and that this type more nearly than any minor division represents what we are accustomed to term a species. If we regard Herr von Schlicht's volume from this point of view, we may easily see how it may possess considerable value, though not exactly of the sort that was intended by its author.

We should just add, that though the paper and letterpress are excellent, the plates are scarcely equal in solidity and clearness to the lithographic work we have been accustomed to see in German memoirs on the Foraminifera.

H. B. BRADY

ENCKE THE ASTRONOMER

Johann Franz Encke: sein Leben und Wirken. Von. Dr. C. Bruhns. (Leipzig, 1869. London: Williams and Norgate.)

FOUR years have passed since Encke died. Even those four years have witnessed notable changes in the aspect of the science he loved so well. But we must look back over more than fifty years if we would form an estimate of the position of astronomy when Encke's most notable work was achieved. At Seeberge under Lindenau, Encke had been perfecting himself in the higher branches of mathematical calculation. He took the difficult work of determining the orbital motions of newly discovered comets under his special charge, and Dr. Bruhns tells us that every comet which was detected during Encke's stay at Seeberge was subjected to rigid scrutiny by the indefatigable mathematician. Before long a discovery of the utmost importance rewarded his persevering labours. Pons had detected on November 26, 1818, a comet of no very brilliant aspect, which was watched first at Marseilles, and then at Mannheim, until the 29th December. Encke next took up the work and tracked the comet until January 12. Combining the observations made between

December 22, and January 12, he assigned to the body a parabolic orbit. But he was not satisfied with the accordance between this path and the observed motions of the body. When he attempted to account for the motions of the comet by means of an orbit of comparatively short period, he was struck by the resemblance between the path thus deduced and that of Comet I, 1805. Gradually the idea dawned upon him that a new era was opening for science. Hitherto the only periodical comets which had been discovered, had travelled in orbits extending far out into space beyond the paths of the most distant known planets. But now Encke saw reason to believe that he had to deal with a comet travelling within the orbit of Jupiter. On February 5, he wrote to the eminent mathematician, Gauss, pointing out the results of his inquiries, and saying that he only waited for the encouragement and authority of his former teacher, to prosecute his researches to the end towards which they already seemed to point. Gauss, in reply, not only encouraged Encke to proceed, but counselled him as to the course he should pursue. The result we all know. Encke showed conclusively that the newly discovered comet travels in a path of short period, and that it had already made its appearance several times in our neighbourhood.

From the date of this discovery, Encke took high rank among the astronomers of Europe. His subsequent labours by no means fell short of the promise which this, his first notable achievement, had afforded. If, as an astronomical observer, he effected less than many of his contemporaries, he was surpassed by few as a manipulator of those abstruse formulæ by which the planetary perturbations are calculated. It was to the confidence engendered by this skill that we owe his celebrated discovery of the acceleration of the motion of the comet mentioned above. Assured that he had rightly estimated the disturbances to which the comet is subjected, he was able to pronounce confidently that some cause continually (though all but imperceptibly) impedes the passage of this body through space, and so, by one of those strange relations which the student of astronomy is familiar with, the continually retarded comet travels ever more swiftly along a continually diminishing orbit.

Bruhns' life of Encke is well worth reading, not only by those who are interested in Encke's fame and work as an astronomer, but by the general reader. Encke the man is presented to our view, as well as Encke the astronomer. With loving pains the pupil of the great astronomer handles the theme he has selected. The boyhood of Encke, his studies, his soldier life in the great uprising against Napoleon in 1813, and his work at the Seeberge Observatory; his labours on comets and asteroids; his investigations on the transits of 1761 and 1769; his life as an academician, and as director of an important observatory; his orations at festival and funeral; and lastly, his illness and death, are described in these pages by one who held Encke in grateful remembrance as "teacher and master," and as "a fatherly friend."

Not the least interesting feature of the work is the correspondence introduced into its pages. We find Encke in communication with Humboldt, with Bessel and Struve, with Hansen, Olbers, and Argelander; with a host, in fine, of living as well as of departed men of science.

R. A. PROCTOR

OUR BOOK SHELF

Elementary Introduction to Physiological Science. (London: Jarrold and Sons.)

ANY one may teach the higher branches of science; none but masters should dare to give elementary instruction. The truth of this fundamental article of the teacher's creed is very strikingly confirmed by this little book, which professes to give uninstructed persons some elementary knowledge—first, of the chief chemical products of animal and vegetable life; secondly, of vegetable physiology; and lastly, of animal physiology. One of the rules of teaching which a real teacher has soonest and most forcibly brought home to him says, "Never use an illustration if you can do as well without it." The practice of the author of this work is evidently, "Never miss a chance of using a metaphor, or simile, or image, or illustration that occurs to you. If it is 'striking' or 'homely,' use it as often as you can." The author possibly understands his subject; we cannot tell for certain whether he does or no, for we cannot disentangle the real things from his striking illustrations of them. We never know whether he is speaking soberly or in metaphor, and we are perfectly sure that a lad of lively imagination, reading this book by way of an introduction to biology, would get into his head such fearful and vivid ideas of what was going on inside plants and animals, that no subsequent teaching could ever set him right, and life would ever afterwards be a burden to him.

Compendium der Physiologie des Menschen. Von Prof. Julius Budge. Zweite Auflage. (Leipzig: Günther. London: Williams and Norgate.)

VERY truly called a compendium, an account of as many as possible of the facts of human physiology being compressed into about three or four hundred pages. To a reader ignorant of physiology, the book would probably be wholly unintelligible; to a German student about to undergo an examination in physiology, it would doubtless be very acceptable, for by it he might refresh his memory on every point about which he is likely to be questioned. Perhaps after all, however, it is well for the English student that we have nothing like it in the English language. The author, in the second edition, has done his best to bring the work up to the level of the most recent knowledge. Unfortunately, however, science will not stop while an author is correcting proofs; and this, like all works professing to give the latest results, records not the ultimate but the penultimate researches. This is not, however, of very great importance; for, as in so many German physiological investigations the ultimate result is the exact opposite of the penultimate, it is very easy to calculate out the former from the latter, and add it on.

Chenes de l'Amerique Tropicale.—*Iconographie des Espèces nouvelles ou peu connues. Ouvrage posthume de* F. M. Liebmann, *achevé et augmenté d'un aperçu sur la Classification des Chênes en général, par* A. S. Oersted. Copenhagen, 1868. 1 vol. folio, 29 pp. Tabb. 57.

LIEBMANN was occupied at the time of his decease in 1856 with a monograph of the American Oaks. He left behind him a number of folio copper-plate engravings which he intended for the illustration of his work, and brief descriptions of fifty-two new species. These were entrusted for publication to Prof. Oersted, who has put all in proper train, drawn up a valuable essay on the classificatory characters of the genus, prepared an analysis of many of the species, and added ten plates of leaves of various species of oak in physiotype,—making altogether an important contribution to illustrated botanical literature, and a worthy memento of his friend. Liebmann died comparatively young, about thirteen years after returning from his botanical expedition in Mexico, where he amassed very fine collections, which are still in course of determination and distribution by the Danish botanists. A short sketch of his life precedes Prof. Oersted's memoir, the substance of which had been already published in a scientific journal of Copenhagen.

The principal novel feature in Prof. Oersted's arrangement of the numerous species of oak—a genus including about 160 species in the Old World, and 120 in the New,—consists in the importance, for classificatory purposes, attributed to the form of the style and stigmatic surface. Upon these organs the sub-genera are chiefly based. We have had no opportunity of testing these characters, which it is unfortunate were not investigated by M. Alph. de Candolle, when preparing the *Cupuliferæ* for the "Prodromus," published in 1864. The omission of a Species-Index to the genus *Quercus* in the "Prodromus," makes it very tedious to ascertain how many of Liebmann's species are included in that work. Let us express the hope that in the final volume of this great work, yet to be published, we may be spared this annoyance in the case of the larger genera.

D.O.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Prismatic Structure in Ice

OF late years attention has not unfrequently been called to this singular structure in ice, of which a number of instances are collected by the Rev. G. F. Browne, in his valuable book on the "Ice Caves of France and Switzerland" (chap. xviii.) In August, 1865, I had the opportunity of examining in his company some of these curious caverns; and since then have been on the look out for other instances of this structure. In January, 1867, I found it very well exhibited on a pond in Cambridge, an account of which may be found in the Proceedings of the Cambridge Philosophical Society, Part IV. and (more briefly) in my "Alpine Regions," pp. 94, 334. I again saw it last summer in a block of river or lake ice, which was brought on board a steamer at Christiansand (Norway) from an ice house. This block was about 8 inches thick. The prisms were rather irregular in form, the area of their ends varying from about a quarter of a square inch to one square inch, the sides being usually five or six in number. The prisms were at right angles to the planes of freezing, which were well marked.

These two were the only cases in which, from the first date until a few months back, I had succeeded in finding this prismatic structure clearly exhibited, but the present winter has proved very favourable to its development. I have seen it several times; in fact, after every severe frost; and under circumstances which have led me to suspect that I have often overlooked it on former occasions. In almost all the cases which I have lately noticed, the prisms were small, the area of their ends being generally about one-sixteenth of an inch. Hence, frequently the structure could not be detected without very close examination; as it was masked on the surface exposed to the air by the usual layer of disintegrating ice; and even when the under and unmelted side of a slab was examined, it had to be partly dried, before the delicate reticulation produced by the jointed structure could be observed by allowing the light to fall obliquely on it. The simplest mode of detecting it was to break the slab across, when instead of the usual conchoidal fracture of ice, a columnar structure was distinctly shown. Not unfrequently the first hint of its presence was given by the presence of a number of small holes in the under side of the slab. These, of course, were formed by water, which had trickled down from the thawing upper surface between the angles of the prisms, and had thus drilled itself a small tube. In one case—during a frost after a partial thaw—I found the structure mapped out, as it were, on the surface of the ice, but quite obliterated internally, except where some vertical lines of air bubbles marked the position of a tube or wider joint. In one of the cases above described, I totally obliterated the internal columnar structure by placing the ice in a freezing bath. I have often looked for, but never found it in glacier ice. I am therefore inclined to think that, though the large and strongly marked prisms are of comparatively rare occurrence, this finer structure may be found, if looked for, in every tolerably gradual thaw. Repeated examination has also convinced me that the structure has no immediate connexion with the hexagonal form of the ice crystals; the angles of the prisms are too irregular and variable to admit of this explanation. Their sides, however, so far as I have seen, are always at right angles to the surface of freezing, and are best developed when the temperature of the neighbouring air for a considerable time does not differ much from 32° Fahr. I therefore consider the structure to be produced by contraction in the ice as it approaches the melting point, and so to be analogous to the columnar structure in basalt, though due to a rise instead of to a fall in temperature.

St. John's College, Cambridge T. G. BONNEY

A Probable Cause of Malaria

SINCE men of science, such as Dr. Carpenter, Jeffreys, and Wyville Thomson, have proved by repeated and well-conducted experiments that there is life in the ocean,* that there are moving, sensible, living creatures, of nearly every description, in its deepest recesses, it seems rather an idle question, "de lanâ caprinâ," which has been raised lately about their manner of living there; how they get their food where no plant of any description has ever grown; whether they take in their food by *intussusception* with a mouth, or by that kind of oozing-in-and-out styled endosmose and exosmose,† or by any other kind of absorption, suiting the glair-like sarcodic stuff which the eozoon of old was made up of, and which is still at work in building, roll upon roll, the myriads and myriads of microscopic *Globigerinæ*.‡ Yet these seemingly idle questions when treated by men of science and of experience may become the source of discoveries far greater and more important perhaps than they anticipate.

Thus it is that the indefatigable Italian diatomist, Count Castracane, after having proved the very abundant growth of his puny *protégés* in the brackish waters of the *Maremme* and *Paludi pontine*, did not esteem it a bootless task to search for what they live upon, and also why they suddenly die away nearly all at once.

Such is the subject of a recent memoir which he has lately presented to the Roman Academy *Dei Lincei*, of which he is one of the most active members. After insisting upon the necessity of mastering the subject more thoroughly before attempting any new revision or classification of the diatoms, showing the system he had followed himself, and the results he had obtained, especially during the last year in making the round of the Istrian peninsula, taking his headquarters at Trieste and Pirano most particularly, where he gathered a rich harvest of very important materials for future study, he goes on to state that nothing is so fatal to the life of marine or even brackish water diatoms as a sprinkling of pure fresh water. This he proved by repeated and carefully performed experiments. From this fact he comes to the very probable conclusion that the sudden dying away of myriads of diatoms, besides, perhaps, myriads of other living creatures, during the rainy season might be, if not the only, at least one of the most efficient causes of *malaria*.

Before concluding this letter I wish to call the attention of the British scientific public to another Italian naturalist, M. A. Acorti, Professor of Natural History at the R. Gymnasium of Trieste, who has made the Adriatic a special subject of his studies, and is now engaged in the publication of the diatoms of that sea. "The sketching of his figures," says Count Castracane, "is of such beauty that I never saw anything better of the kind, and I hope they will be soon published that I may purchase them."

J. GAGLIARDI

* We have now plenty of living Protozoa, Radiata, Annulosa, Mollusca, and even of Vertebrata *abyssicolæ*.

† On account of the porous substance, which is a speciality of those wonderful beings, Johnstone has classed them under the significant name of *Amorphozoa porifera*.

‡ After the late remarks on this subject by Prof. Wyville Thomson in NATURE, it is curious to see the manner in which a Fellow of the Royal Society of the last century (John Ray) treated "the various ways of extracting the nutritious juice out of the aliment in several kinds of creatures. For oviparous quadrupeds," he says, "as chameleons, lizards, frogs, as also in all sorts of serpents" (there were, of course, no protozoa known in his time), "there is no mastication or comminution of the meat either in mouth or stomach; but as they swallow insects or other animals whole, so they void their skins unbroken, having a heat or spirits, powerful enough to extract the juice they have need of, without breaking that which contains it: as the Parisian Academists tell us. I" (subjoins Ray candidly) "cannot myself warrant the truth of the observation in all. I have taken two entire adult mice out of the stomach of an adder, whose neck was not bigger than my little finger. These creatures, I say, draw out the juice of what they swallow without any comminution, or so much as breaking the skin; even as it is seen that the juice of grapes is drawn as well from the rape (cluster), where they remain whole, as from the vat, where they are bruised, to borrow the Parisian philosopher's similitude."

The Motion of a Free Rotating Body

I SHALL feel obliged if, through the medium of your widely-circulated journal, you will allow me to point out an extraordinary mistake into which Mr. Radau has fallen, in a memoir inserted in the *Annales Scientifiques de l'Ecole Normale Supérieure* tom. vi. 1869, in which he criticises certain of my conclusions about the representation of the motion of a free rotating body contained in a paper published by me in the "Philosophical Transactions" for 1866. In his preamble, M. Radau says, speaking of the theory of rotation in connection with the names of Poinsot, Rueb, Jacobi, and Richelot:—"Tout récemment M. Sylvester a essayé d'appliquer au même sujet des considérations nouvelles qui l'ont conduite à des résultats intéressants, à côté d'autres dont l'exactitude peut être contesteé."

Later on in his memoir M. Radau points out, and accompanies with very biting (albeit toothless) criticism, the nature of his objection, which is, in short, that I suppose Poinsot's ellipsoid, under the influence of an original impulse, to roll without slipping by virtue of its friction against the plane with which it is in contact. My answer is, that of course I do. And why not? when I suppose the plane "indefinitely rough" (see p. 761 of "Philosophical Transactions," 1866), and have actually determined the friction and pressure at each point of the motion, so that by solving a maximum and minimum problem of one variable, the extreme value of the ratio of one of these forces to the other, or if we please to say so, the limiting angle of friction, or, in other words, the necessary degree of roughness of the plane may be analytically determined for every given case. M. Radau falls into the schoolboy blunder of making the *ratio between the friction and pressure constant throughout the motion*, confounding the actual friction with its limiting maximum value! It is, indeed, surprising that such a perversion of the facts of the case should have found insertion in a serious journal, such as that published by the Ecole Normale Supérieure, and I might fairly have expected from M. Radau the courtesy habitual with his adopted countrymen, of applying to me for information on anything in my paper which might have appeared to him obscure or erroneous, before rushing into print with such a *mare's nest*.

But out of evil cometh good. M. Radau says:—"Mais M. Sylvester va plus loin; il pense que le problème pourrait se résoudre par l'observation directe du mouvement d'un ellipsoide matériel tournant sur un plan fixe en même temps qu'il tournerait autour de son centre également fixe. On ne se figure pas facilement par quel artifice on fixerait le centre d'un ellipsoide matériel."

In a future number of your esteemed journal (as time at present fails me) I propose to show how, by the simplest contrivance in the world, a downright material top of ellipsoidal form may be actually made to roll, with its centre fixed, on a fixed plane and so exhibit to the eye the surprising spectacle of a motion precisely identical *in time*, as well as in its successive displacements of *position*, with that of a body, turning round a fixed centre, but otherwise absolutely unconstrained.

This mode of representation, which flashed upon my mind almost instantaneously when my eye first lighted upon M. Radau's objections, is the compensating good to the evil of being made the victim (to the temporary disturbance of my beloved tranquillity) of so hasty and futile a criticism as has been allowed insertion in the "Scientific Annals" of so great an institution as the Ecole Normale of Paris.

The *bureau de rédaction* must surely have been nodding when they allowed such observations, so easily refuted by turning to the original memoir, to pass unchallenged. It was only within the last few days that I received M. Radau's paper.

Athenæum Club, March 8 J. J. SYLVESTER

"Engrais Complet"

IN England many people have no faith in simple remedies with simple names, such, for instance, as brimstone and treacle; but make the same materials into a jam, disguise its flavour, and call it, say, the "Universal Purgative Extract," and then believers in its efficacy will soon be reckoned by the thousand. It seems from a review in a recent number of NATURE, that farmers in France are similarly incredulous on the subject of manures with intelligible names, that they require what is really useful to be mixed with something useless, and called "Engrais Complet," before they will apply it to their land. The English idiosyncracy benefits a large number of patent medicine vendors, and I presume this French variety of it benefits the manure merchants. Let us hope, however, that English farmers will continue to mix their own "Engrais Complet," obtaining, as heretofore, their nitrogen from farmyard manure, guano, and nitrogenous salts; their phosphorus from guano and superphosphate; their potash from organic excreta and potash salts. Under ordinary circumstances, with the Norfolk four-course system, the "Engrais Complet" for barley is left on the land by sheep feeding off roots and oil-cake; that for roots is farmyard manure and super-phosphate; that for wheat is clover roots, with a top-dressing of guano and salt. Clover requires little from the land but potash and good cultivation; but every crop should be fed well enough to leave something handsome for its successor.

Pray excuse my homely comparisons, for although a reader and I hope a student of NATURE, I am still

ONLY A CLOD

The Preservation of Mollusca

THE notice in a recent number of the use of creosote by M. Holbein for the preservation of mollusca, &c., leads me to remark that I have found it of great value for the preservation of coleoptera and other insects. The solution of creosote and water appears to be quite as effectual a preservative as alcohol, and does not harden the tissues or cause discoloration. After an immersion of about a week the solution should be drained off, and the insects placed in tins and covered with sawdust. Probably small reptiles, &c., could equally well be preserved in this way, which would save the danger of leakage and breakage which now ruins so many consignments.

Cambridge. J. R. CROTCH

Frankland and Duppa on the Action of Sodium on Acetic Ether

IN their recent communication to the Royal Society, reported in the last number of NATURE, Messrs. Frankland and Duppa ascribe my not getting hydrogen by the action of sodium on the acetic ethers to the high pressure existing in my sealed tubes.

How could there be a high pressure in my tubes unless I had first developed a large quantity of hydrogen? How then could it possibly be high pressure which prevented my getting any hydrogen? The pressure could not be due to the tension of the vapours of the acetic ethers, for in one experiment I employed acetate of amyl, which boils at 140° C., whilst I heated only to 100° C., and in this case, instead of getting 250 c.c. of gas, I got not a trace of gas. Moreover, the experiment with potassium was made in an open vessel.

On the other hand nothing is plainer than that Frankland and Duppa were operating upon alcohol as well as upon acetic ether, and hence their hydrogen.

London, March 3 J. ALFRED WANKLYN

Sir W. Thomson and Geological Time

I AM curious to know in which of his writings Sir W. Thomson makes the assertion "that there was a time when the earth rotated too swiftly for the existence of life." I cannot see how the assertion, even if it were true, could be of the least use in determining questions as to the length of time during which the earth has been habitable. Certainly it has not the slightest connection with Thomson's argument as to the date of consolidation of the earth, founded on its figure and on the retardation of its rotation by tidal friction. Yet the assertion is distinctly ascribed to Thomson—*first* in the *Pall Mall Gazette*, May 3, 1869, and *secondly* in the *Edinburgh Review* for January last.

If the passage quoted, or at least something resembling it, cannot be found in Thomson's writings, I am anxious to know whether the charge is due to simple stupidity on the part of the critics (or critic?), or whether it proves more?

G. H.

Little Gull (*Larus minutus*)

IN the proceedings of the Royal Physical Society of Edinburgh, as reported in NATURE, July 17, Dr. Smith notices the capture of a specimen of the Little Gull (*Larus minutus*) in Scotland, and remarks that it is a rare straggler to Scotland, only some two or three specimens having been previously recorded. Although rare in Scotland, it is by no means uncommon on the Yorkshire coast during the autumn and winter, and specimens are frequently shot during these seasons near Flamborough Head and along the Bridlington coast. This winter they have been more than usually plentiful. Mr. Richardson, of Beverley, in a letter dated February 18, informs me "I have received thirteen Little Gulls, shot on the Bridlington coast during the last fortnight, seven adults and six immature." And, in a recent communication, "There have been twenty-nine Little Gulls shot in all, nineteen old and ten young birds."

I have a photograph of an adult bird in breeding plumage, with the black head, shot at Flamborough on July 13, 1868.

Great Cotes, Ulceby, Feb. 25 JOHN CORDEAUX

THE MICROSCOPIC FAUNA OF THE ENGLISH FEN DISTRICT

THE results of some recent researches amongst the Entomostraca of the rivers and "broads" of Norfolk and the adjacent counties have proved so interesting that a brief *résumé* of the subject will probably not be unacceptable to the readers of NATURE.

My attention was first directed to the district in the following manner:—My friend, Mr. E. C. Davison, a gentleman attached to the staff of H.M.S. *Porcupine*, has for several years interested himself very kindly, during the annual cruises of the vessel, in collecting for me such Entomostraca and other Microzoa as came in his way. Amongst the gatherings which thus came into my hands were two samples of sand from the Dutch rivers Maas and Scheldt, some similar dredgings from the English river Ouse (Norfolk), and one from Oulton Broad in Suffolk. The Dutch gatherings had been in my hands for several years, and their ostracoda described in the "Annals and Magazine of Natural History," before I received those from the English localities. An examination of these at once revealed a remarkable similarity between the inhabitants of all the localities—several species, up to that time unknown in Britain, being recognised as identical with some of those taken in Holland. This interesting observation induced me, in company with Mr. D. Robertson, of Glasgow, to visit the Fen district with a view of more thoroughly investigating its microscopic fauna—an inquiry which has resulted in very much strengthening our original view as to its close relationship with that of Holland, and seeming, moreover, to indicate that we have in the English fens a very remarkable group of Ostracoda and Foraminifera marked out by a hard and fast line, and forming a district fauna quite unparalleled in its isolation, as regards the surrounding British species.

The fact of a partial relationship between the fauna of the Fen counties, or East Anglian district, as we may conveniently call it, and that of North-Western Europe is not new; and the best account of the matter that I know of may be found in an interesting article on "The Fens," by the Rev. Canon Kingsley, in *Good Words* for 1867. The facts which most prominently indicate this relationship are the presence of various fishes of the family Cyprinidæ—roach, dace, &c., which attain their highest development in the rivers and lakes of Sweden,—of the "bearded tit," now however probably nearly extinct, and of the remains of the fresh-water tortoise, *Emys lutaria*, now an inhabitant only of Central and Eastern Europe, and whose presence in England can scarcely be accounted for except on the supposition of a free river communication between our island and the Continent during a bygone geological epoch. That the Straits of Dover were, indeed, not very long ago (geologically speaking) bridged over by dry land, and that at that time the rivers of North-Western Europe emptied themselves into one great estuary situated between us and the Scandinavian peninsula are well-established facts; and it is as giving additional confirmation to this belief by exhibiting perhaps more fully than has previously been done the close relationship of the fluvial faunas of East Anglia and Holland, that our present observations claim their chief interest. For it is evident that two faunas, possessing in common, even according to our present imperfect knowledge, a considerable number of species at once very peculiar in character, apparently very restricted in their distribution, and separated at the present time by a wide expanse of sea, must have sprung originally from one common centre, and can scarcely have been finally separated for any great length of time. The fishes to which we have referred have indeed spread, either through natural or artificial agencies, from the eastern rivers to other parts of England and even to Ireland. But this crustacean fauna seems to be rigidly confined to the Fen district of Norfolk and Suffolk on the western side of the German Ocean, and to the rivers of Holland on the eastern side. We make this assertion with some reserve, because much yet remains to be done in the examination of aquatic microzoa everywhere, and it is just possible that some of those species which we take to be peculiar to the Fen fauna may turn up elsewhere. But we have ourselves examined dredgings from many English rivers, especially on the east coast, and have explored in the search for Entomostraca (though without dredging), the lake districts of England and Southern Scotland, without ever meeting with any of them. In no part of the continent of Europe have the Entomostraca received so much attention as in Scandinavia, where, if anywhere, we should expect a similar fauna to be found. But neither Müller, Lilljeborg, nor Sars appears to have met with such. Nor does M. Felix Plateau's recent memoir on the "Fresh-water Crustacea of Belgium" mention any similar species, though we cannot help thinking that had the dredge been used there, the result would have been different.

Out of about 180 known species of British Ostracoda, eighty may be frequently met with in river estuaries or in marine situations where much fresh water habitually mingles with the salt. Of these, thirteen may be considered as coming down to the debatable ground from the fresh-water side and fifty-six from the sea; the remaining eleven haunt brackish water almost exclusively, so much so, indeed, that were they found to any large extent in a fossiliferous deposit, we should have no hesitation in saying that it was produced under brackish conditions.

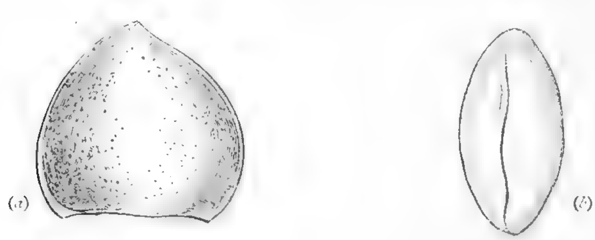
Of about 100 species and varieties found in the Fen district and its outlets, sixty-eight may be looked upon as usual inhabitants of either marine or estuarine situations. These are met with chiefly in the river outlets, and being, doubtless, derived from the sea may be left out of sight in any consideration of the fauna of the Fens. Again, nineteen are widely-distributed fresh-water species, of which little need be said except that those of the genus *Candona*, especially *C. compressa*, *albicans*, and *lactea*, seem here to attain a finer development and to exist in much greater abundance than in any other district. In connection with this it is curious to observe that the genus occupies an intermediate position between the crawling, non-natatory marine Cytheridæ and the freely swimming fresh-water Cyprides. Twelve (?) species, mostly undescribed, seem to be entirely or almost entirely confined to the fens of England and the corresponding districts of Holland, for we regard their appearance in dredgings from the estuaries of the Scheldt and Meuse as evidence, not of their *living* in those situations, but of their probable abundant existence nearer the water-head. Dead shells of the same species are met with in a similar manner in the river outlets of Norfolk, such as the Ouse and Breydon water, their real habitat being the fresh-water "broads" and the dykes and rivers as high up as, and very probably higher than, Peterborough and Ely.

The peculiar species of the district are the following:—*Goniocypris mitra*, Brady and Robertson; *Metacypris cordata*, B. and R.; *Cypris fretensis*, B. and R.; *Cypridopsis Newtoni*, B. and R.; *Candona Kingsleii*, B. and R.; *C. hyalina*, B. and R.; *Cythere fuscata*, Brady; *Limnicythere monstrifica*, Norman; *L. Sancti Patricii*, B. and R.; *Polycheles Stevensoni*, B. and R.; with some few other species of which few examples only have been found, and those are not yet fully worked out. Of the ten enumerated above, four of the most remarkable (*M. cordota, C. fuscata, P. Stevensoni, C. fretensis*) have occurred in the gatherings from the Meuse and Scheldt. The new species are not yet published, but will shortly be fully figured and described by the present writer, in conjunction with Mr. D. Robertson, in the *Annals and Magazine of Natural History.*

The Foraminifera of the broads and fen rivers are scarcely less interesting than the Entomostraca, and embrace some new species and varieties; we are not yet, however, in a position to institute any comparison between them and those of the Dutch rivers. One point of interest may

Polycheles Stevensoni, magnified 40 diameters: (*a*) seen from side; (*b*) seen from below. The young fry are seen through the translucent shell at its posterior end. The species is probably viviparous.

Metacypris cordata, magnified 84 diameters: (*a*) seen from side; (*b*) seen from below.



Goniocypris mitra, magnified 84 diameters: (*a*) seen rom side; (*b*) seen from below.

be noticed, that although, on the site of Whittlesea mere, Foraminifera are very abundant, scarcely any are to be met with in the river Nene, which is closely adjacent. This would seem to indicate that the faunas of the two places are independent of each other, or, at any rate, that the Foraminifera of the Fens are not recruited indirectly from the sea through the medium of river communication.

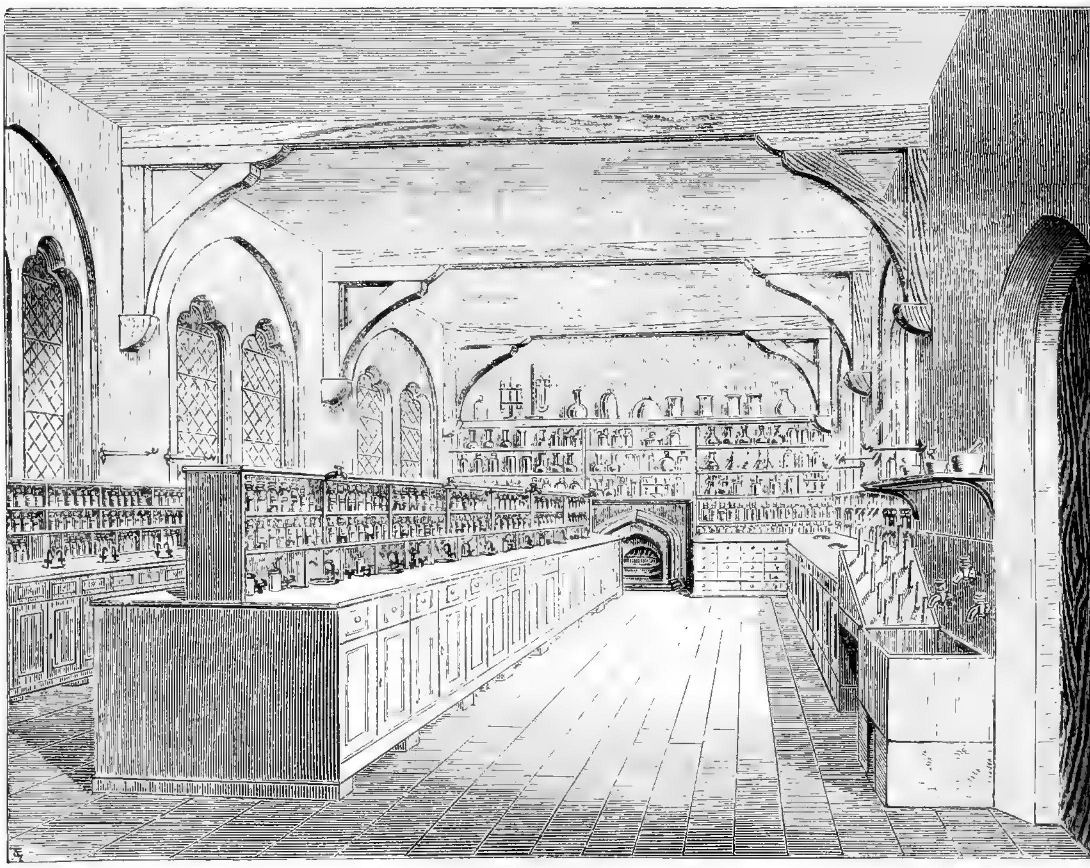
In conclusion it must be said that the free-swimming Entomostraca of the whole fen district present, so far as we have found, nothing calling for remark; many of the common fresh-water Lyncei and Copepoda are very abundant in the broads, rivers, and dykes, throughout the district; but had it not been for the use of the dredge we should have found nothing of great interest. *Not one* of the new species would have been found (though one of these is everywhere abundant, and some of the rest by no means rare), except *Goniocypris mitra*, of which one or two detached valves were observed in a gathering from Somerton Broad.

The explanation of the origin of this peculiar fauna is perhaps not very easy. If we might be allowed to speculate, we should say that it is probably the last surviving representative of a group of species which may have inhabited in remote times a large, lagoon-covered district possibly continuous between this country and Holland, the water of which we should suppose to have been ordinarily but slightly brackish. Possibly if this condition lasted during any great period of time, the species in question may have been developed by a process of modification from those inhabiting the estuaries on one side and the fresh water on the other. But two or three of them are so far removed in character from any others with which we are at present acquainted that it is impossible to speak more positively on the subject. Enough has been said to show that the subject is one of no little interest, and that the waters of the districts referred to would very probably well repay the labours of investigators in other departments of natural history.

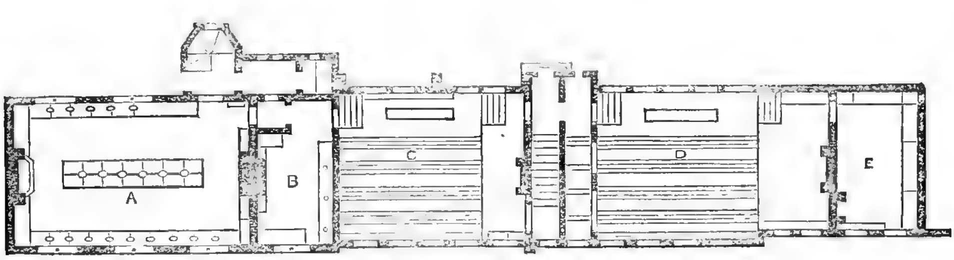
G. S. BRADY

THE NEW NATURAL SCIENCE SCHOOLS AT RUGBY

ALTHOUGH a brief notice of the new schools at Rugby has already appeared in the pages of this journal, a more detailed account of them may not be unacceptable to the readers of NATURE, especially at a time when so much attention is being paid to the subject of science teaching in schools.



GENERAL VIEW OF LABORATORY



GROUND PLAN

SCALE OF FEET

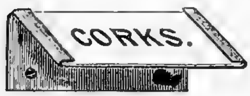
The accompanying ground-plan will show the general arrangement of the rooms.

The laboratory is 35 ft. by 22, and is intended to accommodate thirty boys. It is not, properly speaking, one of the new schools, as it was formerly the only Natural Science lecture-room; but it has been much altered and entirely refitted, in order to convert it into a laboratory. The working tables are divided into compartments, seven on each side of the centre table, and ten and six in those along the sides of the room. Each compartment comprises a cupboard and two drawers, two shelves for bottles, two gas taps, waste basin with water supply, and a working space of 3 ft. 6 in. by 1 ft. 9 in. The water taps and basins in the central table are placed so as to serve for boys working on either side, and thus much space is gained. The water taps have a small orifice, and are specially adapted for filling test tubes. A water pipe is also carried along the highest shelf and there are taps at intervals for filling tall vessels, for working with Liebig's condenser, &c.

The sink, with arrangements for washing and drying bottles, is seen near the door in the drawing.

At one end of the room is an open fireplace, with shelves and nests of drawers on either side. The drawers contain the various articles that are in general use in the laboratory, such as corks, cork-borers, elastic tubing, holders of different kinds, glass tubes and rods, &c. Every drawer is labelled on a simple plan that I find very convenient.

A bit of zinc is bent at an angle of 45°. The two edges of the one half are then just turned over, and the whole is screwed to the front of the drawer. A card slipped under the turned-down edges is held perfectly tight, and can be removed at any time. Labels so arranged are much more easily seen than if they were simply fastened to the face of the drawers. (One is shown in the figure.)



The lower shelves above the drawers contain all the dry chemicals required in Harcourt and Madan's "Practical Chemistry" (the book we chiefly use in the laboratory), together with the more costly re-agents, and others that are in less frequent use. Each boy has a complete set of all the ordinary acids and test solutions on the shelves of his compartment.

The contents of the drawers and shelves on either side of the fire-place are arranged in duplicate—a complete set on each side. In this way all chance of confusion and crowding is avoided, as no boy can have occasion to cross over from the side of the room on which he is working to the opposite side, everything being ready to his hand.

A common balance with sets of gramme weights is placed on the table above each nest of drawers. Here also are kept the various measuring flasks and cylinders. At the other end of the room is an ordinary six-feet kitchen range, which has been slightly modified so as to serve for a furnace. It has sand-bath, boiler, and drying-oven. On one side of the furnace is a cupboard to contain a stock of glass and porcelain apparatus. On the other side are two spacious evaporating closets with sliding glass doors. These are supplied with hoods and jets for creating a powerful draught. The draught can be still further increased, when necessary, by lighting a large ring of jets in the flue communicating with the closets.

A small cupboard for tools and a glass-blower's table complete the furniture of the laboratory.

The room marked B, in the ground plan, was formerly the only laboratory for the use of the school. It was built some years ago, at the same time as the Natural Science lecture-room, and, though small, was exceedingly well arranged. It is now converted into a private laboratory for the use of the chemical lecturer. It contains a large evaporating closet, also a sand-bath and distilling apparatus, both of which are worked by the fire in the school laboratory by means of appropriate dampers. Here also is the flue for obtaining a down-draught at the lecture-table in the adjoining chemical lecture theatre. As several pipes open into this flue it was found necessary to place the large ring of gas-jets for creating the draught at a considerable elevation above the floor. To light this ring an artifice was employed that it may be worth while to mention. A supplementary gas-pipe was carried alongside of the supply-pipe from a few feet above the floor to the ring of jets. This was pierced with small jets at short intervals all the way to the top. A separate tap turns on the gas in this pipe, and upon applying a light to the lowest jet the flame runs rapidly up the pipe and lights the ring at the top. The gas is then turned off from the supplementary pipe and the ring alone left burning.

From the private laboratory a door opens into the chemical lecture-room. This is provided with seats for fifty boys, the forms and desks rising tier above tier so that experiments at the lecture table are well seen by all. The down draught at the lecture table, already alluded to, is most useful. Experiments with chlorine may be performed with hardly any smell escaping.

The theatre is well supplied with shelves, cupboards, apparatus cases, diagram-screens, and black-board. There is also a capital cellar for stock chemicals, batteries and empty cases.

The Physical Science lecture theatre, D, is of still larger dimensions, and will hold sixty boys. A space at one end is fitted up with work-tables, &c., where experiments may be prepared, and also where boys may themselves learn how to use physical apparatus under the eye of a master.

The walls of the room, E, are entirely lined with glass cases for the reception of the school apparatus. Here, also, is a lathe with table-vice and bench, where an assistant, accustomed to mechanical work, can make various lecture illustrations, and repair instruments that are out of order.

I ought to add that the Natural Science Schools are only part of an extensive block of new buildings containing several classical and other schools, and that the whole has been erected from the designs of Mr. W. Butterfield. T. N. HUTCHINSON

NOTES

M. DELAUNAY is the new director of the Paris Observatory. We must congratulate the French Government upon their appointment. M. Delaunay, who has just received the Medal of our Royal Astronomical Society for his researches on the moon's motion, is an astronomer second to none, and is in every way admirably qualified for such an important post.

AT the Royal Society's Soirée on Saturday last, a number of interesting objects were exhibited, among which we may mention Mr. Roberts's specimens of electro-deposited iron; Mr. Siemens specimens of cast steel from the Landore-Siemens Works; a chronoscope of elaborate construction, exhibited by Capt. Noble, for recording at one observation the velocity with which a projectile passes different parts of the bore of a gun. The principle of this instrument is that of registering, by means of electric currents, upon a recording surface, travelling at a uniform and very high speed, the precise instant at which a shot passes certain defined points in the bore. It is capable of indicating intervals of time as minute as one-millionth part of a second. We shall again refer to some of the objects exhibited.

AT the meeting of the Royal Society last week, the names of the candidates for election, fifty-three in number, were read. From these, in accordance with the usual practice, fifteen will be chosen to be elected by the Fellows of the Society in June next. Last year the number of candidates was forty-five.

AT the same meeting two short papers were read from Mr. Le Sueur, who has charge of the great telescope at Melbourne, giving an account of his observations of some of the nebulæ included in Sir John Herschel's Cape Catalogue. The details are interesting, and full of promise for the future; as are also the particulars of spectroscopic observations of Jupiter which accompany the observations of nebulæ.

THE *Athenæum*, in reporting that Mr. Hind has issued a circular showing the path of the moon's shadow in the eclipse of the sun which will take place on the 22nd December, remarks that it is to be hoped that our Government will send out an expedition thoroughly equipped with spectroscopes to settle the nature of the corona; one of the last remaining questions of solar physics.

IT is satisfactory to know that the Municipal authorities of Glasgow are alive to the prospective benefits which their city is likely to gain, in a sanitary point of view, from the investigations which are to be instituted by the Sewage Committee of the British Association. If any city more than another needs the sanitarian besom it must surely be Glasgow, when it is remembered that it enjoys the unenviable notoriety of having the highest death-rate of all the great towns of the kingdom. Its desire to get this stigma removed is indicated by the fact that the Police Commissioners, at their last meeting, on the motion of a genuine sanitarian, the chairman of the Health Committee, voted the sum of 100*l.* towards defraying the expenses of the British Association Committee referred to above. We understand that the fund already amounts to upwards of 1,000*l.*

THE Swiney Lectures on Geology are to be delivered at the London Institution, by Dr. Cobbold, F.R.S., commencing on March 10th. During the course it is proposed to discuss, among other subjects, "The scope and tendency of the physical and biological sciences," "The best modes of acquiring adequate conceptions of geologic time," "Evidences of the incompleteness of the geological record," and "The claims of geology as an aid to the acquirement of high mental culture."

ON the 13th of January died F. T. Otto, Professor at the Polytechnic School of Brunswick, known chiefly as the translator of Graham's "Elements of Chemistry." Two editions of this translation having been rapidly sold, a third edition was commenced in 1852, in which the plan of the original was entirely changed. Otto treated mineral chemistry in three volumes; theoretical chemistry being reserved to Buff, Kopp and Zamminer, and organic chemistry to Kolbe and Fehling. Otto's chemical researches were not considerable. His books, however on the manufacture of vinegar and on agricultural industry are held in great esteem. Otto was born in Saxony in 1809.

THE paper to be read on Thursday at the Royal Society, by Mr. Warren de la Rue, Dr. Balfour Stewart, and Mr. Loewy, is expected to be of great interest.

PROFESSOR UNGER, of Vienna, a well-known botanist, whose death we reported last week, was, it is now stated, found murdered in his bed at Graz; and no trace of the murderer has as yet been discovered. A priest has taken this opportunity to assert from the pulpit at Cilly, Styria, that the body of the late philosopher had probably been destroyed by the devil himself, who had just claims upon his soul!

WE learn from the *Society of Arts Journal* that a Hygienic Council, attached to the Turkish Ministry of the Interior, has been created, with the function of improving the drainage, enforcing proper street scavengering and public cleanliness, both in the capital and throughout the provinces. Its further duty will be to improve existing civilian hospitals, and establish new ones where needed.

THE examination of candidates for the Royal Agricultural Society's prizes will take place in the week commencing 26th April.

THE Royal Asiatic Society offer to treat with any learned Society for the use of rooms in their new premises in Albemarle Street, which are more than they require.

THE *Photographic News* announces the death of Mr. Bingham, an English photographer long resident in Paris, and at one time assistant to Faraday.

THERE is a talk of an International Congress of Geographers at Antwerp. Many eminent French *savants* have promised to take part.

MR. ALGLAVE reports in the *Revue des Cours Scientifiques* that the Sars Fund now amounts to about 260*l.*

WE acknowledge the receipt of the ninth number of the *Free Sunday Advocate*, with a supplement, containing Professor Huxley's lecture "On the forefathers and forerunners of the English people"—a paper by Wm. Duthie, Esq, "On the social economy of Sunday, stating reasons for the opening of picture galleries, museums, and gardens, and running railway trains and steamboats on Sunday"—also the first of Dr. Carpenter's lectures "On the physical conditions and animal life of the deep sea."

Cosmos complains that the approaching réunion at the Sorbonne instead of being an assemblage of philosophers is to be merely a gathering of students, to compete for and receive prizes.

WE acknowledge the receipt of the Meteorological Tables for the Quarter ending 31st December last by Mr. Glaisher.

THE *Revue des Cours Scientifiques* states that the botanical collection formed by Baron Delessest, and since maintained by his son, who died lately, has been left to the town of Geneva. The library has been deposited in the Academy of Sciences.

WITH reference to Prof. Stanley Jevons's paper, read last month at the Royal Society, on the representation of logical processes by mechanism, it seems right to mention that Mr. Alfred Smee, F.R.S., published a book twenty years ago on the "Progress of Thought," in which engravings were given of a machine for the representation of mental operations. At present it is difficult to see what would be the utility of such machines; but if they are to be regarded as a step towards one that will some day be really useful, then the invention may be accepted as something more than an ingenious curiosity.

IN the report of the Royal Commission on Pollution of Rivers, the presence of arsenic in the water and mud of rivers near alkali works is pointed out, and it is also stated that the London sewage at Barking contains as much as ·004 of arsenic in 100,000 parts.

THE *Levant Herald* states that the Turkish Government is about to adopt the French Metric System. It is to be gradually brought into use. The oke very nearly corresponds to the kilogramme.

THE second of a course of weekly lectures on subjects connected with Economic Science, especially as concerned with labour and capital, under the auspices of the Social Science Association, was delivered inthe house of the Society of Arts, John Street, Adelphi, on Tuesday evening, by Frederick Hill, Esq., on "The Identity of the Interests of Employers and Workpeople." The chair taken by George Godwin, Esq.

THE Council of the Society of Arts will consider the award of the Albert medal early in May next.

AN injunction has been granted to restrain the Corporation of Leeds from discharging sewage into the river Aire.

THE first Exhibition of Spring Flowers at the Gardens of the Royal Botanic Society, is to take place on the 30th and 31st of this month.

AT a Session of the Council of University College, London, on Saturday last, Mr. George Grote, president, in the chair, Mr. Henry Maudsley, M.D. Lond., Fellow of the College, was appointed Professor of Medical Jurisprudence. A Whitworth Exhibition of 25*l.* was awarded to Mr. Robert Forsyth Scott, a student of the college.

THE new chemical laboratory erected for the use of the scholars at Eton College has just been opened for school purposes, under the superintendence of Mr. Madan. There are two large rooms, one of which will be used for lectures and the other for school purposes.

FROM a circular lately issued to the Government science teachers, we learn that the Lord President and the Vice-President of the Committee of Council on Education have found it advisable to modify the provisions of the Council's minute of the 30th November, 1869, in reference to the mode of paying those teachers for their arduous work of instructing the industrial classes in elementary science. Since the teachers held their meeting at Manchester, the complaint which they brought against the Science and Art Department of breach of faith, and repudiation of engagements made with them, has been pressed upon the Government by a strong force of Lancashire and Yorkshire members of Parliament.

THE *British Medical Journal* states that Prof. Agassiz is ill from nervous prostration and over-work, not being able even to write letters.

THE Gulstonian Lectures for this year will be delivered at the Royal College of Physicians, by Dr. Maudsley, on the 11th, 16th, and 18th of this month, the subject being "The Relations between Body and Mind, and between Mental and other Nervous Disorders." The Croonian Lectures will be on "Aneurism of the Heart," and will be delivered by Dr. Gibson on the 23rd, 25th, and 30th of March. The subject of the Lumleian Lectures on the 1st, 6th, and 8th of April, will be "The Natural History and Diagnosis of Intra-Thoracic Cancer," by Dr. J. R. Bennett. The lectures will commence in each case at 5 o'clock.

THE Acclimatation Society of Paris has awarded to Mr. P. L. Simmonds its silver medal, of the first class, for his paper on "Silk cultivation and supply," read before the Indian Conference of this Society last year. A similar medal has been awarded to Mr. G. W. Hart, of Hayling Island, for his labours in oyster culture.

THE Instituto Tecnico of Palermo has published another part of the *Giornale di Scienze Naturali ed Economiche*, which well sustains the character of the work. Among the papers therein contained we notice—"Avifauna del Modenese e della Sicilia," "Sui materiali per costruzione di mattoni refrattarii per le zolfare," "Nuove specie di funghi," "Determinazione del luogo chimico nelle sostanze aromatache," and "Studii palæontologici sulla fauna del calcario a telebratula janitor del nord di Sicilia." Besides all this, the part contains eight numbers of the *Bullettino* of the Royal Astronomical Observatory at Palermo, in which are records of observations astronomical and meteorological, notices of sun-spots and magnetic perturbations, and on shooting-stars and meteors, with lithographic illustrations. It is gratifying to find that even in Sicily science is making progress.

THE Government of India has lately sanctioned the commencement of the Damoodah Canal, at an estimated cost of about 540,000*l*. Its total length will be just 100 miles. One end of it will terminate in the heart of the Bengal coal-fields, and it will thus be the means of affording a cheap line of transport for carrying coals into Calcutta, relieving at the same time the railway of a portion of that traffic. A secondary but very important result of this canal is likely to be the drainage of the tract of land lying between the railway and the Damoodah, which for the last seven years has been desolated by malarious fever.

WE learn that the success of the Lectures for Women during the present term has equalled the most sanguine expectations of the originators of the scheme. Between seventy and eighty ladies are now attending eight courses of lectures, the number of attendances (counting each lecture separately) being in all 115. The committee proposes to issue in June a complete programme of the lectures for the next academical year. The present courses will be continued during the next (Easter) term at the present hours, unless special notice of a change be given.

WE have received from the Hydrographic Office of the Admiralty a copy of the notice to mariners stating that, on or about the 1st of April next, a telegraphic station vessel will be moored by the International Mid-Channel Telegraph Company off the entrance to the English Channel, in from fifty-five to fifty-nine fathoms water, in lat. 49° 20′ 30″ N., long. 6° 17′ W. of Greenwich. The vessel will be painted black, with the words "Telegraph Ship" in white letters on her sides; she will have three masts. At the top of the mainmast a large black cone will be hoisted during daytime, and a powerful globular light at night, elevated thirty feet above the sea, which in clear weather should be seen from a distance of six miles. A flare-up light will also be shown every fifteen minutes during the night, from an hour after sunset to an hour before sunrise. During foggy weather, day or night, a bell will be rung continuously for half a minute every quarter of an hour; and for the first six months, or until the 1st day of October 1870, a gun will be fired every quarter of an hour, and after that date every hour. The commercial code of signals for the use of all nations will be used on board, to the exclusion of all other codes, and none other can be noticed. In reference to this, M. Delehaye remarks in the *Bulletin* of the Association Scientifique of France that it will be of great service to navigation by saving time, and obviating risk and expense. For meteorological purposes also he believes this station will be very useful. He might have extended his list.

*ON THE TEMPERATURE AND ANIMAL LIFE OF THE DEEP SEA**

I.

THE present discourse embodies the most important general results obtained by the exploration of the deep sea in the neighbourhood of the British Isles, carried on during the summer of 1869 in H.M. surveying vessel *Porcupine*, with the view of completing and extending the inquiries commenced in the *Lightning* expedition of 1868, of which an account was given by the speaker at the Friday evening meeting of April 9, 1869.†

The expedition of the *Porcupine* was divided into three cruises. The first of these, which was placed under the scientific charge of Mr. J. Gwyn Jeffreys, F.R.S., accompanied by Mr. William L. Carpenter, as chemical assistant, commenced from Galway near the end of May, and concluded at Belfast at the beginning of July. It was directed in the first instance to the south-west, then to the west, and finally to the north-west as far as the Rockall Bank. The greatest depth at which temperature-sounding and dredging were carried on in this cruise was 1,476 fathoms; and these operations, through the excellent equipment of the *Porcupine* and the skill of her commander, Captain Calver, were so successfully performed, that it was confidently anticipated that still greater depths might be reached with an equally satisfactory result.

The second cruise, which was under the scientific charge of Prof. Wyville Thomson, F.R.S., with Mr. Hunter as chemical assistant, was consequently directed to the nearest point at which a depth of 2,500 fathoms was known to exist, viz., the northern extremity of the Bay of Biscay, about 250 miles to the west of Ushant. In this cruise temperature-sounding and dredging were carried down to the extraordinary depth of 2,345 fathoms, or nearly three miles—a depth nearly equal to the height of Mont Blanc, and exceeding by more than 500 fathoms that from which the Atlantic Cable was recovered. This sea-bed, on which the pressure of the superincumbent water is nearly three tons for every square inch, was found to support an abundance of animal life; about 1½ cwt. of "Atlantic mud," chiefly consisting of *Globigerinæ*, having been brought up in the dredge, together with various types of higher animals, Echinoderms, Annelids, Crustaceans, and Mollusks; among them a new Crinoid—referable, like the *Rhizocrinus*, whose discovery by M. Sars, jun., had been the starting-point of the present inquiry—to the *Apiocrinite* type which flourished during the Oolitic period.

The third cruise was under the scientific charge of the speaker, with Mr. P. H. Carpenter as chemical assistant; but he had the great advantage of being accompanied by his colleague Prof. Wyville Thomson, who, as in the *Lightning* expedition, took the entire superintendence of the dredging operations. The object of this cruise, which commenced in the middle of August and terminated in the middle of September, was a more thorough exploration of the area between the North of Scotland and the Faroe Islands, which had been found in the *Lightning* expedition to afford results of peculiar interest in regard alike to the inequality of temperature and to the distribution of animal life on the sea-bed, which here ranges between the comparatively shal-

* A Lecture delivered at the Royal Institution.
† Proceedings of the Royal Institution, vol. v. p. 503.

low depths of from 350 to 650 fathoms—the last-named being the greatest depth to which dredging had been carried in 1868.

The weather, during nearly the whole of the *Porcupine* expedition, was as favourable to its work, as during the greater part of the *Lightning* expedition it had been unfavourable; and the results obtained not only far exceeded the most sanguine expectations of those who had promoted it, but may be said, without exaggeration, to be such as no previous scientific exploration of so limited an extent and duration is known to have yielded.

The results of the temperature-soundings will be first stated, with their bearing on the doctrines advanced in the former discourse as probable inferences from the observations made during the *Lightning* expedition. These observations indicated that two very different submarine climates exist in the deep channel which lies E.N.E. and W.S.W. between the North of Scotland and the Faroe Banks; a minimum temperature of 32° having been registered in some parts of this channel, whilst in other parts of it, at the like depths, and with the same surface temperature (never varying much from 52°), the minimum temperature registered was never lower than 46°,—thus showing a difference of 14°. It could not be positively asserted that these minima are the bottom-temperatures of the Areas in which they respectively occur: but it was argued that they must almost necessarily be so:—first, because it is highly improbable that sea-water at 32° should overlie water at any higher temperature, which is specifically lighter than itself, unless the two strata have a motion in opposite directions sufficiently rapid to be recognisable; and secondly, because the nature of the animal life found on the bottom of the cold-area, which consists of quartzose sand including volcanic particles, exhibited a marked correspondence with its presumed reduction of temperature, whilst the sea-bed of the warm area is essentially composed of *Globigerina*-mud, and the animal life which it supports is characteristic of the warmer-temperate seas.

This conclusion, it is obvious, would not be invalidated by any error arising from the effect of pressure on the bulbs of the thermometers; since, although the actual minima might be, as was then surmised, from 2° to 4° below the recorded minima, the difference between temperatures taken at the same or nearly the same depths would remain unaffected.

The existence in the cold area, of a minimum temperature of 32°, with a Fauna essentially Boreal, could not, it was argued, be accounted for in any other way than by the supposition of an under-current of Polar water coming down from the north or north-east: whilst, conversely, the existence in the warm area, of a minimum temperature of 46°, extending to 500 or 600 fathoms' depth, in the latitude of 60° (being at least 8° above its isotherm), together with the warmer-temperate character of its Fauna, seemed equally indicative of a flow of equatorial waters from the south or south-west.

It was further urged that if the existence of two such different submarine climates in close proximity can only be accounted for on the hypothesis of an Arctic stream and an Equatorial stream running side by side (the latter also spreading over the former in consequence of its lower specific gravity), these streams are to be regarded (like the Gulf Stream) as particular cases of a great general Oceanic Circulation, which is continually bringing the water cooled-down in the Polar regions into the deepest parts of the Equatorial ocean-basins, whilst the water heated in the Equatorial regions moves towards the poles on or near the surface. Such a circulation was long since pointed out to be as much a physical necessity, as that interchange of *Air* between the Equatorial and Polar regions which has so large a share in the production of winds; but whilst physical geographers remained under the dominant idea that the temperature of the deep sea is everywhere 39°, they could not fully recognise its importance.

These doctrines have been fully tested by the very numerous and careful temperature-soundings taken in the *Porcupine* expedition; and the result has been not merely to confirm them in every particular—so that they may now take rank as established facts,—but also to show that a temperature 2½° below the freezing-point of fresh water may prevail over the sea-bed in a region far removed from the Polar, and that even this extreme reduction is by no means antagonistic to the existence of animal life in great variety and abundance.

All the temperature-soundings of the *Porcupine* expedition were taken with thermometers protected from the effects of pressure by the enclosure of the bulb of each instrument in an outer bulb, sealed round the neck of the tube; about three-fourths of the intervening space being filled with spirit, but a small vacuity being left, by which any reduction in the capacity of the outer bulb is prevented from communicating pressure to the inner. This plan of construction, which was suggested by Prof. W. A. Miller, has been so successfully carried into practice by Mr. Casella, that thermometers thus protected have been subjected to a pressure of three tons on the square inch, in a testing-machine devised for the purpose, without undergoing more than a very slight elevation, of which a part, at least, is attributable to the heat given out by the compression of the water in which they were immersed: whilst the very best thermometers of the ordinary construction were affected by the same pressure to the extent of 8° or 10°, the elevation in some instruments reaching as much as 50° or 60°.* Two of these protected Miller-Casella thermometers were used in each observation, and they always agreed within a fraction of a degree. The same pair was used throughout the expedition; and notwithstanding that they were used for 166 separate observations, in which they travelled up and down nearly 100 miles, they came back in perfectly good order; a result mainly due to the care with which they were handled by Captain Calver. It may be affirmed with great confidence that the temperatures which they indicated were correct within 1° (Fahr.); an approximation quite near enough for the scientific requirements of the case.

In order to connect the work of the *Porcupine* with that of the *Lightning* expedition, it will be desirable to commence with the third cruise of the former, in which a detailed survey was made of the area traversed in the preceding year by the latter. In this cruise bottom-soundings were taken at thirty-six different stations, at depths varying from 100 to 767 fathoms; of these, seventeen were in the cold area and fourteen in the warm, whilst five exhibited intermediate temperatures, in accordance with their border position between the two. In order to ascertain whether the minimum temperatures thus obtained were really the temperatures of the bottom, serial soundings were taken at three stations, of which one was in the warm area and two in the cold—the temperature at different depths between the surface and the bottom being ascertained by successive observations, at the same points, at intervals of 50 or 100 fathoms. All these results agreed extremely well with each other; and they closely accorded with the fifteen observations made in the *Lightning* expedition, when the requisite correction for pressure (from 2° to 3° according to the depth) was applied to the latter.

The following general summary of these results brings into marked contrast the conditions of the warm and cold areas, which occupy respectively the W.S.W. and E.N.E. portions of the Channel between the north of Scotland and the Faroe Islands, and lie side by side in its midst.

The surface-temperature may be said to be everywhere nearly the same, viz. 52°; the variations above and below this being attributable either to atmospheric differences (as wind, sunshine, &c.) or to difference of latitude. Alike in the warm and the cold areas there was a fall of from 3° to 4° in the first 50 fathoms, bringing down the temperature at that depth to 48°. A slow descent took place nearly at the same rate in both areas through the next 150 fathoms; the temperature in the warm area at the depth of 200 fathoms being 47°, whilst in the cold it was 45·7°. It is below this depth that the marked difference shows itself. For whilst in the warm area there is a slow and pretty uniform descent in the next 400 fathoms, amounting to less than four degrees in the whole, there is in the cold area, a descent of fifteen degrees in the next 100 fathoms, bringing down the temperature at 300 fathoms to 30·8°. Even this is not the lowest; for the serial soundings taken at depths intermediate between 300 and 640 fathoms (the latter being the greatest depth met with in the cold area, midway between the Faroe and the Shetland Islands) showed a further progressive descent; the lowest bottom-temperature met with being 29·6°. Thus, while the temperature of the superficial stratum of the water occupying the cold area clearly indicates its derivation from the same source as the general body of water occupying the warm area, the temperature of the deeper stratum, which may have a thickness of more than 2,000 feet,

* See Prof. W. A. Miller's "Note upon a Self-Registering Thermometer, adapted to Deep Sea Soundings," in "Proceedings of the Royal Society," June 17, 1869.—The same principle had been previously applied in thermometers constructed under the direction of Admiral Fitzroy; the space between the two bulbs, however, being occupied with mercury instead of spirit. Owing, however, to some imperfection in their construction, their performance was not satisfactory, and they were found very liable to fracture.

ranges from the freezing point of fresh water to 2½° below it. Between the two is a stratum of intermixture of about 100 fathoms thickness, which marks the transition between the warm superficial layer and the body of frigid water which occupies the deeper part of the channel.

The shortest distance within which these two contrasted submarine climates were observed at corresponding depths, was about 20 miles; but a much smaller distance was sufficient to produce it when the depth rapidly changed. Thus near the southern border of the deep channel, at a depth of 190 fathoms, the bottom-temperature was 48·7°; while only six miles off, where the depth had increased to 445 fathoms, the bottom-temperature was 30·1°. In the first case, the bottom evidently lay in the warm superficial stratum; whilst in the second it was overflowed by the deeper frigid stream.

It seems impossible to account for these phenomena on any other hypothesis than that of the direct derivation of this frigid water from the Arctic basin. And this agrees very well with other facts observed in the course of the exploration. Thus:—(1) The rapid descent of temperature marking the "stratum of intermixture" began about 50 fathoms nearer the surface in the most northerly portion of the cold area examined, than it did in the most southerly, as might be expected from the nearer proximity of the cold stream to its source. (2) The sand covering the bottom contains particles of volcanic minerals, probably brought down from Jan Mayen or Spitzbergen. (3) The Fauna of the cold area has a decidedly Boreal type; many of the animals which abound in it having been hitherto found only on the shores of Greenland, Iceland, or Spitzbergen.

Although the temperatures obtained in the warm areas do not afford the same striking evidence of the derivation of its whole body of water from a southern source, yet a careful examination of its condition seems fully to justify such an inference. For the water at 400 fathoms in lat. 59½° was only 2·4° colder than water at the same depth at the northern border of the Bay of Biscay, in a latitude more than 10° degrees to the south, where the surface-temperature was 62·7°; and the approximation of the two temperatures is yet nearer at still greater depths, the bottom-temperature at 767 fathoms at the former stations being 41·4°, whilst the temperature at 750 fathoms at the latter point was 42·5°. Now, as it may be certainly affirmed that the lowest temperature observed in the warm area is considerably above the isotherm of its latitude, and that this elevation could not be maintained against the cooling influence of the Arctic stream but for a continual supply of heat from a warmer region, the inference seems inevitable that the bulk of the water in the warm area must have come thither from the S.W. The influence of the Gulf Stream proper (meaning by this the body of superheated water which issues through the "Narrows" from the Gulf of Mexico), if it reaches this locality at all—which is very doubtful—could only affect the most superficial stratum; and the same may be said of the surface-drift caused by the prevalence of south-westerly winds, to which some have attributed the phenomena usually accounted for by the extension of the Gulf Stream to these regions. And the presence of the body of water which lies between 100 and 600 fathoms' depth, and the range of whose temperature is from 48° to 42°, can scarcely be accounted for on any other hypothesis than that of a great general movement of Equatorial water towards the Polar area; of which movement the Gulf Stream constitutes a peculiar case modified by local conditions. In like manner, the Arctic Stream which underlies the warm superficial stratum in our cold area, constitutes a peculiar case, modified by the local conditions to be presently explained, of a great general movement of Polar water towards the Equatorial area, which depresses the temperature of the deepest parts of the great Oceanic basins nearly to the freezing-point.

W. B. Carpenter

SOCIETIES AND ACADEMIES

London

Royal Society, March 3.—The following papers were read:—"Results of the Monthly Observations of Dip and Horizontal Force, made at the Kew Observatory, from April 1863 to March 1869 inclusive." By Dr. Balfour Stewart. "Spectroscopic observations on stars and nebulæ made with the Great Melbourne Telescope." By A. Le Sueur. "On the nebula of Argo, and on the spectrum of Jupiter." By A. Le Sueur. We shall return to these papers next week.

Geological Society, February 18.—Annual general meeting, Prof. T. H. Huxley, president, in the chair. The secretary read the Reports of the Council, of the Library and Museum Committee, and of the Auditors. The general position of the society, as evinced by the state of its finances, and by the continued increase in the number of its members, was stated to be very satisfactory. In presenting the Wollaston Gold Medal to John Evans, Esq., for transmission to M. G. P. Deshayes, the president requested him to transmit it to M. Deshayes as an expression on the part of the Geological Society of the high estimation in which his services to palæontology and geology, especially in regard to the classification of the tertiary formation, are held by the geologists of this country; adding, that six years ago the council of this society demonstrated the interest which it took in M. Deshayes's valuable investigations by awarding him the Donation-fund. Now that those researches, commenced just fifty years ago, are completed, and the labours of a life devoted to science are crowned by the publication of five great volumes containing descriptions and figures of all the mollusca of the Paris basin, it has seemed to the Council a fitting opportunity for bestowing the highest honour at its disposal upon the pupil, editor, and continuator of Lamarck, and the worthy successor of his great master in the Chair of Natural History in the Muséum d'Histoire Naturelle. Mr. Evans acknowledged on the part of M. Deshayes, the award of the Wollaston Medal, and read a letter from M. Deshayes expressing his sense of the honour conferred upon him. The president presented the balance of the proceeds of the Wollaston Donation-fund to Mr. Evans, for transmission to M. Rouault, Keeper of the Geological Museum at Rennes, in aid of his researches upon the Palæontology of the Devonian and Silurian Rocks of Brittany, and remarked that the cosmopolitanism of science was well illustrated by the fact that all the honours at the disposal of the society this year are gladly accorded to foreigners.—The President then read his anniversary address, prefaced by biographical notices of deceased Fellows, including Prof. Brayley, F.R.S.; Dr. Hermann von Meyer; Dr. B. Shumard; Dr. Roget, F.R.S.; Prof. Graham, F.R.S.; Prof. Jukes, F.R.S.; Dr. W. Clarke, F.R.S.; Mr. J. W. Salter; the Vicomte d'Archiac, &c. The ballot for the council and officers was taken, and the following were duly elected for the ensuing year:—President: Mr. Joseph Prestwich. Vice-Presidents: Sir P. de M. G. Egerton, R. A. C. Godwin-Austen, Sir Charles Lyell, Bart., Warrington W. Smyth. Secretaries: P. Martin Duncan, John Evans. Foreign Secretary: Professor D. T. Ansted. Treasurer: J. Gwyn Jeffreys. Council: Prof. D. T. Ansted, William Carruthers, W. Boyd Dawkins, P. Martin Duncan, Sir P. de M. G. Egerton, John Evans, David Forbes, J. Wickham Flower, Capt. Douglas Galton, R. A. C. Godwin-Austen, Harvey B. Holl, J. Whitaker Hulke, Prof. T. H. Huxley, J. Gwyn Jeffreys, Sir Charles Lyell, George Maw, John Carrick Moore, Prof. John Morris, Joseph Prestwich, Warrington W. Smyth, Rev. W. S. Symonds, Rev. Thomas Wiltshire, Henry Woodward.

Zoological Society, February 24.—Dr. E. Hamilton, V.P. in the chair. A communication was read from Mr. R. Swinhoe containing some information on the subject of the exact locality of the Amherst's pheasant (*Thaumalea amherstiæ*), which was stated to be the mountains between the Chinese province of Sechuen and Tibet.—A letter was read from Sir George Grey in reference to Professor Owen's communication of a letter from Dr. Haast read at the previous meeting. Sir G. Grey was of opinion that there were good grounds for believing that the *Dinornis* had been extirpated by the direct ancestors of the present race of Maories.—A second letter was read addressed to the Secretary by Mr. W. H. Hudson on the ornithology of Buenos Ayres.—Mr. Sclater exhibited a specimen of a new lemur, which had been lately discovered by Mr. Van Dam in North-eastern Madagascar, and had been named by Mr. Pollen *Propithecus damanus.*—Messrs. C. H. T. and G. F. L. Marshall read some notes on the classification of the birds of the family *Capitonidæ.*—Two communications were read from Mr. R. Swinhoe on the white wag-tails (*Motacillæ*) of China, and on a new species of *Accentor* from Northern China proposed to be called *A. erythropygius.*—Mr. P. L. Sclater read a paper on the deer living in the Society's menagerie, amongst which there were stated to be examples of several recently described and very little known species. Mr. Sclater concluded his paper with remarks on the arrangement and the geographical distribution of the *Cervidæ*, and in particular of the species of the genus *Cervus.* The total number of *Cervi* recognised as probably valid species were twenty-three in the Old World and seventeen in the New World.

Chemical Society, March 3.—Prof. Williamson, F.R.S, president, in the chair. Mr. Ch. P. Sandberg, of Stockholm, was elected a fellow of the society. The first paper was by Dr. Gladstone on "Refraction Equivalents," to which we shall return. The next paper was by Dr. Thudichum, on "Kryptophanic Acid," a normal ingredient of human urine. The substance is obtained from the primary material by first forming its lime salt, transforming this by neutral lead-acetate into lead-kryptophanate, and decomposing the latter by sulphuretted hydrogen. Kryptophanic acid is an amorphous, gummy mass, transparent and nearly colourless. It forms salts with the alkalis, the alkaline earths, and other metals. Mercuric nitrate produces in the aqueous solutions of its earthy salts a white precipitate; the ordinary analysis for urea is thus shown to be liable to error. The acid is dibasic, and has the formula $C_5H_9NO_5$, but in some instances it may be viewed as tetrabasic and in that case its formula must be written $C_{10}H_{18}N_2O_{10}$.

Linnean Society, March 3.—Mr. J. E. Howard read a paper by Mr. Broughton, chemist to the cinchona plantations in the Madras Presidency, "On hybridisation among cinchonas." He believes that the sub-varieties of *Cinchona officinalis* are permanent, but that hybrids can be artificially obtained, although they do not occur in nature. The cinchona has long been known to belong to the class of dimorphic plants. In the discussion which followed, Dr. Anderson, superintendent of the Botanic Gardens at Calcutta, gave some interesting particulars of the cultivation of cinchona at the Darjeeling plantations.—Dr. Hooker read a very interesting and important communication from Sir Henry Barkly, Governor of Mauritius, on the "Fauna and Flora of Round Island," a very little-known dependency of that colony. Although only about twenty-five miles from Port St. Louis, and the intervening sea not more than 400 feet deep, both plants and animals differ not only in species, but also in genera, from those of the Mauritius. The exploring party were only in the island one day, but during that time they captured four species of snakes and several lizards, no species of either family being found in the Mauritius. The insects and shells obtained were also peculiar, one of the latter being a *Cyclostoma.* Of flowering plants only twenty-four species were collected, but of these more than half were not natives of the Mauritius, including three species of palm, a *Pandanus*, or screw-pine, and two species of ebony. One of the palms is between thirty and forty feet high; another is similar to the Mauritian *Areca alba*, but different; and a third has a most remarkable bottle-shaped stem. Round Island is only about three miles in circumference and one and a quarter across. It consists of a mound of tufa about 1,000 feet in height, very little vegetation being found in the lower part. Sir H. Barkly believes the area to be one of elevation rather than subsidence.

Royal Archæological Institute, March 4.—The following papers were read:—"Remarks on a piece of Roman sculpture, found at Sens, and representing fresco painting." By Mr. J. G. Waller.—"On the Emerald Vernicle of the Vatican, with notices of other ancient portraitures of Our Saviour." By Mr. C. W. King, M.A.—"On an ancient Alms-box, found at Browne's Hospital, Stamford." By the Rev. C. Nevinson, warden of the hospital. Among the objects exhibited were a drawing of a leaden vessel containing Roman coins, found in Cornwall, by the Hon. W. O. Stanley, M.P.—Fragment of Anglo-Saxon M.S., found at Stamford Court, Worcester, by Sir T. E. Winnington, Bart.—Silver plate engraved with historical and allegorical subject, three portraits in Dresden porcelain, by Mr. Octavius Morgan, M.P.—Stone and bronze implements, found in Lincolnshire, by the Rev. E. Jarvis.

Anthropological Society, March 1.—Dr. Beigel, V.P., in the chair. Mr. Robert Wright and Dr. Hilliard, were elected Fellows. "On the Circassian slaves and the Sultan's harem." By Major Millingen. The author showed by what means the Turks insured to themselves in former days a supply of white slaves, so as to recruit their armies and their harems. The facts stated by the author with regard to the slave-trade seemed to prove that, from the highest to the lowest, all the ladies of Constantinople, those at least who have capital to invest, are regular slave-dealers. The author subsequently showed that the use of white slaves is a necessity for Mussulman nations on religious, social, and state-policy reasons, as slavery serves to keep women under subjection and in a state of seclusion; while politically it is indispensable for the maintenance of the reigning dynasty, whose matrimonial alliance with any other but slaves is against the statutes of the empire. A description of the seraglio then followed, its organisation being accurately exposed, while ample details were given concerning the wives and odalisks of the Sultan. In the seraglio the lot of the Circassian slaves was said to be better than that which befalls the generality of slaves; there they are provided with everything, and can attain high honours and power. The system was condemned by the author on account of its being a source of ruin and depravity for both slave and master. The author maintained that it is impossible that the Turks should seriously think of doing away with slavery for the reason that it is so much a part of the social and political edifice, that an attempt to alter the existing state of things would inevitably hasten its downfall. In conclusion, he said that if the Turks, instead of importing women and good-for-nothing slaves, had given their minds to peopling their half-deserted country with an emigration of hardy and industrious men, Turkey might be now at the head of the civilised countries of the earth.—Mr. E. Charlesworth exhibited some remarkable flint implements from Honduras.

Royal Geographical Society, February 14.—Sir R. Murchison, president, in the chair. "On the Runn of Cutch and neighbouring regions." By Sir Bartle Frere. The author defined the region as a broad belt of country between the Indus on the west and the Arivalli Mountains on the east, extending from the Himalaya to the Peninsula of Cutch on the Indian Ocean; the length was about 600 miles, and its breadth varied from 100 to 150 miles. The southern portion, called the Runn of Cutch, forms a level plain 150 miles in length, distinguished by the total absence of vegetation. It forms, during the greater part of the year, a plain of firm sand, saturated with salt, on which the hoofs of horses and camels in passing make scarcely any impression. It is so level that a heavy rainfall remains like a vast slop on the surface, and is blown about by the wind until it evaporates. During the south-west monsoon, however, the high tides flow into it and cover it with water to the depth of one or two feet. Travellers and caravans pass over it, but are sometimes lost, for there are absolutely no landmarks; the danger is somewhat lessened on the side of the hills of Cutch by a beacon-fire which is regularly lighted by a Mahommedan family there settled, to whom has descended the religious duty of thus guiding the wandering traveller over this desolate waste. The surface remains damp even in the driest season, and the soil never pulverises. Mirage and other surprising atmospheric phenomena are common in this singular district. North of the Runn the desert waterless tract is called the Thurr. The whole region slopes very gradually from the sub-Himalayan ranges, between the Jumna and the Sutlej, towards the south-west. The rivers descending from these lower ranges disappear as they advance into the desert, and none of them reach the Indus. The Thurr is covered with a constant succession of sandy ridges, rising as high as 200 feet above the valleys, and the aspect of the country is that of a billowy ocean converted into sand. In districts where rain falls and where the inhabitants have dug wells, some of which are 300 feet deep, there are cultivation and settlements; but the soil is throughout sandy, and over the whole region not a stone can be found that is not imported. That part where there is a hard level plain with abrupt sandhills, is called the "Put." Sir Bartle believed that the native terms of "Runn," "Thurr," and "Put," might be adopted in physical geography as denoting varieties of plain which are totally unlike savannah, prairie, steppe, pampa, or any other known description of land-surface. Travellers in attempting to cross the Thurr are subject to sudden death, not, as might be supposed, from the effects of sunstroke, but from some peculiar condition of the atmosphere connected with the intense heat and the nature of the soil, most of the fatal attacks occurring after sunset. The Runn of Cutch and the region north of it are much subject to volcanic disturbance. The great earthquake of 1819 is still remembered by the inhabitants; it was described by Lieutenant Burns, in an admirable paper on the Indus, read before the Royal Geographical Society in 1833. Sir Bartle was inclined to attribute the singular levelness of the salt-plain of Cutch to the great frequency of slight shocks or tremors. During earthquakes, mounds are thrown up some ten or twelve miles in length, and of considerable height, formed, Sir Bartle believed, by a crack or fissure of the surface at right angles to the direction of the earthquake wave, one lip of the fissure being tilted up and overlapping the other, so as to form a ridge. Small craters and hillocks of ejected sand are sometimes formed on the surface of the Runn, and afterwards subside again to the level of the plain. Dry beds of rivers are traceable throughout the desert tract to the north. From the difficulties of access to the Thurr, it had been for centuries the place of refuge to remnants of various races and nations who had invaded Hindoostan, or succumbed to the fortunes of war. Here are still found specimens of the wild Bheels who claim to be the autochthones and whose blood is essential to ratify every solemn ceremony of the Rajpoot dynasties; Coolies, who are anterior to the earliest Hindoo immigrants; Jutts, who are said to be of Scythian origin and are hardly ever known to forsake their ancestral occupation as breeders of cattle. Hindoos of every tribe and caste are here found, and many representatives are seen of later immigrations—Belooches, Afghans, Kurds, Arabs, and even Turcomans. One tribe of Rajpoots in the Desert, the Sodas, retain their primitive custom of bringing up all their female children, and, in consequence, all the chiefs in Rajpootana, where female infanticide had become established, have had for ages to take their wives from the humble Soda settlements. The poor Soda chiefs have therefore powerful connections among their wealthy sons-in-law; but, though they often pay a round of visits among them, they are said never to exchange their lives of freedom and simplicity, in the desert, for the palaces of Rajpootana. In the discussion which followed, Lord Napier of Magdala stated his belief that if the improvements Sir Bartle Frere suggested, when Commissioner of Scinde, had been put in execution at the time, a great alteration for the better would by this time have taken place in the desert tract which he had described. — The following new fellows were elected: — Rev. T. H. Braim, John E. Dawson, E. Hutchins, J. Irvine, M. H. Lackersteen, Joseph Moore, Commander Noel Osborn, J. N. Robertson, Joseph Starling, Henry Stilwell, Charles Stenning, John Wilton.

February 28.—Sir R. I. Murchison, president, in the chair. The following Fellows were elected:—Donald Butler, Commander George M. Balfour, W. A. M. Browne, W. L. Barclay, F. W. Buxton, Lieutenant E. F. Chapman, Colonel D. Carleton, Dr. R. H. Hilliard, R. A. Hankey, W. M. James, Colonel Charles E. Law, the Hon. Henry Lyttelton, John Markham, W. C. Midwinter, Major-General W. C. McLeod, Lieutenant-Colonel George W. Raikes, Right Hon. Sir John Rose, W. A. Whyte.

"A Visit to Yarkand and Kaskgar." By R. B. Shaw. The author commenced by saying that the common idea of Tartary was that of a succession of vast plains, over which hordes of barbarians wandered at will with their cattle and tents. He had found the reality widely different. It was a well-cultivated country, containing flourishing cities of more than 100,000 inhabitants, where many of the arts of civilisation are carried on. Security of life and property exists, commerce is protected, the roads are full of life and movement, and markets are held on a fixed day of the week, even in the smallest villages. In the towns extensive bazaars, covered in against the rays of the sun, contain rows of shops, where goods of every kind and from every country are exhibited. In Yarkand alone there are sixty colleges, with endowments in land, for the education of students of Mussulman law and divinity, while every street contains a primary school attached to a mosque. There are special streets for the various trades. In one street will be found the silks of China, in another the cotton goods and prints of Russia, while a third will contain robes made of both materials, three or four of which make up the ordinary dress of the Turki inhabitants. In some streets all kinds of groceries are sold: others are set apart for the butchers, who offer a choice of horse-flesh, camel, beef, or mutton. The first is rather a luxury, but the two last are most abundant, selling at about one penny a pound. The bakers make most excellent light loaves by a process of steaming the bread. The greengrocers present abundant supplies of vegetables in great variety, besides cream nearly as thick as that of Devonshire, and delicious cream-cheeses. Everywhere sherbet made of fruit is sold, which you can get cooled at any street corner, where there are stalls for the sale of ice. There are tea-shops where the great urns are ever steaming, and eating-houses in abundance. Such is the manifold life of this little-known nation; living a life of its own, making history very fast, and looking upon European politics with the same indifference with which its own have been regarded by us. The author, who made his journey with the view of opening the way for trade, especially in tea, between India and Eastern Turkistan, described the manner of his reception by the Governor of Yarkand, and by the Atalìgh Ghazee, the ruler of the country, then resident in Kashgar, who now seems firmly established as king over a productive region containing a population variously estimated at from 20 to 60 millions. The Andijanis occupy the chief places in the administration, and form the strength of the army; but their attitude towards the native Yarkandis is very conciliatory, and they are looked upon, not as conquerors, but as brothers in faith and blood, who have delivered them from the yoke of unbelievers and idolaters. The Yarkandis are naturally addicted to commerce and the arts of peace, while the Usbeks of Andijan find their most congenial occupation in administration and arms. Both peoples speak the same language, which is essentially that of the Turks of Constantinople. The Atalìgh, Yakoob Beg, impressed Mr. Shaw as a man of remarkable intelligence and energy. Merchants from India are beginning to frequent Yarkand, and it only required the removal of a few obstacles in the hill countries subject to our own influence to open out a field for trade, of which it would be difficult to over-estimate the importance. The whole region forms a vast elevated basin, in Central Asia, about 4,000 feet above the sea-level, surrounded on three sides by a wall of snow-covered mountains, reaching in many places an altitude of more than 20,000 feet. On the east it passes into the sandy desert of Gobi, which separates it from China. All the rivers which descend from the snows of the mountain, flowing eastward, are lost in the sands, and, as there is little or no rain, the soil has to be fertilised by canals and irrigation. The beautiful cultivation and luxuriance of the thickly-peopled parts are entirely due to these irrigating canals, which are exceedingly numerous and carefully kept. Mr. Shaw stated that the King himself superintended the works at a new canal whilst he was there, and even laboured at it himself. The country is separated from the plains of India by the mountain-system of the Himalaya, forming an elevated belt 500 miles broad, with eleven more or less elevated parallel ridges of mountains lying along it. The most northerly of these ridges was styled Kuen-lun by the Chinese, but was not a distinct chain from the rest of the mountains. Mr. Shaw concluded by describing his return journey over the Karakorum Pass. Sir Henry Rawlinson said that the Government of India had considered Mr. Shaw's discoveries of so much importance that they had entered into negotiations with the Maharajah of Cashmere for the purpose of encouraging trade with Eastern Turkistan, and arrangements had been entered into by which all transit duties through Ladak would be abolished. The difficulties of the route northward from Ladak over the Karakorum would probably be obviated by the adoption of the much easier road to the east *viâ* Changchenmo, or, still better, by the elevated level plains of Rudok still farther east. The difficult Sanju Pass over the Kuen-lun would also be avoided in future by the adoption of the Yenghi Pass, all that was necessary being the establishment of a fort at its foot to protect caravans from the depredations of hordes of robbers who frequent that district.—The President reminded the meeting that Mr. Shaw was the first European since the days of Marco Polo who had penetrated to Yarkand, and been allowed to return from that wonderful country. The Society's envoy, Mr. Hayward, had reached the place a few days after him; but the two were not allowed to see each other until they were on the way back again.—A second paper was read, "On a Journey through Shantung and a visit to the Tomb of Confucius," by Mr. J. Markham, Consul at Chefoo. The paper contained a most interesting account of the author's reception at Kio-foo, the city of Confucius, and his examination of the monuments and temples connected with the fame of the Chinese sage. The great majority of the inhabitants of the city are descendants of Confucius and bear his surname, and the magistrate's office is hereditary in the family. The result of the author's experience acquired in journeys throughout the length and breadth of this important province was that the middle and lower classes of China were, as a rule, inclined to be friendly to strangers, and that all acts of offence are instigated by the governing class of mandarins.

Royal Institution of Great Britain, March 7. — Colonel P. J. Yorke in the chair. His Royal Highness the Prince Christian of Schleswig-Holstein was elected an honorary member, and W. H. Barlow, A. J. Booth, F. W. Buxton, J. T. Clover, Rev. J. Congreve, G. H. Darwin, F. Galton, Lord R. Gower, R. Grubb, J. Gurney, H. Hoare, J. Houldsworth, Lieut.-Colonel G. Ives, T. Jacomb, E. C. Johnson, Sir J. J. T. Lawrence, F. M'Clean, J. O'Halloran, H. Pechell, F. Pennington, G. Phillips, M. R. Pryor, Dr. J. Rae, Rev. D. M. Salter, A. G.

Sandeman, G. Stone, A. A. de Lille Strickland, C. B. Thurston, the Hon. J. G. P. Vereker, Mrs. Michael Wills, and H. Woods, were elected members of the Royal Institution.

CAMBRIDGE

Philosophical Society, March 7.—The following communications were made to the society:—"On the Centro-surface of an Ellipsoid," by Prof. Cayley. "On the correct expressions for the resistance which bodies experience whilst moving in gases and liquids: with a description of the verifying experiments," by Mr. Potter.

DUBLIN

Royal Irish Academy, February 14.—Rev. J. H. Jellett, president, in the chair. The president read a paper entitled "Researches in the application of Optics to Chemistry," No. 1, "Combinations of Nitric Acid with Quinia."—A letter from M. De Vismes Kane, was read, describing the circumstances under which the large stone implement and the curious wooden vessel, which he had presented to the Academy's museum, through Dr. Stokes, were found.—The secretary read a description by Mr. R. R. Brath, of an Ogham inscribed stone at Kiltena, county Waterford.

PARIS

Academy of Sciences, February 28.—M. A. Trécul presented the third part of his memoir on the position of the tracheæ in the ferns. His object in this important paper is to show that there is "no unity of constitution, circulation, and symmetry" in the vascular Acrogens, and in illustration of this view he describes the arrangements of the tracheæ in the following forms:—*Athyrium filix-femina*, several species of *Aspidium* and *Asplenium*, *Struthiopteris germanica*, *Adiantum tenerum*, *Scolopendrium officinale*, *Ceterach officinarum*, and *Gymnogramme chrysophylla* and *calomelanos*.—A letter by Father Secchi on the modifications produced by magnetism in the light emitted by rarefied gases, was read. In this the author described some experiments made by him with a powerful electro-magnet upon Geissler's tubes. He stated that when a tube is placed between or close to the poles of the electro-magnet the light is condensed towards the part of the tube most distant from the magnet, so that instead of a diffused light a bright streak is visible. The effect was said to be very curious, appearing as if the gas itself was displaced, and resembling the great movements of the streamers in the Aurora Borealis. The more brilliant light gives a more brilliant and distinct spectrum, and the author stated that when the gas has a double spectrum, the two spectra are produced separately—one from the brilliant part of the tube, the other from the parts nearer the magnet. The author remarked that the effect of magnetism was as if it narrowed the tubes. He ascribed it to a repulsion of the rarefied gases, due to diamagnetism. M. Dumas remarked that M. de la Rive had been carrying on some experiments of a like nature, the results of which are not yet published, but he believed that in some points they coincided with Father Secchi's.—In a memoir on the spectra of various kinds of simple bodies, M. Dubrunfaut ascribed the double spectra obtained from some vacuum tubes to impurity in the gases employed, and indicated some other sources of error. He referred especially to hydrogen. He also noticed that variations of temperatures may cause anomalies in spectrum analysis, and remarked that the line K *a* of potassium may be made to appear and dissappear by raising and lowering the temperature.—Notes of a further investigation of propylic, butylic, and amylic aldehydes were presented by MM. I. Pierre and E. Puchot. Their researches related chiefly to the temperatures of ebullition and densities of these bodies, as to which their results differ considerably from those of former writers.—In a memoir by M. Gustave Lambert on the experimental determination of the form of the earth, that gentleman proposed a simplification of the method of observation by means of the pendulum, and a ready means of measuring a base-line. He submitted his methods to the judgment of the Academy, intending to employ them, if approved, in the projected French Arctic expedition. — M. Delaunay communicated a report by MM. Wolf, André, and Capitaneano, on a bolide observed by them at the Paris Observatory on the 26th February.—This meteor started from between α and β *Canis minoris*, and passed as a yellow streak between Sirius and β *Canis majoris*, when it took the form of a very brilliant, bluish white ball about 5′ in diameter, followed by a broad yellow tail; near ν *Canis majoris*, it burst into several fragments and disappeared. The phenomena commenced at $9^h\ 35^m\ 20^s$ and lasted about 3 seconds. No sound was heard.—M. F. Lucas presented a note relating to the physical state of bodies; M. H. Montucci a memoir on Gauss's method for the reduction of trinominal equations; and M. H. Sainte-ClaireDeville a note by M. A. Martin on Léon Foncault's "method of autocollimation" and its application to the investigation of parabolic mirrors.—M. H. Caron communicated a note on the solution of reductive gases by iron and carburets of iron in fusion, in which he suggested a cause of the spirting of cast-steel and iron in cooling.—M. H. Sainte-Claire Deville made some remarks on this paper.—A memoir on the oxidation of iron by Mr. P. Crace Calvert, was read; from his experiments he concludes that it is the presence of carbonic acid in the air that causes the rusting of iron.—M. Chevreul made some remarks npon this paper.—A note on the dissociation of ammoniacal compounds, by M. F. Isambert, was presented by M. H. Sainte-Claire Deville.—The author noticed the compounds formed by the sulphates of zinc and cadmium with gaseous ammonia, and the tensions of the ammoniacal gas set free from these compounds by the action of heat, which are constant at given temperatures.—M. Campana communicated a note "On the texture and differential character of the Lungs in Birds," in which he described the mode of origin and distribution of the secondary bronchial tubes, which, he stated, terminate in a single tertiary tube, and this in its turn unites with the extremity of another secondary tube. This applies also, according to the author, to the lateral tertiary tubes.—M. Elie de Beaumont communicated an extract from a letter of M. Prost giving an account of earthquake shocks experienced at Nice, and containing a journal of shocks observed during the years 1866—1869.—M. H. Sainte-Claire Deville presented a note by Father Denza on an Aurora borealis and some other meteorological phenomena observed in Piedmont on the 3d of January, 1870.

BERLIN

German Chemical Society, February 29.—C. Liebermann communicated the result of his researches on chrysene, of which large quantities have lately been obtained from coal tar. He has specially devoted attention to the chinone of chrysene, obtained by oxydising this hydro-carbon. The colouring properties of this substance are very inferior to those of its analogous anthracene.—C. Scheibler reported on betain, a base he obtained from beetroot-juice, or molasses. The young roots contain considerable quantities of this substance, and certain molasses furnish as much as 3 per cent. of it. The base has been found identical with oxyneurin, lately discovered in the brain, in eggs, &c., by Leibriech. It is not poisonous, and yields well crystallised salts.—H. Wichelhaus has determined the vapordensity of chloronidtride of phosphorus, thus proving the correctness of the formula $P_3N_3Cl_6$ which had already been fully established by Gladstone and Holmes.—C. Rammelsberg delivered a lecture on meteorites, giving a succinct and interesting history of these remarkable bodies, the existence of which had been regarded as a superstition up to the end of the last century.—Mr. Gordon has prepared Reisets' and Magnus' salts containing ethylamine, aniline, and toluidine in the place of ammonia.—T. Thomsen of Copenhagen sent a paper on the heat of combination. The heat produced by adding an acid to a base attains the maximum when the latter is neutralised by the former. Based upon this observation, the author concludes that sulfhydric acid must be monbasic, a startling fact, which in order to be fully confirmed appears to need further examination.—Two papers were sent in after the last meeting of the society, and printed in the abstracts of that meeting. One is by Kekulé, on the substance described as chloraceten. The author proves the non-existence of this substance, a solution of oxychloride of carbon in para-aldehyde having been taken for a chemical individual. The other paper is by Ceck, describing the combustion of part of the Bohemian diamond, and removing any uncertainty concerning its nature.

German Geological Society.—At the February meeting Dr. Lossen reported on the composition of Karpholithe from the metamorphic slate of Biscaroda, in the Harz Mountains. Hauchecorne and Meyne reported on borings made at Stade for rocksalt. Its discovery was anticipated with certainty. Lindig reported on the borings made at Spurenberg (thirty miles from Berlin), where an immense saltlayer was discovered two years ago. The boring is now 2,630 feet deep, 2,347 of which go through one layer of pure rocksalt! The temperature was found to be 31° 5′ C. at the bottom.

VIENNA

Imperial Academy of Sciences, January 20.—The Ministry of Commerce called upon the Academy to appoint a member to arrange the reproduction of the French standard meter, and also forwarded a nautical instrument for the correction of the course of vessels, invented by Carl Zamara.—A note by Prof. G. Hinrichs of Iowa, on the structure of quartz, was communicated by Prof. von Haidinger.—Prof. E. Mach communicated the results of an investigation by M. C. Neumann upon the vibrations of a string under the bow. His results for the most part confirm Helmholtz's theoretical views.—Dr. Boué presented a geographico-geognostic map of the valley of Sutchesa, and remarked upon its peculiarities.—Dr. A. Friedlowsky communicated a memoir on three cases of augmentation of the carpal and tarsal bones in man.—Prof. F. Simony gave a comparative account of the conditions of temperature in the Lakes of Hallstatt, Gmund, and Langbath, at different depths, and Dr. J. Hann presented a memoir on the decrease of temperature with elevation on the surface of the earth.—The table of the meteorological and magnetic observations at the Central Observatory during the month of December last was also communicated.

February 3.—Memoirs were read by Prof. Rochleder "On some colouring matters from Madder," and by M. A. von Miller-Hauenfels on "The dualistic functions," and "On the electrical current which appears to stand in relation to endosmose." Dr. L. J. Fitzinger communicated the second and concluding portion of his "Critical revision of the family of the *Rhinophylli*," in which he treats of the genera *Ariteus*, *Rhinolophus*, *Rhinonycteris* and *Aquias*. — "Investigation of the white mustard seed." By Professor H. Will. In place of the myronate of potash found in black mustard seed there is in white mustard seed an analogous body sinalbin which splits up into sugar or sulphocyanogen compound and acid sulphate. The sulphocyanogen compound is not volatile, it contains an oxygenated radicle akrinyl C_7H_7O. The acid sulphate contains in place of potassium sinapisin. The sulphocyanide of akrinyl freed from sulphur and treated with alkali when in the state of nitryl yields ammonia and a salt of the acid $C_8H_8O_3$, which melts at 136° C, and is not identical with any known acid of the same formula.

Geological Institution, February 15.—Herr von Hauer in the chair. Prof. von Ettingshausen communicated the results of his study of the fossil flora from the environs of Berlin, Bohemia. Nearly five hundred species have been determined from six beds of different age. The oldest of them—the freshwater-chalk of Kostenblatt and the strata of Kutschlin—correspond with the Aquitanian series; the plastic clay of Priesen, as well as the clay and spherosiderit of Languageyd, belong to the middle part of the Miocene formation. The menilites and opales of the Sichrow valley, as well as the shists of Sobrusan, contain the plants of the Oemingen series. Herr Flanenschild pointed out that the existence of large layers of the so-called Alpine chalk (Alpenkreide), the mud of glaciers, which eroded the dolomitic rocks, indicates the existence of old glaciers in the Alm- and Steierling valleys, Upper Austria. This mud consists, therefore, of carbonate of lime and carbonate of magnesia, and, when burnt at a low temperature, gives a good hydraulic cement.—Herr. Ch. Paul exhibited detailed sections of the small mountain range near Homonna, North-eastern Hungary, consisting of different layers of the triassic, rhætic, liassic, jurassic, and cretaceous formations. Of high interest is the discovery of marls with fossils of the *Gault* series, which are so very rare in the eastern Alps and Carpathians.—Herr Stache exhibited geological maps of the environs of Unghvar and Mandak, North-eastern Hungary, which he had surveyed last summer. Trachytes with their tufts, and Carpathian sandstones of Eocenic age, are the prevailing formations.

DIARY

THURSDAY, MARCH 10.

ROYAL SOCIETY, at 8.30.—On some Elementary Principles in Animal Mechanics (No. III.): Rev. S. Haughton.—On the Contact of Conics with Surfaces: W. Spottiswoode.—On the Spotted Area of the Sun's Visible Disc from the Commencement of 1832 up to May 1868: W. De la Rue, B. Stewart and B. Loewy.—Tables of the Numerical Values of the Sine-Integral, Cosine-Integral, and Exponential-Integral: J. W. L. Glaisher.

SOCIETY OF ANTIQUARIES, at 8.30.—Roman Inscription in the Disney Collection: Mr. H. C. Coote.

ZOOLOGICAL SOCIETY, at 8.30.—Dinornis (Part XV.): Professor Owen.—New species of *Ampullaria*: Dr. J. C. Cox.—Birds of Veragua: Mr. O. Salvin.—New birds from the Yantze-kiang: Mr. R. Swinhoe.

MATHEMATICAL SOCIETY, at 8.

ROYAL INSTITUTION, at 3.—Chemistry: Prof. Odling.

LONDON INSTITUTION, at 7.30.—Swiney Lecture: Dr. Cobbold.

FRIDAY, MARCH 11.

ROYAL INSTITUTION, at 8.—On Art: Mr. Westmacott.

QUEKETT MICROSCOPICAL CLUB, at 8.

ASTRONOMICAL SOCIETY, at 8.

SATURDAY, MARCH 12.

ROYAL INSTITUTION, at 3.—Science of Religion: Prof. Max Müller.

ROYAL BOTANIC SOCIETY, at 3.30.

MONDAY, MARCH 14.

MEDICAL SOCIETY, at 8.—Anniversary.

SOCIETY OF ARTS, at 8.—Cantor Lecture: Dr. Paul.

TUESDAY, MARCH 15.

ROYAL INSTITUTION, at 3.—Nervous System: Dr. Rolleston.

ANTHROPOLOGICAL SOCIETY, at 8.—On Strange Peculiarities observed by a Religious Sect of Moscovites, called Scoptsis: Dr. Kopernicky and Dr. Barnard Davis.—Phallic Worship: Mr. Hodder Westropp.—Consanguineous Marriages; Mr. George C. Thompson.

STATISTICAL SOCIETY, at 8.—The Financial System of the Free Church of Scotland: Rev. D. Buchanan.

PATHOLOGICAL SOCIETY, at 8.

INSTITUTION OF CIVIL ENGINEERS, at 8.—1. Discussion upon Mr. Fox's paper "On the San Paulo Railway;" 2. and if time permits, the following paper will be read, "On the Conditions and the Limits which govern the Proportions of Rotary Fans:" Mr. Robert Briggs.

WEDNESDAY, MARCH 16.

SOCIETY OF ARTS, at 8.—Surface Decoration: Mr. Pitman.

ROYAL HORTICULTURAL SOCIETY, at 1.30

METEOROLOGICAL SOCIETY, at 7.

THURSDAY, MARCH 17.

ROYAL INSTITUTION, at 3.—Chemistry: Prof. Odling.

ROYAL SOCIETY, at 8.30.

LINNEAN SOCIETY, at 8.—The Flora and Fauna of Round Island: Sir Henry Barkly.—Algæ found in the North Atlantic Ocean: Dr. Dickie.

CHEMICAL SOCIETY, at 8.

ZOOLOGICAL SOCIETY, at 4.

NUMISMATIC SOCIETY, at 7.

ANTIQUARIES' SOCIETY, at 8·30.

BOOKS RECEIVED

ENGLISH.—The Bottom of the Sea: B. Z. Sonrel; illustrated. Translated and edited by Elihu Rich (Sampson Low and Marston).—Weapons of War: A history of arms and armour from the earliest periods to the present time: A. Demmin; illustrated. Translated by C. C. Black (Bell and Daldy).—Sketches of Life and Sport in South Eastern Africa: C. Hamilton; illustrated (Chapman and Hall).—The North British Review (Williams and Norgate).—A Search for Winter Sunbeams in the Riviera, Corsica, Algiers, and Spain: S. S. Cox (Sampson Low and Marston).—The Natural History of Man: Rev. J. G. Woods; illustrated (Routledge and Sons).—Our Iron-clad Ships: E. J. Reed (Murray).—Physical Geography: D. T. Ansted.—The Earth's History; or, First Lessons in Geology: D. T. Ansted.—The World we live in; or, First Lessons in Physical Geography: D. T. Ansted (W. H. Allen and Co.)—The Science and Art of Arithmetic: Sonnenschein and Nesbitt (Whittaker and Co).—Treatise of Medical Electricity: J. Althaus.

FOREIGN.—Nachrichten der K. Gesellsch. der Wissenchaften, 1869. Petermann's Mittheilungen—Manuel des Humeurs: F. Papillon.—Die Parasiten der weiblichen Geschlechtsorgane des Menschen und Einiger Thiere nebst Beiträge: Dr. D. Haussmann.—Archiv für die Landes durchforschung-Böhmen.—Neue Untersuchungen über den elektrisirten Sauerstoff: Dr. G. Meissner.—Lehrbuch zur Bahnbestimmung der Kometen und Planeten; T. Oppolzer.—Beitrage zur Petrographie der plutonischen Gesteine: J. Roth.—Handbuch der Physiologisch-und Pathologisch-chemischen Analyse: F. Hoppe-Seyler.—Chemismus der Pflanzenzelle: Dr. H. Karsten. (Through Williams and Norgate.)

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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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THURSDAY, MARCH 17, 1870

ON FLOATING MATTER AND BEAMS OF LIGHT

BEAMS of light may be employed to reveal the existence of floating matter in the air; or the floating matter may be employed to reveal the track of the beams.

When the beam is intense it becomes an extremely powerful searcher and revealer of the state of the air. Thus examined, the air of a room which in diffuse daylight appears absolutely pure is seen to be loaded with suspended matter. Many of the fine clouds developed in my experiments on the action of light upon vapours disappear utterly in diffuse daylight; while when the room is darkened and the light of an intense beam confined to the clouds themselves, they appear highly luminous. The eye is the real re-agent here. Rendered sensitive by darkness, and receiving light from the floating matter alone, the amount of light competent to produce a sensible effect is incalculably small. The power of the light to make an impression is moreover increased by the extension given to the body which emits it.

The mobility of these actinic clouds is in some cases quite extraordinary. The differences of temperature introduced by the act of decomposition often cause the clouds to assume forms of astonishing complexity and beauty. The clouds which thus shape themselves by internal action are also exceedingly sensitive to external action. Supposing a thin actinic cloud to fill the experimental tube, the whole of it being flooded with the light of a beam passing longitudinally through the tube, an instant's contact of the tip of a spirit lamp flame with the under surface of the tube causes the cloud to break upwards in a violent current, and to whirl itself into the most beautiful vortices right and left of the vertical line. The rapidity with which the heat passes through the thick glass and sets the cloud in motion is surprising. The warmth of the finger suffices to produce an effect feebler than, but substantially the same, as that produced by the spirit lamp flame.

In fact, the floating matter of the air, properly illuminated, might be converted into a thermoscope of surpassing delicacy. A little brown paper smoke was diffused in an ordinary glass shade; the track of the beam through it was much whiter than through the air. Hence the invasion of the smokeless air could be instantly seen by the darkness it produced. On introducing the hand at the open base of the shade, a violent uprush of air immediately occurred. The smoke was violently whirled about, and the course of the whirlwinds distinctly marked by the relative action on the light of the smoky and the unsmoky air. I was not prepared to see so small a difference of temperature produce so large and prompt an effect.

Nor is it necessary to introduce dark extraneous air to render the currents through nebulous matter visible. The current produced in the actinic cloud by the spirit flame forms a dark vertical septum between the two adjacent parts of the cloud. When the current curls to form a cyclone, the septum curls also, producing dark spirals through the illuminated nebulæ.

The late Principal Forbes often referred to the floating scum on water slowly flowing through a channel, the lateral parts of which are retarded by friction. Such scum, or froth, arranges itself in distinct striæ, separated from each other by comparatively free intervals. It is practically impossible to establish differential motions, either in solids or liquids, without producing some effect of this kind. Fibrous iron shows it; while in the atmosphere differential currents produce cirrus clouds. I have often watched the way in which the suspended matter of the turbid Arve at Chamouni traced itself through the water. Notwithstanding the tossing endured from the source of the Arveyron downwards, the mixture of mud and liquid was by no means perfect. In fact, every new obstacle which introduced differential motion introduced also the striæ, and destroyed all uniformity of mixture.

Five or six weeks ago I had a square chamber constructed, the upper half of which is glazed, its floor consisting of transverse rails, over which is placed a thick mat of cotton wool. The chamber has a brass chimney, in which a rose burner can be lighted. An upward current is thus established in the chimney, the air below entering through the cotton-wool to supply the place of that discharged by the flame. When the chamber is filled with the ordinary laboratory air, a beam sent through it tracks its course on the floating matter. When the flame is ignited, the air enters through the cotton-wool; but the consequence is not a uniform enfeeblement of the light of the beam. Perfectly dark striæ pass through the luminous track, and they sometimes bend and whirl so as to form gracefully curved streams of darkness. Even air urged from the nozzle of a bellows through the luminous track, shows a tendency to form those striæ, though it, like the water of the Arve at Chamouni, is filled with the same floating matter as that of the air through which it is urged.

On a recent occasion the following effects were described, and an attempt was then made to explain them:—

In a cylindrical beam, which powerfully illuminated the dust of the laboratory, was placed an ignited spirit-lamp. Mingling with the flame, and round its rim, were seen wreaths of darkness resembling an intensely black smoke. On lowering the flame below the beam the same dark masses stormed upwards. They were at times blacker than the blackest smoke that I have ever seen issuing from the funnel of a steamer, and their resemblance to smoke was so perfect as to lead the most practised observer to conclude that the apparently pure flame of the alcohol lamp required but a beam of sufficient intensity to reveal its clouds of liberated carbon.

But is the blackness smoke? This question presented itself in a moment. A red-hot poker was placed underneath the beam, and from it the black wreaths also ascended. A large hydrogen flame was next employed, and it produced those whirling masses of darkness far more copiously than either the spirit-flame or poker. Smoke was therefore out of the question.

What then was the blackness? It was simply that of stellar space; that is to say, blackness resulting from the absence from the track of the beam of all matter competent to scatter its light. When the flame was placed below the beam the floating matter was destroyed *in situ;* and the air, freed from this matter, rose into the beam, jostled aside the illuminated particles, and substituted for their light the darkness due to its own perfect transparency. Nothing could more forcibly illustrate the invisibility of the agent which renders all things visible. The beam crossed, unseen, the black chasm formed by the transparent air, while at both sides of the gap the thick-strewn particles shone out like a luminous solid under the powerful illumination.

But here a difficulty meets us. It is not necessary to burn the particles to produce a stream of darkness. Without actual combustion, currents may be generated which shall exclude the floating matter, and therefore appear dark amid the surrounding brightness. I noticed this effect first on placing a red-hot copper ball below the beam, and permitting it to remain there until its temperature had fallen below that of boiling water. The dark currents, though much enfeebled, were still produced. They may also be produced by a flask filled with hot water.

To study this effect a platinum wire was stretched across the beam, the two ends of the wire being connected with the two poles of a voltaic battery. To regulate the strength of the current a rheostat was placed in the circuit. Beginning with a feeble current the temperature of the wire was gradually augmented, but before it reached the heat of ignition a flat stream of air rose from it, which when looked at edgeways appeared darker and sharper than one of the blackest lines of Fraunhofer in the solar spectrum. Right and left of this dark vertical band the floating matter rose upwards, bounding definitely the non-luminous stream of air. What is the explanation? Simply this. The hot wire rarefied the air in contact with it, but it did not equally lighten the floating matter. The convection current of pure air therefore passed upwards *among the particles*, dragging them after it right and left, but forming between them an impassable black partition. In this way we render an account of the dark currents produced by bodies at a temperature below that of combustion.

This explanation has been found difficult. When the wire is white hot, it sends up a band of intense darkness. This, I say, is due to the *destruction* of the floating matter. But even when its temperature does not exceed that of boiling water the wire produces a dark ascending current. This, I say, is due to the *distribution* of the floating matter. The difficulty alluded to is probably to be referred to the brevity of the explanation. Imagine the wire clasped by the mote-filled air. My idea is that it heats the air and lightens it, without in the same degree lightening the floating matter. The tendency, therefore, is to start a current of clean air through the mote-filled air. Figure the motion of the air all round the wire. Looking at it transversely we should see the air at the bottom of the wire bending round it right and left in two branch currents, ascending its sides and turning to fil the partial vacuum created above the wire. Now as each new supply of air filled with its motes comes in contact with the hot wire, the clean air, as just stated, is first started through the inert motes. They are dragged after it, but there is a fringe of cleansed air in advance of the motes. The two purified fringes of the two branch currents unite above the wire, and, keeping the motes that once belonged to them right and left, they form by their union the dark band observed in the experiment. This process is incessant. Always the moment the mote-filled air touches the wire this distribution is effected, a permanent dark band being thus produced. Could the air and the particles under the wire pass *through* its mass we should have a vertical current of particles, but no dark band. For here, though the motes would be left behind at starting, they would hotly follow the ascending current and thus abolish the darkness.

It has been said that when the platinum wire is intensely heated, the floating matter is not only distributed, but destroyed. Let this be proved. I stretched a wire about four inches long through the air of an ordinary glass-shade resting on its stand. Its lower rim rested on cotton wool, which also surrounded the rim. The wire was raised to a white heat by an electric current. The air expanded, and some of it was forced through the cotton wool, while when the current was interrupted and the air within the shade cooled, the expelled air in its return did not carry motes along with it. At the beginning of this experiment the shade was charged with floating matter; at the end of half an hour it was optically empty.

On the wooden base of a cubical glass shade measuring eleven and a half inches a side, upright supports were fixed, and from one support to the other thirty-eight inches of platinum wire were stretched in four parallel lines. The ends of the platinum wire were soldered to two stout copper wires which passed through the base of the shade and could be connected with a battery. As in the last experiment the shade rested upon cotton wool. A beam sent through the shade revealed the suspended matter. The platinum wire was then raised to whiteness. In five minutes there was a sensible diminution of the matter, and in ten minutes it was totally consumed. This proves that when the platinum wire is sufficiently heated, the floating matter, instead of being distributed, is destroyed.

But is not the matter really of a character which permits of its destruction by the moderately heated platinum wire also? Here is the reply:—

1. A platinum tube with its plug of platinum gauze was connected with an experimental tube, through which a powerful beam could be sent from an electric lamp placed at its end. The platinum tube was heated till it glowed feebly but distinctly in the dark. The experimental tube was exhausted and then filled with air which had passed through the red-hot tube. A considerable amount of floating matter which had escaped combustion was revealed by the electric beam.

2. The tube was raised to brighter redness and the air permitted to pass slowly through it. Though diminished in quantity, a certain amount of floating matter passed into the exhausted experimental tube.

3. The platinum tube was rendered still hotter; a barely perceptible trace of the floating matter now passed through it.

4 The experiment was repeated, with the difference that the air was sent more slowly through the red-hot tube. The floating matter was totally destroyed.

5. The platinum tube was now lowered until it bordered upon a visible red heat. The air sent through it still more slowly than in the last experiment carried with it a cloud of floating matter.

If then the suspended matter is destroyed by a bright red heat, much more is it destroyed by a flame whose temperature is vastly higher than any here employed. So that the blackness introduced into a luminous beam where a flame is placed beneath it is due, as stated, to the destruction of the suspended matter. At a dull red heat, however, and still more when only on the verge of redness, the platinum tube permitted the motes to pass freely. In the latter case the temperature was 800° or 900° Fahrenheit. This was unable to destroy the suspended matter; much less, therefore, would a platinum wire heated to 212° be competent to do so. Such a wire can only distribute the matter, not destroy it.

The floating dust is revealed by intense local illumination. It is seen by contrast with the adjacent unilluminated space; the brighter the illumination the more sensible is the difference. Now the beam employed in the foregoing experiments is not of the same brightness throughout its entire transverse section. Pass a white switch, or an ivory paper-cutter, rapidly across the beam, the impression of its section will linger on the retina. The section seems to float for a moment in the air as a luminous circle with a rim much brighter than its central portion. The core of the beam is thus seen to be enclosed by an intensely luminous sheath. An effect complementary to this is observed when the beam is intersected by the dark band from the platinum wire. The brighter the illumination, the greater must be the relative darkness consequent on the withdrawal of the light. Hence the cross section of the sheath surrounds the dark band as a darker ring.

The following four paragraphs, though printed nearly two months ago, have not been published hitherto. Might I say that whatever my opinion on the subject of "spontaneous generation" may be, I purposely abstain from expressing it here? That expression shall be given at the proper time. I desire now to show the practical value of the luminous beam as an investigator of the state of the air.

The question of "Spontaneous generation" is intimately connected with our present subject. On this point a kind of polar antagonism has long existed between different classes of investigators. Van Helmont gave a receipt for the manufacture of mice, and it was for ages firmly believed that the maggots in putrefying flesh were spontaneously produced. Redi, a member of the famous Academy del Cimento, destroyed this notion by proving that it was only necessary to protect the meat by a covering of gauze to prevent the reputed generation. In 1745 two very able men, Needham and Spallanzani, took opposite sides in the discussion, the forming affirming and the latter denying the fact of spontaneous generation. At the beginning of our own century, we find on the affirmative side Lamarck, Oken, and J. Müller; and on the negative Schwann, Schultze, and Ehrenberg. The chief representatives of the two opposing parties in our day are Pouchet and Pasteur.

The method of inquiry pursued in this discourse will, I think, help to clear the field of discussion. The experimenters do not seem to have been by any means fully aware of the character of the atmosphere in which they worked; for if this had been the case, some of the experiments recorded would never have been made. For example, to make the destruction of atmospheric germs doubly sure, M. Pouchet, the distinguished supporter of the doctrine of spontaneous generation, burnt hydrogen* in air and collected the water produced by the combustion. Even in this water he afterwards found organisms. But supposing he had seen, as you have, the manner in which the air is clouded with floating matter, would he have concluded that the deportment of water which had been permitted to trickle through such air could have the least influence in deciding this great question? I think not. Here is a quantity of water produced and collected exactly as M. Pouchet produced and collected his. This water is perfectly clear in the common light; but in the condensed electric beam it is seen to be laden with particles, so thick-strewn and minute, as to produce a continuous cone of light. In passing through the air the water loaded itself with this matter, and hence became charged with incipient life.*

Let me now draw your attention to an experiment of Pasteur, which I believe perplexes some of the readers and admirers of that excellent investigator. Pasteur prepared twenty-one flasks, each containing a decoction of yeast, filtered and clear. He boiled the decoction, so as to destroy whatever germs it might contain, and while the space above the liquid was filled with pure steam he sealed his flasks with a blow-pipe. He opened ten of them in the deep, damp caves of the Paris Observatory, and eleven of them in the courtyard of the establishment. Of the former, one only showed signs of life subsequently. In nine out of the ten flasks no organisms of any kind were developed. In all the others organisms speedily appeared.

Now here is an experiment conducted in Paris, which shows that the air of one locality can develop life when the air of another locality cannot. Let us see whether we cannot here in London justify and throw light upon this experiment. I place this large flask in the beam, and you see the luminous track crossing it from side to side. The flask is filled with the air of this room, charged with its germs and its dust, and hence capable of illumination. But here is another similar flask, which cuts a clear gap out of the beam. It is filled with unfiltered air, and still no trace of the beam is visible. Why? By pure accident I stumbled on this flask in our apparatus room, and on inquiry learnt that it had been a short time previously taken out of one of the cellars below stairs. Other flasks were in the same cellar. I had three of them brought up to me; they were optically empty. The still air had deposited its dust, germs and all, and was itself practically free from suspended matter. You can now understand the impotence of the air of the Paris caves. The observation illustrates at once the influence of the germs and the accuracy of Pasteur.

* In this case a polished silver basin was soldered to one end of a wide brass tube; the tube was filled with ice, the hydrogen flame was permitted to play upon the basin, and the water of condensation was then collected. Dr. Child also objects to Pouchet's experiment.

The air of the cellar was afterwards examined by the electric lamp. Though less heavily charged than the air outside, it was by no means free from particles. This was to be expected, because the door of the cellar was frequently opened. The flasks themselves were the true tranquil chambers; on their sides the dust had been deposited, and to them it firmly clung. To prove this several flasks about ten inches in diameter were filled with common air, corked, and laid upon a table in the laboratory. After two days' quiet they were optically empty.

Nor is it necessary even to cork the flasks; for with their mouths open the air within them is scarcely disturbed, certainly not displaced. Two days' rest on one of the laboratory tables suffices to deposit the organic dust and to render the open flasks optically empty.

I have had a chamber erected with a view to experiments on this subject. The lower half is of wood, its upper half being enclosed by four glazed window-frames. The chamber tapers to a truncated cone at the top. It measures in plan 3 ft. by 2 ft. 6 in., and its height is 5 ft. 10 in. On the 6th of February this chamber was closed, and every crevice that could admit dust or cause displacement of the air was carefully pasted over with paper. The electric beam at first revealed the floating dust within the chamber as it did in the air of the laboratory. The chamber was examined almost daily; a perceptible diminution of the floating matter being noticed on each occasion. At the end of a week the chamber was optically empty, exhibiting no trace of matter competent to scatter the light. But where the beam entered, and where it quitted the chamber, the white circles stamped upon the interior surfaces of the glass showed what had become of the dust. It clung to those surfaces, and from them instead of from the air, the light was scattered. If the electric beam were sent through the air of the Paris Caves, the cause of its impotence as a generator of life would, I venture to predict, be revealed.

It cannot, I think, be doubted that the method of observation here pursued is destined to furnish useful control and guidance in researches of this nature.

Royal Institution, March 14 J. TYNDALL.

HEREDITARY GENIUS

Hereditary Genius, an Inquiry into its Laws and Consequences. By Francis Galton, F.R.S., &c. (Macmillan & Co.)

IN this book Mr. Galton proposes to show that a man's natural abilities are derived by inheritance, under exactly the same limitations as are the form and physical features of the whole organic world. Many who read it without the care and attention it requires and deserves, will admit that it is ingenious, but declare that the question is incapable of proof. Such a verdict will, however, by no means do justice to Mr. Galton's argument, which we shall endeavour to set forth as succinctly as possible. He first discusses the classification of men by "reputation," and from a study of biographical dictionaries and obituaries for certain years taken at wide intervals, arrives at the conclusion that not more than 250 men in each million, or 1 in 4,000, can be termed "eminent"; and he shows what a small proportion that is, by the well-known fact that there are never so many as 4,000 stars visible to the naked eye at once, and that we feel it to be an extraordinary distinction in a star to be the brightest in the sky. These "eminent" men are the lowest class he deals with. The more illustrious names are as one in a million or one in many millions; but unless a man is so much above the average that there is only one like him in every 4,000, he is not admitted into the ranks of the eminent men on whom Mr. Galton founds his deductions.

He next discusses the classification of men according to their natural gifts. He shows first, that each man has a certain defined limit to his mental as well as to his physical powers, and that this limit is in most cases soon discovered and reached. He next shows the enormous difference that exists between mediocre and high class men, by the evidence of examination papers; the senior wrangler at Cambridge, for example, often getting thirty times as many marks as the lowest wrangler, who must himself be a man very far above the average. Statistics show, that the number of imbeciles and idiots are about the same per thousand as the eminent men. He then applies Quetelet's "law of deviation from an average" (which will be new to many of his readers), and deduces from it, that if men are divided into sixteen equal grades of ability, eight above and eight below the average, the six mediocre classes will comprise nineteen-twentieths of the whole; while it will be only the sixth, seventh, and eighth above the average who will rank as eminent and illustrious men, and form about one in four thousand of the adult male population.

The next chapter relates to the important question on which, indeed, the possibility of any solution of the problem depends, of whether "reputation" is a fair test of "ability." The subject is very ably discussed, and it is, I think, proved, that notwithstanding all the counteracting influences which may repress genius on one side, or give undue advantage to mediocrity on the other, the amount of ability requisite to make a man truly "eminent" will, in the great majority of cases, make itself felt, and obtain a just appreciation. But if this be the case, the question of whether "hereditary genius" exists is settled. For if it does not, then, the proportion of mediocre to eminent men being 4,000 to 1, we ought to find that only 1 in 4,000 of the relations of eminent men are themselves eminent. Every case of two brothers, or of father and son, being equally talented, becomes an extraordinary coincidence; and the mass of evidence adduced by Mr. Galton in the body of his work, proves that there are more than a hundred times as many relations of eminent men who are themselves eminent, than the average would require.

Turning now to the concluding chapters of the book, we meet with some of the most startling and suggestive ideas to be found in any modern work. The law of deviation from an average enables us to determine the general intellectual status of any nation, if we are able to estimate the ability of its most eminent men, and know approximately the amount of the population. We have these data in the case of ancient Attica; and Mr. Galton arrives at the conclusion, that the Athenians of the age of Pericles were, on the lowest possible estimate, nearly two whole grades of ability higher than we are. With all our boasted civilisation, and the vast social and scientific problems with which we have to grapple; with all our world-wide interests, our noble literature, and accumulated wealth; the intellectual status of the most civilised modern nation is actually lower than it was more than two thousand years ago! Well may Mr. Galton maintain that it is most essential to the well-being of future generations that the average standard of ability of the present time should be raised. Not less striking is his exposition of the effects of prudential restraints on marriage, on the general character of a nation. If one class of people, as a rule, marry early, and another class marry late in life, the former have a double advantage, both in having on the average larger families, and in producing more generations in each century. But, by the supposition, it is the imprudent who gain this advantage over the prudent; and Mr. Galton therefore denounces the doctrine of Malthus, that marriage should be delayed till a family can be supported, unless the rule could be imposed on all alike. I hardly think that this argument is sound, and I doubt if the imprudent who make early marriages do, in the long run, increase more rapidly than the prudent who marry late. Increase of population depends less upon the number of children born, than on those which reach manhood; and I believe that the prudent man who has acquired some wealth and wisdom before he marries, will give to the world more healthy men and women, than the ignorant and imprudent youth, who marries a girl as ignorant and imprudent as himself. It is also to be remembered that the men who marry late often marry young wives, and have as good a chance of large families as the imprudent.

Mr. Galton traces the long-continued darkness of the Middle Ages, and our present low intellectual and moral status, to the practice of celibacy and to religious persecution. Whenever men and women were possessed of gentle natures, that fitted them for deeds of charity, for literature, or for art, the social condition of the times was such that they had no refuge but in the bosom of the Church; and the Church exacted celibacy. Those gentle natures left no offspring; and thus was the race of our forefathers morally deteriorated. The Church acted as if she had aimed at selecting the rudest portion of the community for the parents of future generations; and the rules as to fellowships at our Universities are a relic of this barbarous custom, being bribes to men of exceptional ability not to marry. Religious persecution acted in the same way. The most fearless, truth-seeking, and intelligent were year by year incarcerated in dungeons or burned at the stake; so that, by this twofold selection, human nature was brutalised and demoralised, and we still feel its hateful effects in the long-continued antagonism to the essential requirements of an advancing civilisation. These concluding chapters stamp Mr. Galton as an original thinker, as well as a forcible and eloquent writer; and his book will take rank as an important and valuable addition to the science of human nature.

ALFRED R. WALLACE

SPECTRUM ANALYSIS

Die Spectral Analyse in ihrer Anwendung auf die Stoffe der Erde und die Natur der Himmelskörper. By Dr. H. Schellen, director der Realschule I.O., Cologne. (Brunswick, Westermann, 1870. London: Williams and Norgate.)

THIS book contains an accurate and luminous account of the recent discoveries in celestial chemistry and physics, and especially of the researches of our countrymen Huggins and Lockyer. As regards the completeness of that portion of the work bearing directly upon terrestrial chemistry, readers will, I fear, be disappointed. The first division of the book is devoted to a description of the means employed for the artificial evolution of light and heat of great intensity, beginning with combustions in oxygen, and ending with the electric-light. The second division is headed "The simple and compound spectra in their application to terrestrial matter;" whilst in the third and most important division Schellen considers the application of spectrum analysis to the heavenly bodies. The illustrations throughout the work are good, though many of them are not new, and are borrowed, without acknowledgment, from other books.

With respect to the physical constitution of the sun, it behoves us in this, the infancy of our knowledge, to be very careful in drawing positive conclusions. In the first place, there is no doubt that whilst Kirchhoff's original theory must undergo certain modifications, it will remain in its grand features as having first pointed out to us the true physical condition of the sun. The discovery of the chromosphere by Mr. Lockyer, in which, as a rule, only the bright hydrogen lines are seen, together with the yellow mysterious line of unknown origin, renders it difficult for us, especially if we accept Frankland and Lockyer's conclusions respecting the excessive tenuity of the upper chromospheric layers, to suppose that an atmosphere containing iron and the other 13 difficultly volatilisable metals can exist outside the chromosphere of sufficient density to effect such a powerful selective absorption as we see in the darkness of Fraunhofer's lines. Hence we should be inclined to agree with Lockyer that the absorption does not take place, as Kirchhoff suggested, in a far outlying layer of solar atmosphere, or in what we term the corona, but that the dark lines are produced within the chromosphere. But, on the other hand, upon what known physical basis are we entitled to assume that the higher lying portions of the solar atmosphere consist almost entirely of glowing hydrogen gas, whilst the lower lying layers contain the more easily condensible gases of the other 14 elements? The well-known laws of gaseous diffusion (to say nothing of the cyclones of vast magnitude and of enormous rapidity, which Lockyer has taught us are constantly mingling up the various layers of solar atmosphere), forbid us to suppose that the lighter hydrogen gas can ascend whilst the heavier metallic gases remain quietly below. If the components of the solar atmosphere are gaseous, they must be uniformly, or nearly uniformly, mixed. How then can we account for the constant presence in the chromosphere of the hydrogen lines, whereas the lines of the other constituents of the solar atmosphere are scarcely visible, except in special cases of the occasional projection of the vapours of magnesium and other metals, whilst the absorption is to occur in a lower gaseous layer, having a totally different composition?

Another point to be remembered is, that according to the law of exchanges the fact of the existence of absorption *necessitates* the existence of a lower temperature in the absorptive medium than in the *media* (either above or below) in which such absorption is not exhibited, and which may either give continuous or broken spectra, according to the physical and chemical nature of the incandescent bodies. How then can the iron and magnesium vapour exist nearer to the white-hot body of the sun than the hydrogen and yet possess a lower temperature? I am here forcibly reminded of the plausibility of a suggestion thrown out by Kirchhoff, in a conversation with me a few weeks ago, viz.: that the upper regions of the solar atmosphere may be constantly illumed by discharges of electricity; that the incandescent hydrogen may be heated not from below but from within its own mass, either by continuous flashes of lightning or constant auroral discharges; and, indeed, Zöllner has noticed the flashing out of certain bright points in the prominences, which may possibly be caused by solar lightning.

We must also bear in mind that the existence in the sun of a solid or liquid white-hot nucleus, as originally assumed, is not proved by the results of subsequent research; inasmuch as we learn from the recent researches of Frankland, Lockyer, and Wüllner (as indeed we may do from much older experiments), that incandescent gases under certain physical conditions emit white light and yield a continuous spectrum. So that spectrum analysis does not give us any *certain* information as to the physical state of that portion of the sun's body from which the main portion of light and heat proceeds.

H. E. ROSCOE

OUR BOOK SHELF

Essays on Physiological Subjects. By Gilbert W. Child, M.A., F.L.S., F.C.S. Second edition, with Additions; pp. 293. (London: Longmans, Green, and Co. 1869.)

THE present edition of Dr. Child's work is by no means a mere reprint of the last. It has undergone considerable modifications, chiefly in the form of additions, which will tend to make it more acceptable to a large class of readers. There is an almost entirely new essay on "Some Aspects of the Theory of Evolution," in which he endeavours to show how this theory is related to religious belief. He believes its proper meaning and tendency to have been much misunderstood; that far from being an "atheistical" conception, it is in reality only the scientific form of natural religion. The subject of "Physiological Experimentation on Animals" is also considered, whilst the last and longest essay, also new, is entitled "Physiological Psychology," in which he endeavours to make known to persons whose chief interest is in psychological rather than physiological science, all the chief points in the anatomy of the nervous system, necessary to be understood before he could explain, as he also attempts to do, the principal physiological conclusions which have been arrived at concerning brain action and mind.

Monographie der Molluskengattung Venus, Linné. I *Band. Sub-genus Cytherea, Lamarck.* Von Dr. Eduard Römer. 4to. (Cassel, 1869.)

NATURALISTS have been divided into those of the field and those of the closet. The author of this monograph may be classed in the latter category; and he certainly shares the indefatigable industry of his countrymen. Such labour, however, when applied to subjects of natural history, sometimes tends to an excessive multiplication of species; and its utility is in that respect questionable. Professor Römer, in a critical examination of the species of *Venus* which he published in 1857, enumerated 145 species arranged in eight sub-genera. In the present work one only of these sub-genera is treated, and includes no less than 209 species. We may well ask, with Cicero, "Quousque tandem abuteris patientiâ nostrâ?" A common European species (*Circe minima*) is described in two sections under different names; and some of the author's new species seem to be merely the young of well-known forms. The method in which he subordinates this host of species is unusual. Eight sections of the sub-genus *Cytherea* are named and described; and the specific names are applied, not to the genus or even to the sub-genus, but to each section. The sectional name is used in a generic sense; so that *Venus meretrix* becomes *Meretrix meretrix*, and *V. Dione* is converted into *Dione Dione*. The description of species is not in every case consistent with the sectional characters. In the first section, *Tivela*, the shape is stated to be "trigona;" but in *T. nitidula* we find it is "ovato-elliptica," and in *T. nucula* "cordato-ovata." It would also be more convenient to have the descriptive characters given in the same order throughout. In the description of the first species colour takes precedence of sculpture; in that of the second species the order of these characters is reversed. The same confusion occurs as to the teeth and pallial scar as well as to other characters. But the excellence of the illustrations compensates to a great extent for the small blemishes which it is the unpleasant duty of a critic to point out. The plates are fifty-nine in number and contain many hundred figures, all of which are evidently truthful, admirably engraved, and exquisitely coloured. The monograph must be indispensable to collectors, who are better pleased with a redundancy than with a paucity of species. Dealers have the same feeling.

J. GWYN JEFFREYS

Abstracts of Two Papers on the Geography of Disease. I. The Geographical Distribution of Heart Disease and Dropsy in England and Wales. II. The Geographical Distribution of Cancer in England and Wales. By Alfred Haviland, M.R.C.S. Pp. 18. (London, 1869.)

THIS pamphlet contains a reprint of two papers, in which the author has endeavoured to map out the districts in which the particular forms of disease above-mentioned are most frequently encountered. The subject of his geographical distribution of disease is a most important one in its bearings upon the great question of the causation of disease. It is a subject, however, in which the facts should be many and the conclusions few, if he who draws them wishes to make lasting contributions to the science of medicine.

Leçons sur la Physiologie Comparée de la Respiration. Par Paul Bert. (Paris: Baillière. London: Williams and Norgate.)

IN his preface, the author to some extent apologises for the imperfections of this volume, on account of the difficulties, including "the singular penury of the laboratory over which he presided," attending the delivery of the course of lectures of which it forms the report. No apology, however, is needed for an interesting and admirable series of discourses on a difficult and yet important topic. The book does not profess to be a complete Treatise on Respiration, but rather treats fully of certain selected points, such as the respiration of tissues, the gases of blood, the respiratory mechanism in various classes of animals, asphyxia, &c., &c. The "graphic method" is employed throughout, by far the larger number of the illustrations being representations of various respiratory movements. We would especially call attention to the chapters on the respiratory movements of fishes, amphibia, reptiles, and birds, in which the graphic method brings out many singular and interesting facts. Even in matters of science, national characteristics come to the surface; and quite apart from the language, it is generally an easy matter to distinguish the work of a Frenchman from that of German or an Englishman. Prof. Bert's work is no exception to the rule, though we must add, with singular pleasure, that it is far more cosmopolitan than many of the writings of his fellow countrymen. The author has evidently studied and appreciated the labours of countries other than his own.

Systematische Beschreibung der bekannten europäischen zweiflügeligen Insekten. Von J. W. Meigen, Achter Theil, von Hermann Loew, Erster Band. Schmidt, Halle, 1869. (London: Williams and Norgate.)

PROFESSOR LOEW, who is to be regarded as the highest authority on European Diptera, contents himself in this book with supplying a sort of supplement to Meigen's great work on the insects of that order inhabiting Europe. It is, perhaps, to be regretted that he does not rather direct his efforts to the production of a complete systematic work on the subject, but he probably thinks that the time is not yet ripe for such an undertaking, and in the meanwhile the full and detailed descriptions of species detected since the publication of Meigen's last volume will be most welcome to entomologists. The present volume contains descriptions of 182 species of two-winged insects, belonging to various families from the *Tipulidæ* to the *Dolichopodidæ*, and especially of numerous forms of *Asilidæ* and *Bombyliidæ*. No fewer than 138 of the species are described as new, and the greater part of the remainder are species described by Professor Loew himself in various scattered papers.

Nachrichten von der K. Gesellschaft der Wissenschaften und der Georg-Augusts Universität zu Göttingen, aus dem Jahre 1869.

THE volume of "Reports of the Royal Society of Sciences and University of Göttingen," for 1869, which has lately reached us, contains a great number of papers of considerable value, for the most part relating to mathematics, physics, and chemistry. There are also some memoirs relating to literary antiquities, but natural history receives little attention, the only papers being a notice of some marine animals and their metamorphoses by Dr. E. Mecznikow, and a revision of the *Butomaceæ*, *Juncaceæ*, &c., collected by the Brothers Schlagintweit in Upper Asia by M. F. Buchenau, to which we may specially call the attention of botanists, as a good many new species are described in it.

Via Medica. A Treatise on the Laws and Customs of the Medical Profession, in relation especially to Principals and Assistants; with Suggestions and Advice to Students on Preliminary Education. By J. Baxter Langley, M.R.C.S., F.L.S. Third edition. (London: R. Hardwicke. 1869.)

THIS little work is full of most useful information concerning the subjects indicated on its title-page. That it meets a demand for information of this description is sufficiently indicated by the rapid sale of the two previous editions.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

The Geological Calculus

MR. WALLACE'S essay, completed in NATURE, No. 18, brings to the front the question whether or no we can measure the Geological Past by the historical unit of years. Have we any basis for fixing with any certainty the date of any geological epoch? Mr. Wallace's answer in the affirmative to this is worthy of a careful analysis, because it represents fairly the ideas current in the minds of many geologists.

There are three ways by which the attempt to solve the problem has been made:—(1.) The slow geological changes which have been noted during the period of history, such as the modification of coast line, the silting up of estuaries, and the like. This method Mr. Wallace very justly discards as being "too minute, too limited, and too uncertain to afford the basis of even any approximate measurement" of the geological past. (2.) The change in organic life. This also is a unit of measurement "which we have not yet been able to get; for the whole length of the Historical Period has not produced the slightest perceptible change in any living thing in a state of nature." Professor Huxley, in 1869, gave expression to very much the same view, in his Presidential Address to the Geological Society. This method, therefore, of approaching the problem may also be given up as hopeless. (3.) The excentricity of the earth's orbit which Mr. Croll has used, in making his ingenious computation of the lapse of time since the glacial period, on the hypothesis that the severity of climate at that time was due solely to astronomical causes, and not, as had been previously supposed, to changes in the physical geography of the earth. But, as Sir Charles Lyell argues, since the distribution of land and water and the course of marine currents now modify climate, they cannot be fairly supposed to have had no share in causing the severity of the glacial period. And therefore, the fact that they are ignored in Mr. Croll's computation, destroys its value as fixing the glacial date, although there may be astronomical reasons for a depression of temperature at certain times in the northern hemisphere without the aid of any terrestrial agent. This, indeed, is practically admitted by Mr. Croll, when he reduces the date of the last glacial period from 750,000 to about 80,000 years ago, because of the amount of sub-aerial denudation that has taken place since that time. There are, moreover, two fatal objections to any estimate that can be formed of the amount of denudation since the glacial period. First of all, the denudation now going on, over any wide area, has not yet been ascertained with anything like accuracy, and it acts unequally, even in any one limited region. Secondly, as we do not know the original thickness of the glacial deposits, or the extent to which the existing valleys were excavated in preglacial times, it is impossible to estimate the amount of denudation since that period, even if we had trustworthy data from our own experience. This third method, therefore, of measuring geological time, is not more satisfactory than the former ones.

Mr. Wallace, however, assumes in the second part of his essay that the *vera causa* of the glacial epoch was the high excentricity of the earth; and then he proceeds to reduce Mr. Croll's lowest estimate by 20,000 years, by using precisely that argument of observed change in physical geography which in the first part was discarded as "too uncertain." From this untenable standpoint hangs the following chain of reasoning.

"Now it is most important to observe that, for the last 60,000 years, the excentricity has been very small—for three-fourths of the time less than it is now. During this time the opposite phases of precession, each lasting 10,500 years, will have produced scarcely any effect on climate, which in every part of the earth will have been *nearly uniform for that long period.* But this is quite an exceptional state of things; for the curve of excentricity shows us that, during almost the whole of the last three million years, the excentricity has been high—almost always twice, and sometimes three and four times as much as it is now. If, therefore, Mr. Croll's theory be correct, there will have been a change each 10,500 years during this vast period (in all the extra-tropical regions at least) from a very cold to a very mild climate. This will necessarily have caused much migration, both of plants and animals, which would inevitably result in much extinction and comparatively rapid modification. Allied races would be continually brought into competition, altered physical conditions would induce variation, and thus we should have all the elements for natural selection, and the struggle for life, to work upon and develop new races. High excentricity would therefore lead to a rapid change of species; low excentricity to a persistence of the same forms; and, as we are now and have been for 60,000 years, in a period of low excentricity, *the rate of change of species during that time may be no measure of the rate that has generally obtained in past geological epochs.* Thus we should have explained the extraordinary persistence of organic forms during the historical period, as well as during the preceding Neolithic age, although slight changes of climate and of physical geograghy have undoubtedly taken place; and it would prove to be not so much the *usually* slow rate of organic change, as the fact of our living in the midst of an *exceptionally uniform climatic epoch*, that has hitherto prevented us from obtaining a measure of the average duration of species."

The major premiss latent in this argument is, that all climatal change from the glacial epoch to the present day has depended solely on the excentricity of the earth's orbit, a proposition which Mr. Wallace himself would be the last to endorse. If it be admitted that the alteration of a marine current here, or the elevation of a sea-bed there, be factors in climatal change, the estimate of 60,000 years in which they are not reckoned is without value. The study of the mammalia, of historic, pre-historic, and post-glacial times does not warrant the conclusion that the persistence of organic forms was "extraordinary," nor the recognition of an "exceptionally uniform climatic epoch." The mammals have exhibited on the whole a steady diminution *in size* from the post-glacial to the present day, owing probably to the fact that they have been worried off their feeding and hunting grounds by man. The non-development of new species during that time may be ascribed to its short duration as compared with past geological epochs, rather than to exceptional conditions of life caused by exceptional excentricity. The deposits in Britain since the glacial epoch are a mere surface film compared with those of previous geological periods. The steady northern retreat of the reindeer during historic times, taken in conjunction with its pre-historic range, testifies to a gradual increase of temperature in central and northern Europe, to say nothing of the historical evidence of the former severity of winter in Gaul and Italy from Cæsar's time to the present.

There is another point which ought not to be omitted. Mr. Scott Moore is quoted as maintaining that the group of mammalia commonly called "Quaternary" is pre-glacial because of the "striking fact, that none of the supposed pre-glacial gravels ever rest on the boulder clay, but always on an older rock, which could hardly have been the case in every instance were they all post-glacial." So far from this being true, the famous Bedford section proves, as Mr. Wyatt showed in 1860, that the mammaliferous and flint-implement producing gravels are post-glacial without the possibility of a doubt. On the Norfolk coast mammaliferous gravel overlies the boulder clay in certain places. The mammalia found in making the Ipswich tunnel were derived from a river deposit, clearly of later date than the boulder clay of the district. Very many other cases might be quoted that would show that this sweeping generalisation is without any foundation in fact.

But can we measure geological time by the lapse of years? If so, we shall have solved a problem infinitely harder than that which has foiled the archæologists. Can they fix the date, say of the introduction of iron into Europe, or of the dawn of the age of bronze or of stone? No man would venture to answer yes. Modern historians are becoming more and more alive to the worthlessness of the so-called chronology of the Assyrian kings and of the Manethonian dynasties. If, then, we are ignorant of the date of any one of these events, which are, comparatively speaking, of yesterday, and we can simply tell that one succeeded another in a definite order, how can we reasonably expect to fix the date of any one period of the geological past? The attempt can only be made by forsaking those laws of rigid induction by which geology has become a science—by the assumption of a premiss which we have no right to assume. The strict interpretation of geological phenomena only warrants our saying that, one event, say the deposition of the chalk, took place in Europe after another,—the deposition of the Neocomian strata,—how much after none can tell. In other words, the geological "when" merely implies before and after, while in history the idea not only of sequence, but of the lapse of how long before and how long after, can be mastered. The attempt to fathom the geological past with our short historical sounding line has up to the present time resulted merely in estimates, varying according to the assumed basis in each by thousands of centuries, that have been about as valuable in geological theory as Archbishop Usher's chronology has been found in Biblical criticism. The problem is hedged in by innumerable difficulties, which cannot be overcome in the present state of science.

W. BOYD DAWKINS

On the Diffraction Spectrum and Wave Lengths

THE letter which I wrote about the diffraction spectrum has called forth several inquiries. I have been asked how it is that in that spectrum the position of a line depends only on its wave-length, and I may take the opportunity of answering these questions through your columns. First, however, let me state that the numbers given in the table in my letter of February 9 are copied, including the obvious errors, *verbatim* from the translation of Mossotti's memoir in vol. v. of Taylor's "Scientific Memoirs." I attach no importance to such analogies. Any analogy between these lines and interdependent notes of music must, I expect, be entirely accidental. The latest experiments made by Mr. Lockyer have shown that the lines given out by a gas vary according to temperature and pressure, and if these be caused by vibrations of the particles of the gas, whether atomic or molecular, the periods of these vibrations must be dependent on the temperature and pressure. A distinct numerical statement of this interdependence is a great desideratum in this part of science with a view of affording the materials for making and testing a mechanical theory of that interdependence. These are the great problems which demand our attention, as I take it, with respect to the fixed lines, and our ability to correlate light with other modes of force.

If a beam of homogeneous light be admitted through a small hole into a dark room, and fall on the opposite wall, it will illuminate only the portion of the wall directly opposite it. But if a series of fine parallel wires, or a fine grating be put across the hole, there will be seen ranged in a line perpendicular to the grating a series of nearly equal distant spots, or rather streaks of light. This is because the wires of the grating shut out those waves of light which at these points would destroy the other waves. To understand this more clearly, suppose A*a*, B*b*, &c., &c., to be a number of consecutive and equidistant points in the front of a wave coming through a small hole, A*a*, &c. These may, by the principle of Huyghens, be regarded each as the origin of a new wave, together having the same effect as the original

wave, all starting in the same phase. There is darkness at every point on an opposite wall, except directly opposite the hole, because of the interference of these elementary waves, which destroy one another everywhere except exactly in front. This is owing to the shortness of the waves and the number of sources. Let P be a point on the wall which we shall suppose sufficiently far from the hole in order that the lines PA, Pa, PB, Pb, &c., may be regarded as all sensibly parallel. On that account also each of these lines exceeds the one next it by the same amount. Now, generally, when the waves from A, *a*, &c. arrive at P, the wave from *a* will not entirely blot out that from A, but a residue will be left, which will be blotted out by other similar residues. But there will be certain points along the wall at which the waves will blot one another out in a peculiarly regular way. We shall suppose P to be one of these points, namely, that each of the distances A P, *a* P, &c., exceeds the one next it by exactly some odd multiple of the length of half a wave—say in this instance half a wave's length. Then in this case the disturbance originating at *a* will arrive at P exactly half a wave's length in advance of that from A, and the wave from A will be exactly blotted out, so to speak, by that from *a*; similarly that from B will be exactly blotted out by that from *b*; and so on. So that if I were to put wires at *a*, *b*, *c*, &c., so as to stop up the waves entering there, the waves from A, B, C, &c., would fall at P each undestroyed and assisting one another, each disturbance being an exact wave-length behind the other, and therefore all in the same phase. Thus light would be restored at P. And similarly at other points where the difference between A P, *a* P, &c., is three, five, &c., semi-wave-lengths. Light would be restored in the same way at no other places because the elementary waves do not at other points destroy one another in this peculiar alternative manner. Supposing *a*, *b*, *c*, &c., to be the centres of the wires, A, B, C, &c., to be the centres of the spaces between, a more refined consideration shows us that the position of P does not depend on the space A *a* being equal to the space *a* B, but only on the total length A B (or *a b*). Hence we have a very accurate method of determining the wave-length from the position of P. For if θ be the angle between the line drawn from the hole straight forward in the direction of the ray and the line drawn to P, then the difference between A P and B P, which is a wave-length, is also A B sin θ. So that to get the wave-length all that we have to do is to measure θ and A B. A B may be very accurately got by ruling the grating on glass with a machine, and counting the whole number of rules given and the total space which they occupy. Adaptations of this method may be made to suit circumstances, as for instance the grating may be attached to the object glass of a telescope used for measuring the angle θ. It is by such a method that the wave-lengths have been found for the principal fixed lines in the solar spectrum, and the wave-lengths of all other lines are determined from these by some formula or other which may best suit the views of the calculator; the constants of the formula being determined so as to constrain the formula to satisfy the truth at those fixed lines whose wave-lengths are got directly from the refraction spectrum. Uncertainty, therefore, prevails about all wave-lengths thus obtained, although, of course, the uncertainty must, from the method of calculation and the number of lines whose wave-lengths have been obtained from the diffraction spectrum, lie necessarily between narrow limits. These latter are the only wave-lengths, however, which have the recommendation of being due to direct observation; and the method of obtaining the wave-length by observation from the diffraction spectrum is one capable of such accuracy, that I have sometimes considered that the wave-length thus determined might be used as an absolute and recoverable standard of linear measure.

Of course, the preceding investigation must not be considered to be perfectly exhaustive in giving the whole character of the phenomena, which are explained by a more refined investigation, in which the space between each wire is regarded, not as the source of one, but of an infinity of waves, so that the application of Huyghens' principle becomes rigidly correct. By this means the difference of the spaces occupied by the wire and the opening is found to have no effect on the position of P, but a certain effect on the brightness there, which, under certain circumstances, causes one of the spectra entirely to disappear: an experimental result which, being thus deducible from the theory of undulations, gives a striking proof of the power of that theory to account for phenomena.

JAMES STUART

Trinity College, Cambridge, March 2

The Valuation of Liquid Town Sewage

IF there is one thing that is more to be deprecated than another, it is the unnecessary importation of personalities into a scientific discussion, or indeed into any serious matter of business, and fortunately this is not now a common proceeding in this country. It was therefore with a feeling of unqualified disappointment that I read Dr. Paul's personal attack on myself in your columns.

Whenever I hear or read an opinion or statement which I believe to be erroneous, I endeavour to point out its fallacy, and shall always continue to do so. It is the undoubted right, as it is in some degree the duty, of every man to do this. But opinions may be criticised and condemned without any reflection on the man who holds them. This is all I did in Dr. Paul's case, and I certainly endeavoured to do it good-naturedly; at all events I not only made no reflection whatever on Dr. Paul's character, but I did not even mention his name. He had, in his article, hazarded an opinion on a question of practical farming, of which, so far as I know, he does not profess to have any personal knowledge or experience whatever. This opinion I knew from experience to be utterly erroneous, although exceedingly plausible. I therefore did my best to point out its fallacy, partly with a view of convincing him. He replies, not by arguments, but by a personal attack on me, the acrimony of which I deplore but cannot explain, and by re-asserting his opinion as "a fact long accepted as beyond question . . . . by authorities too numerous to name." In short, it appears to be "a fact" which the proverbial schoolboy ought to know; but I am never more pleased than when the schoolboy with his universal knowledge is brought out against me. It is generally a sure sign that the assumed "fact" has no other foundation than that intelligent youth's imagination.

In the present case I say that if a man buys sewage he should buy it as he would any other manure, on the basis of a chemical analysis. I say that this is the *only* safe and reliable basis on which to found a calculation of its money value. And I say that if a farmer puts so much money's worth of manure into his land, he is simply a bungler if he does not get it out again with its proper increment of profit, whether he buries it in his land by means of a plough, or of a spade, or of water. Dr. Paul, on the other hand, says that if a man pays so much money for so much sewage because it contains a certain percentage of ammonia he will be ruined. Why? Because of the water.

Of course we all know that water applied to certain crops in certain stages would spoil them; so would manure. If, therefore, a farmer applies sewage under such conditions, he is a bungler. His skill, as a sewage farmer, is shown in so arranging his land and crops as never to injure but always to benefit them by the application of his sewage. This is simply a question of good *versus* bad management. It is one to be decided on the farm and not in the laboratory. Incredible as it may appear to Dr. Paul, on taking a lease of the sewage of the town of Romford, although bound, under penalty, to use it every day in the year, I stipulated for an additional dilution of the sewage to the extent of twenty gallons of water per head of the population *per diem*, and this although I have not got the proportion of "twenty-five acres for every 100 persons," as Dr. Paul says I recommend, but which I never recommended, and should be the first to condemn.

Having defended my opinion, I will now, with your permission, defend my character. Dr. Paul regrets that I should "declare myself a partisan of one particular solution of the town-refuse problem." It may be that he has so recently commenced the study of this large question that he has, as yet, formed no opinion upon it except that by irrigation the value of the manure cannot be recovered; but I have laboured at it for many years, and it is not possible that in those years I should not have formed some very distinct opinions. Will any one else regret that I should "declare" what those opinions are? I think not; and I think that such a declaration is straightforward and honest, though why Dr. Paul should affect to think that I have made it now for the first time I cannot say. My views on this subject have been publicly expressed for many years, and have been so expressed in his presence. Dr. Paul complains that I desire "the promotion of a project at any price." I do. I desire to see sewage utilised all over the country, and by irrigation, if possible, because I believe it is the right thing, and I am gratified to find that my views are in exact accord with those expressed in the unusually careful and able report just published by the Royal Commission on Pollution of Rivers. But when I joined the Committee of the British Association on Sewage, I at once suggested that the scope of their inquiry should be enlarged so as to include a full investigation into every proposal for the utilisation of sewage which presented any appearance of practicability. I also suggested a source from which the necessary funds might be obtained. My suggestions were approved both by the Committee and by the Council of the Association, the funds have been in great part obtained, and the inquiry is about to be prosecuted. Whether Dr. Paul is justified in the personal attack he makes upon me, I will therefore leave to the judgment of your readers.

I will merely add, as regards my opinions, that they were condemned in the most unqualified and unmeasured language by Baron Liebig five years ago; but I have lived to prove Liebig mistaken in this instance, and, on the practical farming part of the question, I think I may claim to be a very much better authority than Dr. Paul. At all events, as the German philosopher said of the author of the Epistle to the Corinthians, "I do not agree with your Dr. Paulus," and I have yet to learn that such a disagreement involves the breach of any law, human or divine, although Dr. Paul is evidently firmly convinced that while *he* has an undoubted right to express "a foregone conclusion," such an expression on *my* part is a sign of great moral depravity. This is a common form of superstition, but it is scarcely scientific, and seldom adds much weight to a man's opinions. W. HOPE

Parsloes, March 6

Transactions of Scientific Bodies

I WISH it were possible to induce our learned societies to be a little more liberal; it should be their aim to spread knowledge, not make it a luxury for the wealthy. I happen to wish to read a paper by Professor Tait on "Rotation," published in the Transactions of the Royal Society of Edinburgh. The only libraries I have access to are those of the British Museum and London Institution. At the Museum there is no volume of the "Transactions" later than 1864; at the London Institution no volume later than 1862; so that if I persevere in my intention of reading the paper, I must buy the volume containing it, for which I must pay 2*l.* 2*s.*—that is, I must buy thirteen papers I don't want in order to be able to read one which I do want: these include one on the temperature of newly-born children, and another on tetanus in cold-blooded animals.

All papers should be published separately; this would lead to a much wider diffusion of them, and the Societies would benefit by their increased sale.

London, March 7 G.

Sir. W. Thomson and Geological Time.

THE *North British Review*, for July last, thoroughly exposes the inaccuracy of the quotation from Prof. Thomson, referred to by your correspondent G.H., in its article devoted to the consideration of Geological Time. J. S.

YOUR correspondent G.H. will find in one of Thomson's papers something very like the assertion "that there was a time when the earth rotated too swiftly for the existence of life," but expressed in a manner at once more precise and less pleonastic. "The existence of life" reminds me of a phrase which I heard a few days ago from a female beggar; she lamented that her husband had "fallen into habits that are habitual." Well; the required reference is the paper "On Geological Time," in the Transactions of the Geological Society of Glasgow, vol. iii. Part I. pp. 15 and 16 (§§ 19 and 20). A thousand million years ago, says Thomson, "there must have been more centrifugal force at the equator due to rotation than now, in the proportion of 64 to 49. . . . If the earth rotated seventeen times faster, bodies would fly off at the equator. . . . If you go back ten thousand million years ago—which, I believe, will not satisfy some geologists—the earth must have been rotating more than twice as fast as at present—and if it had been solid then [which he thinks improbable], it must be now something totally different from what it was." Such a state of things he seems to consider inconsistent with any organic life such as we know of. Surely the connection of this question with the argument from retardation by tidal friction is too plain to need exposition.

Ilford, March 11 C. M. INGLEBY

How large seems the Moon?

READING Mr. R. A. Proctor's communication under the above heading in NATURE of March 3rd, reminds me of an experiment I tried some time ago. I imagined I should get all sorts of answers to the question, varying from "a fourpenny-piece" upwards, without any particular size being more frequently pitched on than any other. I did not collect more than about twenty or thirty replies, but they were sufficient to show that, contrary to my expectation, *one to two feet* was assigned more frequently than other sizes. Mr. Proctor says the estimate of a foot in diameter assigns a distance of 115 feet to the moon. If he were to try to convince the observer of the soundness of this deduction, the latter would probably meet him with vehement reiteration that he only means the moon *looks* a foot large. It seems to me fairer to say that such a man thinks a two-foot rule 115 feet off, a fit and proper measure for celestial objects. I think many, who are aware of the futility of attempting to convey their ideas to other minds by these comparisons, yet involuntarily make them in their own. I am conscious of a lurking idea that the moon is more like a fourpenny-piece in size than anything else. The question is, what is the cause of the "personal equation" which determines for each individual the distance of the imaginary two-foot rule—and why is about 115 feet more common than other distances?

I think it probable the sort of objects with which a man is familiar in his daily life may have some influence on his judgment in this respect. The men I questioned were for the most part engaged in warehouse or out-door work. I should like to know what answers watchmakers or jewellers would give. This theory, however, fails to account for the different estimate formed by the same individual when the moon is high above, or on the horizon; but I imagine, in the latter case, the imaginary rule is superseded, or more properly modified, by the terrestrial objects which are in the field of vision with the moon.

Cardiff, March 7 GEORGE C. THOMPSON

Cuckows' Eggs

MAY I be permitted to make a few observations upon Mr. Sterland's letter in your issue of the 27th of January, relative to the cuckows' eggs' controversy.

In answer to Prof. Newton's query, "If the eggs in question were not cuckows', what birds laid them?" Mr. Sterland says, "My reply is simply that they were laid by the birds in whose nests they were found."

Besides the well-known fact mentioned by Mr. Newton (NATURE, p. 266), "that when birds lay larger eggs than usual the colouring is commonly less deep," which tells so strongly against Mr. Sterland, I will only mention the following instances.

1st. The egg No. 9 in the series given by Herr Baldamus, (see *Zoologist* for April 1868), which the Royal Forester, Mr. Braune, found *in the ovary* of a just-killed cuckow, and which "was coloured exactly like the eggs of Hypolais."

2ndly. The egg No. 26 in the same series, belonging to the collection of Dr. Dehne, described as a "light-greenish blue egg without any markings," and "might have passed for the egg of either species of the redstarts," which specimen "was *laid in a cage* by a cuckoo that was caught in a hay loft." (The *italics* are mine.)

3rdly. The two instances given by Mr. H. E. Dresser, (NATURE, p. 218) of two eggs of the cuckow "closely resembling" those "of the common bunting (*Emberiza miliaria*)," one found in a blackbird's, the other in a robin's nest.

Can Mr. Sterland explain away the 1st and 2nd instances? and how does he reconcile the 3rd instance with his affirmation? Will he venture to say that the two apparent bunting's eggs were laid by a blackbird and a robin respectively, or, will he risk the remark that a common bunting had taken a cuckow-like freak into its head and been laying its eggs in other birds' nests? As either alternative is too absurd to be worth a moment's consideration, we can only conclude that they are cuckows' eggs, unless there has been some mistake as to the nests from which they were taken—scarcely likely, if Mr. Dresser's remarks are carefully read.

Therefore I think Mr. Sterland must admit, if he accepts these facts as authentic, that the cuckow's eggs *do* vary to a large extent, and doing so, he has little foundation for doubting the identity of the specimens mentioned by Herr Baldamus as taken from nests whose eggs they resembled.

For my own part I have every confidence in the discrimination of that ornithologist, and am not afraid that he had been carried away by a pet theory that led him to *imagine* this or that egg taken "out of the nest of the hedge-sparrow or tree-pipit" to be a cuckow's merely because it is "an egg rather larger than the rest, but marked and coloured in a similar manner." If Mr. Sterland will carefully examine Herr Baldamus's evidence he will find that it is not of such a superficial character.

I agree with Mr. Sterland that it is certainly singular that British and Continental observers should come to such opposite conclusions as to this variation of the cuckow's egg in their respective countries; but this is no reason for impeaching (merely because our experience differs) the testimony of the eminent Continental oologists who affirm this extreme variation, and to some of whom Herr Baldamus's theory is probably unknown; as instance, in the two quotations by Prof. Newton (NATURE, p. 266) from *Des Murs* and *Degland et Gerbe*.

Can it be that such extreme variation really does occur on the Continent, and is yet comparatively absent in Britain? I leave it to abler hands than mine to discuss; but if it should prove so, it will be another feature in the already remarkable habits of the cuckow.

Tadcaster, Feb. 7. FRANCIS G. BINNIE

MR. RUSKIN ON RIVER CONSERVATION

IN his recent Friday evening discourse on Verona and its Rivers, at the Royal Institution, Mr. Ruskin, speaking of the Adige and the Po, said: "I want to speak for a minute or two about these great rivers; because in the efforts that are now being made to restore some of its commerce to Venice precisely the same questions are in course of debate which again and again, ever since Venice was a city, have put her Senate at pause—namely, how to hold in check the continually advancing morass formed by the silt brought down by the Alpine rivers. Is it not strange that for at least six hundred years the Venetians have been contending with those rivers at their *mouths*—that is to say, where their strength has become wholly irresistible—and never once thought of contending with them at their sources, where their infinitely separated streamlets might be, and are meant by Heaven to be, ruled as easily as children? And observe how sternly, how constantly the place where they are to be governed is marked by the mischief done by their liberty. Consider what the advance of the delta of the Po in the Adriatic signifies among the Alps. The evil of the delta itself, however great, is as nothing in comparison of that which is in its origin. The gradual destruction of the harbourage of Venice, the endless cost of delaying it, the malaria of the whole coast down to Ravenna, nay, the raising of the bed of the Po, to the imperilling of all Lombardy, are but secondary evils. Every acre of that increasing delta means *the devastation of part of an Alpine valley, and the loss of so much fruitful soil and ministering rain.* Some of you now present must have passed this year through the valleys of the Torcia and Ticino. You know, therefore, the devastation that was caused there, as well as in the valley of the Rhone, by the great floods of 1868, and that ten years of labour, even if the peasantry had still the heart for labour, cannot redeem those districts into fertility. What you have there seen on a vast scale, takes place to a certain extent during every summer thunderstorm, and from the ruin of some portion of fruitful land the dust descends to increase the marshes of the Po. But observe further—whether fed by sudden melting of snow or by storm—every destructive rise of the Italian rivers signifies the loss of so much power of irrigation on the south side of the Alps. You must all well know the look of their chain—seen from Milan or Turin late in summer—how little snow is left, except on Monte Rosa, how vast a territory of brown mountain-side heated and barren, without rocks, yet without forest. There is in that brown-purple zone, and along the flanks of every valley that divides it, another Lombardy of cultivable land; and every drift of rain that swells the mountain torrents, if it were caught where it falls, is literally rain of gold. We seek gold beneath the rocks; and we will not so much as make a trench along the hillside to catch it where it falls from heaven, and where, if not so caught, it changes into a frantic monster, first ravaging hamlet, hill, and plain, then sinking along the shores of Venice into poisoned sleep. Think what that belt of the Alps might be—up to four thousand feet above the plain—if the system of terraced irrigation, which even half-savage nations discovered and practised long ago in China and in Borneo, and by which our own engineers have subdued vast districts of farthest India, were but in part also practised here—here, in the oldest and proudest centre of European arts, where Leonardo da Vinci—master amongst masters—first discerned the laws of the coiling clouds and wandering streams, so that to this day his engineering remains unbettered by modern science: and yet in this centre of all human achievements of genius no thought has been taken to receive with sacred art these great gifts of quiet snow and flying rain. Think, I repeat, what that south slope of the Alps might be; one paradise of lovely pasture and avenued forest of chestnut and blossomed trees, with cascades docile and innocent as infants, laughing all summer long from crag to crag and pool to pool, and the Adige and the Po, the Dora and the Ticino, no more defiled, no more alternating between fierce flood and venomous languor, but in calm clear currents bearing ships to every city and health to every field of all that azure plain of Lombard Italy. . . . . Without in the least urging my plans impatiently on any one else, I know thoroughly that this which I have said *should* be done, *can* be done, for the Italian rivers, and that no method of employment of our idle able-bodied labourers would be in the end more remunerative, or in the beginnings of it more healthful and every way more beneficial than, with the concurrence of the Italian and Swiss Governments, setting them to redeem the valleys of the Ticino and the Rhone. And I pray you to think of this; for I tell you truly—you who care for Italy, that both her passions and her mountain streams are noble; but that her happiness depends, not on the liberty, but the right government of both."

CAPTAIN FRED. BROME

WITH great regret we have to record the death of Captain Fred. Brome, formerly Governor of the Military Prison on Windmill Hill, Gibraltar, and well known to many of our geological and archæological readers as the able and indefatigable explorer of the ossiferous caves and fissures of the rock.

His explorations, an account of which, so far as they related to the human remains and relics, was published in the Transactions of the Congress of Prehistoric Archæology for 1868, were commenced in April, 1863, and unremittingly continued, often under considerable difficulties, to December, 1868, when he was most unaccountably removed from the post he had so long and so well occupied.

The amount of labour and responsibility thus voluntarily undertaken by Captain Brome, solely in the interest of science, and without any personal motive whatever, can scarcely be imagined, nor can the value of the results obtained by him be easily over-estimated.

A more striking instance of self-devotion to a purely scientific object can nowhere be found.

The results of Captain Brome's work may be said to have afforded all, or nearly all, the knowledge we possess of the priscan population of the Rock of Gibraltar, and have added enormously to our materials for determining the nature of its quaternary fauna, as disclosed in the ossiferous breccia and other contents of the rock fissures, from the examination of which Cuvier truly anticipated that the most important information would be derived.

Captain Brome's death occurred, we are sorry to say, under very melancholy circumstances. Having been removed from the post which he had so long and so usefully filled, and for which, from his great experience, extraordinary energy, and high sense of duty, he was so admirably qualified, he was appointed, on coming to England, Governor of the Military Prison at Weedon. Here he hoped to find an asylum for his family, and some compensation for the sacrifices he had been compelled to make in leaving Gibraltar.

But this was not to be. Amongst the numerous reductions of late effected in our military establishments, the disestablishment of the prison at Weedon was one. The notice that his services would be no longer required was received by Captain Brome a short time since, and it seems to have so affected him, from the apprehension that his family would thus be deprived of all support—and this after a public service of thirty years—that, although a strong and vigorous man, he gradually sank, from mental depression, as it would seem, and he may truly be said to have died of a broken heart on the 4th March, leaving a widow and eight children, we fear wholly unprovided for.

A more melancholy case, and one more deserving of the sympathy of the scientific world, and, as we should venture to hope, of the consideration of the authorities at the War Office, it is impossible to conceive. G. BUSK

THE GEOLOGY OF THE HOLY LAND

IN the year 1866 the Duc de Luynes organised an expedition for investigating the physical geography and geology of the Holy Land and part of the surrounding territories. Narratives of some features of the explorations have already been given to the world, but it is only now that the first part of the geological report appears. M. Lartet, the geologist of the expedition, has chosen as the vehicle of publication for his memoir, the opening number of a new magazine—the *Annales des Sciences Géologiques*. Instead of confining himself to a record of what he personally accomplished, he has with much labour given a brief summary of the publications of previous writers, and has incorporated their results with his own, so as to present in a clear and connected form the sum of all that is at present known regarding the geology of the country between Lebanon and the Red Sea. Until the whole of the memoir is published it would be premature to pass judgment upon the position which it will ultimately take in the geological bibliography of Palestine. The present instalment, after its introductory and historical sections, passes on to describe the igneous and crystalline rocks, leaving the great limestone and later formations for a subsequent paper.

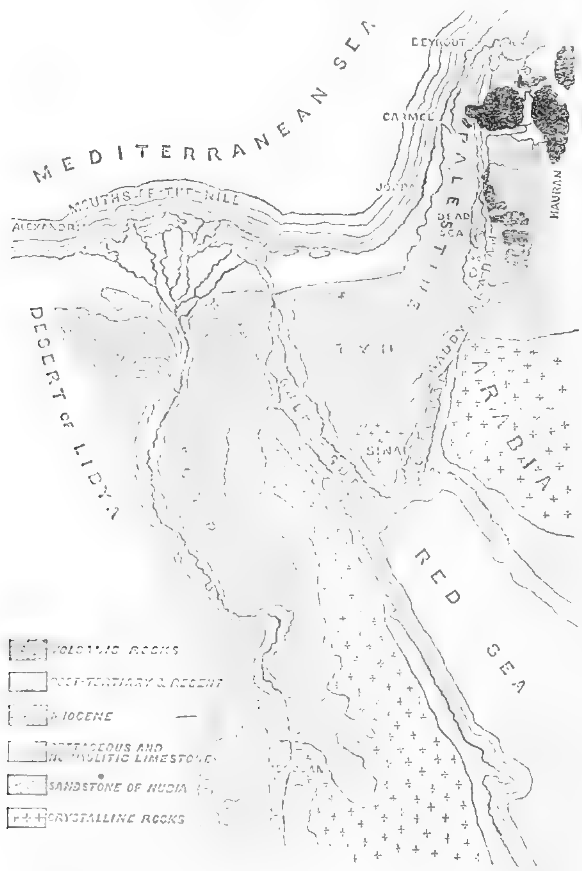
Viewed in the great scale, the geological structure of Palestine is remarkably simple. A long table-land or succession of table-lands, consisting for the most part of horizontal or gently inclined cretaceous and nummulitic limestones, is traversed by the valley of the Jordan, and cut through by transverse valleys, many of which are now quite dry. Stretching southwards into the peninsula of Sinai, these calcareous plateaux end against a mass of high rugged ground—the mountain-group of Sinai and Arabia—consisting of crystalline rocks. Here and there on the west side of the Jordan Valley, but much more markedly on the east side, the table-lands are roughened by rocks of volcanic origin. Everywhere there is evidence of vast denudation, whereby the plateaux have been cut into valleys and hills, and of a former climate when rain and river-water were much more developed than they are now.

M. Lartet describes at some length the crystalline rocks which enclose the upper end of the Red Sea, and enters into considerable detail regarding the mineral differences of these various rocks; but he touches with tantalising brevity upon their geological relations—a fault, however, which he shares with all other writers who have treated of the geology of these regions. We only learn from him that there is a central nucleus of granite round which are folded successive zones of gneiss and various schists and slates, and that all these rocks are pierced by intrusive masses of porphyry, diorite, melaphyre, serpentine, &c. From the granites and old intrusive rocks he passes, by what seems an abrupt and awkward transition, to the basalts and lavas, which are among the most recent of the geological formations of the country; and he then takes up the schistose rocks. This arrangement is much more a petrographical than a geological one. We cannot but think that it interrupts the chronological sequence of events which it is the business of a geologist to decipher and describe. The volcanic rocks were not erupted until the cretaceous table-lands had been long exposed to denudation. It would surely have been better, therefore, to have deferred the history of the eruptions until some account had been given of the rocks over which they took place.

There can be no doubt that Palestine and the surrounding countries have been the scene of powerful volcanic activity from a time which, though in a geological sense recent, is yet immensely remote when measured by human standards. In the Holy Land itself that action has now ceased, though abundant hot springs still testify to its recentness, while along the shores of the Red Sea there are even at this day some still active craters. On the west side of the Jordan Valley, the fertile plain of Esdraelon is strewed over with basaltic débris, while a little farther to the north and east, true *coulées* of basalt are found on the flanks of Little Hermon. Near Tiberias another *coulée* comes down from the west to the margin of the Lake; while still farther north stands the basaltic freshest traces of volcanic phenomena occur; some of the cinder cones still remaining with their enclosed craters like those of the Puys of Auvergne.

The long period during which volcanic action continued to manifest itself is well shown by the fact that the older basalts are found capping limestone plateaux which have since been cut through by valleys descending into the Jordan and the Dead Sea, while these valleys have served as moulds into which the later lava currents have, in numerous instances, been poured. Such a sequence of events is a repetition of the well-known structure of Auvergne. There is a further resemblance to the volcanic district of central France in the singular freshness of some of the cones.

But of all the geological features of Palestine, that which possesses, perhaps, the strongest interest is the



GEOLOGICAL MAP OF PALESTINE AND LOWER EGYPT

mass of Safed, which seems to have been the great volcanic centre of that district. But it is on the east side of the line of the Jordan and Dead Sea that the most remarkable display of volcanic rocks is to be found. The high grounds of Moab and Ammonitis are dotted with the sites of ancient volcanos, from which streams of lava have descended, sometimes even into the Dead Sea. The houses of Rabbath-Moab were built of these basalts. Farther north, from the heights of Ajlun, the eye travels over a vast basaltic plateau, which stretches north to the roots of Hermon and Anti-Lebanon, and eastward until it is crowned by the imposing volcanic mountain of Hauran. Some portions of these regions are dreary beyond expression—rough with dark rugged lava streams and scattered scoriæ, rendering the journey of a traveller slow and laborious. It is in this wild region that the valley or depression which stretches from Lebanon along the line of the Jordan, the Dead Sea, and the Waddi Akabah to the head of the eastern arm of the Red Sea. Notwithstanding the yearly increase of travellers in the Holy Land and the rapid multiplication of descriptions of the country, it must be owned that no very satisfactory account has yet been given of the geographical structure and probable origin of this, the most remarkable depression upon the globe. In the present part of his report M. Lartet does not discuss this subject, nor does he enter into the existing contour of Syria or the causes which may have led to the drying up of the Waddys and the general desiccation of the climate. These questions he will probably discuss in the next portion of his valuable memoir, to which we hope to call attention when it appears.

ARCH. GEIKIE

NOTES

WE are informed that it is probable that Dr. Sharpey, Prof. Huxley, and Sir John Lubbock will be among the members of the Royal Commission to inquire into the present state of Science in this country.

THE Society of Arts has resolved to hold a morning conference on the same subject, which will probably take place on Friday week. The council of the Society has requested Lieut.-Colonel A. Strange to open the discussion with a paper, the title of which will be "On the inquiry by a Royal Commission into the relations of the State to Science." We understand that the Society intends to invite the attendance at the conference of Her Majesty's present and late Ministers, of all members of the Legislature known to be interested in analogous questions, of the councils of all scientific societies, and of learned bodies generally.

IT is surely a sign of the times that we should be able to lay before our readers a scientific lecture delivered on a Sunday before a great audience, composed chiefly of the middle classes. The history—the all too short history—of English Sunday lectures is very curious and, withal, instructive. Some years ago the movement was commenced by lectures in St. Martin's Hall, which lectures, thanks to the activity displayed by "The Lord's Day Observance Society," were brought to a close somewhat suddenly. They were afterwards revived (such is the perfection of our English law) with impunity, by the simple process of enrolling the lecturers and their friends as a religious body! But many of those who had taken an active part in the origination of the lectures declined to shelter themselves under what they conceived to be an unworthy, as well as an unnecessary, subterfuge; and, believing that the law was really on their side, determined to take the earliest opportunity of obtaining experimental proof of the justice of their views. So we have had two movements—one, embodied in the Sunday Lecture Society, a lecture *pur et simple* being delivered each Sunday afternoon, and another, emphatically the working men's movement, in which the exact programme which was at first threatened with prosecution is reproduced. Both these movements have been in operation, and have been the means of doing much good, for some time past; and no attempt has been made to interfere with that "Free Sunday" which is of a good deal more importance to the working men of this country than even a "Free Breakfast-table." Surely one of those quiet victories by which each step in the march of real progress has been made good in English history, has been won.

A NEW mathematical journal, edited under the direction of MM. Chasles, Bertrand, Serret, Delaunay, Puiseux, Darboux, &c., is about to appear, under the name of *Bulletin des Sciences Mathématiques et Astronomiques.* Twelve parts will be issued yearly.

WE have received from Mr. Murray a pamphlet on Compulsory Education, by the Hon. Dudley Campbell, which is clear enough in treatment, and sound enough in argument to do great good at the present time, when the Government bill is before the country. It is very hard for a man of scientific training to bear with the shifts and compromises with which politicians are too often apt to cover their own shortcomings and lukewarmness, but in the matter of compulsory education there is less halting than usual. Mr. Campbell well points out that people are vaccinated and otherwise dealt with compulsorily for the public weal, and he asks why should this system stop just at the point where our lamentable backwardness points in the clearest way for the necessity of Government action. The country not only asks for compulsory education, but we are convinced in time that the system of local boards will be swept away. In connection with this subject we would call special attention to the fearful state to which the voluntary system has reduced education in Birmingham, Leeds, Liverpool and Manchester, as recorded in the reports of Messrs. Fitch and Fearon just presented to Parliament.

THE fund raised in this country for the benefit of the family of that great naturalist, the late Professor Sars, now amounts to 265*l*. 6*s*. 10*d*. Among the contributions from the provinces may be especially noticed those of Newcastle and Glasgow, showing the favour with which science is regarded in those places. Devonshire and Wales have hitherto given no sign, although it might have been expected that the last meeting of the British Association at Exeter would have left some impress of its visit. The French and Belgian subscriptions amount to 6283 fr. or 251*l*. 6*s*. 10*d*.

THE Lectures of the present year at the Royal College of Physicians will be delivered at the College, Pall Mall East, at five o'clock on each of the following Wednesdays and Fridays:—Goulstonian Lectures, by Dr. Maudsley, March 18. "On the relations between body and mind, and between mental and nervous disorders." Croonian Lectures, by Dr. Sibson, March 23, 25, 30, "On aneurisms of the aorta." Lumleian Lectures, by Dr. J. R. Bennett, April 1, 6, 8, "On the natural history and diagnosis of intra-thoracic cancer."

NOTICES of motion have been given by Mr. Strutt for a return relative to the expenditure of the Meteorological Committee, voted in Class 4 of the Civil Service Estimates, 1869-70; by Mr. Grant Duff for a copy of report on measures adopted for sanitary improvements in India; by Mr. Macfie for a select committee to consider and report on the law relating to letters patent for inventions; by Mr. Mundella of an amendment to Mr. Macfie's motion.

A NATURAL HISTORY SOCIETY has just been formed at Winchester College. The subjects it embraces at present are botany, ethnology, and geology, these being the most easy of access under the existing circumstances. One of the main objects of this society is the formation of a museum, which, it is hoped, will tend to keep up an interest in scientific subjects among the members of the school. The meetings have been largely attended, and there is every reason to expect that the society will prove a lasting benefit to the college.

WE must congratulate the Leamington Philosophical Society and its energetic president, Dr. O'Callaghan, upon the successful way in which they are doing the good work of fostering science in Warwickshire by means of lectures, and upon the fact that they can prevail upon such busy men as Mr. E. J. Reed and Sir Bartle Frere—to mention two of their recent lecturers—to help them. Mr. Reed's lecture on "Our Ironclad Navy" was given last week, and we hope to place some parts of it before our readers.

THE prospectus of the forthcoming course of instruction at the Working Men's College is a most gratifying one. Besides classes in Art, History and Law, Languages and Mathematics, we have the following in physical science:—The Use of the Microscope, Mr. J. Slade; Astronomy, Mr. R. B. Litchfield, B.A.; Muscular Anatomy of the Human Body, Mr. J. Beswick Perrin. Besides these classes, there are free general lectures at 8.30 on Saturdays, among which we note four on Crystals, by Prof. N. S. Maskelyne, of the British Museum. All should feel grateful to those connected with this institution who, without fee or reward, devote their small spare time to the arduous work of teaching.

WE regret to hear that Dr. Kirk, the indefatigable friend and former companion of Livingstone finds his efforts to send supplies to the latter paralysed by the presence of cholera on the East Coast of such severity that 10,000 have died in Zanzibar in the course of six weeks. He adds that "the scourge rages up and down the coast. At Quiloa, by the last accounts, there were 200 deaths a day among the slaves; when offered at one dollar a head they found no purchasers, so very worthless had slave property become from the disease. It is also going inland, which is strange, as it came to us from the interior, first showing on the coast at Pangani; now it goes in from Bogamoyo, and has reached Ugogo. Caravans on the route are stopped by death, ivory is left abandoned, and a party is being sent off to bring one large lot down, all the porters being dead in Ugogo. The expedition with valuable goods and a gang of men I sent off to assist Livingstone has been caught by it, and is at a standstill. Many of those I had engaged and paid considerable advances to are dead. There will be much loss this season, and Dr. Livingstone will come in for a share of it."

THE Working Men's Club and Institute Union have, with permission of the authorities, arranged for a series of visits to the national museums on Saturday afternoons, for the members of workmen's clubs. The important feature connected with these visits is, that in each case the party will be under the guidance of some gentleman specially qualified to afford instruction in some particular branch of science and art. A party of fifty workmen were thus enabled to pay a visit to the Egyptian Department of the British Museum on Saturday, under the guidance of Mr. Samuel Sharpe. We are informed that the "Club Union" will be very glad to have similar valuable services rendered by other gentlemen for visits to the national collections.

A LETTER has been received at Alexandria from Sir Samuel Baker, dated Khartoum, February 7, wherein he reports that 32 boats were collected together to convey him and his party to Gondokoro. With the last shipment of troops the total expeditionary force amounts to 700, including a battery of artillery. Mr. Higginbotham is reported to be within four days' march of Khartoum, having crossed the Nubian Desert. He has under his charge the steel steamers for the lake Albert Nyanza. Mr. Higginbotham has command of the rear expedition, and will follow Sir Samuel Baker immediately. All the members of the expedition are in good health and spirits.

THE *Pall Mall Gazette* states that the Arctic explorer, Mr. C. F. Hall, has, in a lecture given at Washington, developed his plans for a third voyage.

THE establishment of the first sewage farm in India has taken place in the vicinity of Madras. It is an experiment, but the results as given in the official report are most hopeful, both as regards the drainage of Indian towns and the profit likely to accrue from the operation. The site is an old swamp four feet only above the sea level; the soil is a stiff clay, mixed with much salt and a little sand—one of the worst possible soils for the purpose. The surface was levelled and protected from floods, and the sewage from Perambore barracks and a small portion of the adjacent village, after being raised 22 feet, is conducted in an open earthenware conduit, and floated over the surface of the ground. The total area is 37 acres, but about 2 acres only have been put under cultivation. The sewage is as thick as pea-soup, and sometimes more diluted. Its smell is overpowering close to the channel, but as it flows over the ground "it loses its offensiveness very soon." Various crops have been tried on the sewaged area. Guinea grass succeeds so well that its yield is at the rate of 88 tons of fresh grass, or 29 tons of hay per acre. The value is 58*l.* per acre. It is stated that grass will take any quantity of sewage, but that other useful crops, chiefly native vegetables, also succeed. Different plants require different treatment. Some of the best crops are native greens, which grow most luxuriantly and take a large quantity of sewage. The report states that the results to health have been satisfactory, and that one great source of disease has been removed. The application of the sewage of two other districts of the city was nearly completed at the date of the report.

CANDIDATES for the first chair of Algebra at the Paris Faculty of Sciences are requested to send in certificates.

MESSRS. MOXON AND CO. are preparing for publication a Dictionary of Science, edited by Mr. G. Farrer Rodwell. It will be uniform with Haydn's "Dictionary of Dates" and "Dictionary of Biography," and will comprise acoustics, astronomy, chemistry, dynamics, electricity, heat, hydrodynamics, hydrostatics, light, magnetism, meteorology, pneumatics, and statics. These subjects will be treated of by Mr. J. T. Bottomley, Lecturer on Natural Science in King's College School; Mr. William Crookes, Mr. Frederick Guthrie, Professor of Natural Philosophy in the Royal School of Mines; Mr. R. A. Proctor, Mr. Richard Wormell; and the Editor.

THE Paris Zoological Acclimatisation Society celebrated their seventeenth anniversary last week in the Hôtel de Ville. Dr. Hooker was unanimously elected an honorary fellow, and the following prizes were awarded:—The gold medal offered to the society by the Minister of Agriculture and Commerce to M. Carbonnier, for the introduction of Chinese fish; another gold medal to M. Vekemans, the director of the Zoological Gardens at Antwerp; grand gold medal to M. Alfred Grandidier for his travels in Africa and America; a prize of 500fr. for the theoretical researches of M. Verreaux on acclimatisation subjects; a similar prize for works of pure zoology to the late Professor Sars for his publication on the littoral fauna of Norway and the development of sea-fish; a prize of 200fr. was also awarded to M. E. Gayot for his essay on *Leporides*.

THE Liverpool Naturalists' Field Club held a soirée at the Royal Institution on the 11th instant, the Mayor and about two hundred members and friends attending. The principal objects exhibited, interesting in a natural history point of view, were a very large collection of British plants beautifully mounted by Mr. Gibson, sen., a member of the club; an interesting case of spiders found in the neighbourhood, preserved in spirits in flat glass bottles, and very effectively displayed by Mr. H. Higgins, son of the president; a selection of valuable shells lately presented to the Free Museum by Mr. Samuel Smith; young salmon; case illustrating anatomical structure of the elephant, &c.; the largest known Nudibranch and the largest known Foraminifer, both taken alive by Dr. Collingwood in the China seas—from the Free Museum; a case of sections of Brazilian creepers, showing curious abnormal structure, specific names unknown—by Mr. Robert Holland. Members of the Microscopical Society illustrated various subjects. A spectroscope and micro-spectroscope were worked by the secretary, Mr. Stearn; and the evening concluded with some chemical experiments bearing on Prof. Tyndall's "Dust and Disease" article in *Fraser*, by Mr. Davis, F.C.S.; the exhibition of Geissler tubes, a number of insects, &c.

AT a recent meeting, the Natural History Society of Montreal presented its medal to Sir William Logan, the distinguished geologist. The following resolution was passed:—"That this Society, in presenting its medal to Sir W. E. Logan, LL.D., F.R.S., although it cannot add appreciably to the many honours which he has received, desires to place on record, not merely on its own behalf, but on that of all the students of Natural Science in Canada, its high estimation of the value of his services in creating as well as directing the Geological Survey of this country, in promoting the development of its mineral resources, in stimulating and aiding the efforts of scientific institutions, and in extending throughout the world the name of Canadian science. We desire also to express our high appreciation of Sir William's admirable qualities, and our hope that he may be spared for many years to Canada and to science, and that the relief from official cares may give him the opportunity to pursue to completion the researches in scientific geology in which he is now engaged."

WE are glad to see that meetings are being held in support of Mr. W. S. Allen's motion in the House of Commons to open museums on week-day evenings. We know of no argument against the experiment, and we believe the experiment would be an entirely successful one.

THE infallibility of photographic reproductions, says the *Photographic Journal*, cannot be prized too highly. In the copying of elaborate tabular forms, containing numerous figures and intricate calculations, the aid of the camera is sometimes of the greatest importance. To obtain an exact and reliable copy of a complex document of this description by clerical means involves much time and labour, beyond the chance and risk of error; but with the camera a reproduction may be secured in a couple of hours, in which all the figures are exact, the totals correct, the calculations checked, the words spelt right, and to which the observation "certified a true copy" may be appended without hesitation.

THE Vicar of Cushendun, county Antrim, communicates the following to *Science Gossip*:—"The following incident was told me the other day by a resident, who vouches for the truth of it, and which happened close to his residence in Cushendun, county Antrim. A rat, nearly white with age, and blind, was frequently seen led to the water by a young rat, by means of a straw, of which the old rat held one end and the young rat the other. This incident corroborates a similar statement given by Jesse in his 'Gleanings of Natural History.'"

SCIENTIFIC SERIALS

THE new number of the *Zeitschrift für Biologie* (VI. i.) contains an interesting paper by Subbotin "On the Physiology of Fats." Towards an answer to the question—Is there in the animal organism any direct passage of fat from the alimentary canal to the cells of adipose tissue? a lean dog was fed for a month on meat, spermaceti, and common fat. Of the 1,000 grms. of spermaceti swallowed, 800, at least, were absorbed; but the merest trace only of spermaceti could be found in the fatty tissue of the body at the close of the experiment. Spermaceti, therefore, though absorbed and consumed in the economy, is not stored up unchanged. Hence there is a presumption that the same is the case with other fats (though it is obvious that many possible events might negative the presumption). Towards solving the further question—Are fats formed in the body out of proteids? a dog reduced to the utmost leanness was fed on leanest meat and palm oil (palmitin and olein) for twenty-five days, during which he gained three kilos in weight. The fat of the body was, at the close, found to contain 13·9 per cent. of stearin, though none had been taken. A very considerable quantity of stearin had therefore been formed in the body. A very lean dog was fed for six weeks on leanest meat, and a soda soap made with palmitic and stearic acids only. At the end of the experiment, the dog having gained over three kilos in weight, the fat of the body was found to consist of 53·6 per cent. palmitin, 13·4 per cent. stearin, and 33 per cent. olein. A large quantity of olein had therefore been formed in this case. But if olein was thus formed, possibly the palmitin and stearin were likewise formed from proteids, and not by synthesis of the fatty acids with the glycerin of the economy. Subbotin further points out that olein is more abundant in the sub-cutaneous than in the deep-seated fat, possibly on account of a less energetic transformation of proteids in the cooler surface regions. So also in cold-blooded animals the fat is proportionally richer in olein.—The same number contains a long paper by Vierordt, in which that distinguished physiologist continues his researches on the connection between the delicacy of touch and mobility of any part of the body. In this memoir he confines his attention to the arm from the shoulder downwards, working upon data provided by his pupils Kottenkamp and Ullrich, who have made a study of the sense of touch in all parts of the arm, to a much greater extent and with much fuller detail than did Weber, and whose elaborate results are given in a paper immediately preceding Vierordt's. In the arm Vierordt finds striking illustrations of his hypothesis that the delicacy of touch in any point in a region of the body which is moved as a whole, is proportional to the distance of the point from the centre of movement of the region. There are also hygienic papers by Pettenkofer and others on the cholera epidemic of 1865 at Gibraltar, and typhus and drinking water at the barracks at Neustift.

The *Journal of Botany*, New Series, No. 1 (double number for January and February, 1870), contains the following articles:—"Suggestions on the 'Species' question as regards *Rubus*," by the Hon. J. B. Leicester Warren; "Notes on *Quercus Wallichiana* Lindl," by Dr. Hance; "Descriptions of four new Chinese *Crassulaceæ*," by Dr. Hance; an interesting and important "Review of the contributions to Fossil Botany, published in Britain in 1869," by Mr. Carruthers, containing references to all papers on vegetable palæontology published in Britain during that period, with observations and a synopsis of the genera and species described in them. "Cinchona cultivation in Bengal," being an official report from Mr. C. B. Clarke, officiating superintendent of the Botanic Garden at Calcutta, and in charge of the Cinchona cultivation in Bengal, for the year ending March 31, 1869. It appears from this report that during the year the number of plants of Cinchona at the Darjeeling Government plantations was increased by 673,654, making a total (including those in private plantations) of upwards of three million plants, covering 965 acres. By far the larger number of plants are of the species *C. officinalis* and *succirubra*, with a few of *C. Calisaya* and *micrantha*, *C. Pahudiana* being considered worthless. The tallest plant of *C. succirubra* is 19 feet high, and of *C. officinalis* 11¼ feet. There is besides a small plantation of *C. succirubra* at Nunklow, in the Khasia Hills. "Review of the genus *Narcissus*," by Mr. J. G. Baker. An abridgment and translation by Mr. A. W. Bennett of Van Horen's paper in the *Bulletin de la Soc. Roy. de Bot. de Belgique*, "On the hibernation of Lemnaceæ," showing the production in several species of duck-weed of submerged leaves adapted to live through the winter. "The genus *Ascobolus*," by M. Boudier, from the *Annales des Sciences Naturelles*. Reviews of books, proceedings of societies, and shorter articles.

The *Geological Magazine* for the present month (No. 69) opens with an article by the editor on the Liassic Pterodactyle (*Dimorphodon*) as described by Professor Owen in the volume of memoirs just published by the Palæontographical Society. The most important paper in the number is one by Mr. Poulett Scrope, "On the character and composition of lavas," and next to this, in general interest, two articles on "Faults in Strata," by Mr. W. T. Blandford and Mr. G. H. Kinahan.—Two of the remaining papers are by lady geologists, namely, a description of the Pleistocene deposits of North Shropshire, by Miss Charlotte Eyton, and a notice of vegetable fossils in the Water Blain iron mines in South Cumberland.—A paper on "The Water-bearing Strata in the neighbourhood of Norwich," by Messrs. Taylor and Morant, contains some remarks upon sand-pipes in the chalk; and the final article is the conclusion of Mr. Davies' paper "On the Millstone Grit of the North Wales Border."—The usual notices of memoirs, reports of proceedings, letters, and miscellaneous intelligence make up the rest of the contents.

Revue des Cours Scientifiques, March 8.—This number contains a report of the congress of German naturalists and medical men at Innspruck; a paper on "Alsace during the Tertiary period," read by M. Delbos at the Mulhouse Conferences; a review of M. Gréhant's researches on the excretion of urea and on the respiration of fish, also a fifth list of subscribers to the Sars fund.

The *Revue des Cours Scientifiques* for the 12th inst., contains an admirable lecture by M. Wolf, of the Paris Observatory, on the Figure of the Earth, and a translation of Dr. Tyndall's lecture on Dust and Disease.

Moniteur Scientifique, February 15.—This number contains several abstracts of papers on dyeing materials, by Messrs. Hofmann, Martius, and Weidel.—A paper descriptive of the peat at Avigliana, near Turin, by MM. Kopp and Fino, shows that, in the air-dried state, its efficacy as fuel is little more than one-fourth that of coke.—In a paper by M. Fremy on nitrous acid, he points out the production of nitrous oxide by the reaction of nitrous acid with sulphurous acid, regarding this as one of the causes of loss in the manufacture of sulphuric acid, when there is an excess of sulphurous acid in the chambers. In the reaction of nitric acid with nascent hydrogen, he has ascertained the production of another substance besides nitrous acid and ammonia. By means of sodium amalgam he obtained it in large quantity but not sufficient for complete examination. Arsenious acid and arsenites give, with sodium amalgam, a similar product. Both the nitrogen and arsenic compounds are characterised by a remarkable reducing power. M. Fremy is continuing his examination of the subject.

THE FOREFATHERS OF THE ENGLISH PEOPLE *

THE English people of the present day present two types of physical structure, which are extremely different in their most marked forms, though they pass into one another by every shade of gradation. The one type is tall, fair-complexioned, yellow or red haired, and blue-eyed; the other, short, dark-complexioned, black-haired, and black-eyed. The two types and their intermediate gradations are, at present, to be found side by side in most parts of the British Islands; but there is a marked predominance of the fair type in the eastern half of Britain. The languages spoken by the English people have, at the present time, no relation to these two physical types; English speakers and Celtic speakers belonging no less to the one type than to the other. Nor are the two Celtic dialects, Cymric and Gaelic, confined to people of the one or the other physical type, as both the types described are exhibited in their extreme forms among Welshmen, Highlanders, and Irishmen.

The earliest historical records of the nature of the population of Britain, furnished by Cæsar, Strabo, and Tacitus, take us back nineteen hundred years, and show that, at that time, the physical characters of the population might be described in the same language as at present. The people of South-eastern England and of Caledonia were certainly tall, fair, and blue-eyed, with hair varying from yellow to red in hue; while, in South Wales, they had dark hair and complexions, resembling the Spaniards of that day. But there was a wonderful difference in language between the ancient and the modern inhabitants of these islands, inasmuch as all these people of Britain, so far as we know, spoke the Cymric dialect of the Celtic tongue; while it is probable, though we have no absolute knowledge on this point, that in Ireland they spoke Gaelic. Thus, at the time of the Roman invasion, the outward physical characters of the population of these islands were much what they are now, though the language spoken was, probably, altogether Celtic. And there was no parity between the distribution of the Cymric and Gaelic dialects of the Celtic and that of the two physical types, any more than there is now between English and Celtic and the fair and dark stocks by which those languages are spoken. If we confine our attention to the British Islands, therefore, we have absolutely no means of ascribing any special physical characters to the Celtic-speaking people. A British, or Irish, "Celt" might be tall or short, dark or fair, rounded-headed or long-headed; and the remark of Professor Max Müller that it is as rational to speak of a dolichocephalic language as of a Celtic skull is, for the "Celts" of Britain, perfectly justified.

Whence was this Celtic-speaking people, with its two contrasted dark and fair forms, which inhabited Britain nineteen hundred years ago, derived? The position of the British Islands is sufficient to suggest the extreme probability that it migrated from Europe, the eastern and the southern faces of these islands being within easy reach of the shores of those countries which are now Norway, Denmark, North Germany, Holland, Belgium, and France. And the probability suggested by the facts of geography becomes converted into a certainty by those of ethnology and of history.

In the first place, if we turn to the existing population of the continent of Europe and Asia, we shall at once recognise our two physical types—the fair and the dark. From Norway to North-eastern France the predominant constituents of the riverain population of the North Sea and of the British Channel are tall, fair-haired, and blue-eyed. In North-western France the proportion of short and dark people increases, until, in Southern and South-western France, they are the chief constituents of the population. A traveller who should set out from the Orkney Islands and call at every port in the North Sea, and who then should make a land journey from the mouth of the Elbe to that of the Don, would find the people with whom he met to be generally, and in many regions exclusively, of the fair type. On the other hand, if he set out from Galway and cruised along the western coasts of these islands, and of France and of Spain and the north shore of the Mediterranean, he would find as marked a predominance of the dark type. In fact, the population of the southern and western parts of France, of Spain, of the Ligurian shore, and of Western and Southern Italy, is as generally dark as that of North Germany is fair.

There is no reason to think that climatal conditions have had anything whatever to do with this singular distribution of the fair and the dark types. Not only do the dark Celtic-speakers of the Scotch Highlands lie five or six degrees farther north than the fair Black-foresters of Germany; but, to the north of all the fair inhabitants of Europe, in Lapland, there lives a race of people very different in their characters from the dark stock of Britain, but still having black hair, black eyes, and swarthy yellowish complexions.

Thus, having regard only to physical characters, the population of Europe falls into three broad bands, which run in a rough way from west to east. In the north is the zone of the black-haired, black-eyed Mongoloid Lapps. In the south is the zone of the people who resemble the dark type of the British Islands, and who have been called *Melonochroi;* between them lies the broad belt of fair people, who have been termed *Xanthochroi.* And if this were a mere natural history question, the facts I have mentioned would allow us to draw but one conclusion as to the origin of the population of these islands—namely, that the dark type has been furnished by immigrants from the Continental *Melanochroi;* the fair type by immigrants from the Continental *Xanthochroi.* But history and philology have every right to be heard in such a matter as this; and I must now try as well as I can (for I am neither historian nor philologer) to put before you what they have to say.

What history tells us, so far as it goes, is quite in accordance with the suggestions of biology. It is certain that, from the fifth century to the tenth a vast number of people from North Germany and Scandinavia poured into the British Islands on all sides, but, as might be expected, most persistently and numerously into the eastern moiety of Britain. They brought with them languages which may properly and conveniently be termed dialects of Teutonic, in contradistinction to the indigenous dialects of Celtic. Out of the North German dialects the language usually known as Anglo-Saxon was developed, and from it, by subsequent modification and absorption of, for the most part, Scandinavian, Celtic, and French elements, has grown English. The invasion which thus changed the language of Britain introduced no new element into the physical conformation of the people, so far as stature and complexion are concerned, though it may have done so in the matter of cranial conformation. It is unquestioned that Saxons, Danes, and Norsemen were alike a tall, fair-haired people; and their immigration strengthened the Xanthochroic element of our population, but added nothing new, unless it were a longer form of head. It is a very remarkable circumstance that the skulls of the existing Scandinavians—and of the Allemanni and Saxons, if not of the whole of the ancient Germans—are long, while those of the South Germans and Swiss of the present day, and those which very probably belonged to the ancient Belgæ, are round. Thus, to put the matter in another way, tall stature, fair hair, and blue eyes, in a native of Britain, are no evidence of his descent rather from the primitive Celtic-speaking, than from the immigrant Teutonic-speaking, element of our population, or the reverse. He is as likely to be a "Celt" as a "Teuton;" a "Teuton" as a "Celt."

But history teaches us more than this. There is the clearest evidence that the Gauls—the Celtic-speaking people who burnt Rome nearly four centuries before our era—belonged to the fair type, and neither by their stature, their complexions, the colour of their eyes or their hair, were distinguishable from such Teutonic-speaking people as the Goths, who sacked Rome four centuries after it: and that, for these eight centuries at any rate, North-western, Central, Eastern Europe, and the western part of Central Asia were occupied by a tall, fair, blue-eyed people* who were known by the names of Celtæ, Belgæ, Germani, Venedi or Wends, and Alani, according to the districts which they occupied and the languages which they spoke.†

Thus, when history first makes known the Celtic language to us, it is in the mouths of a people extremely similar in their outward appearance to the Germans and the Slavonians; and when the affinities of the Celtic, the Teutonic, and Slavonic languages are worked out by the philologer, they are all found to belong to the same great group of Aryan languages. The argument to be drawn from the physical affinity of the Celtic-speaking with the

* A Lecture delivered by Prof. Huxley, in St. George's Hall, on Sunday, March 13, and revised by the author.

* The story told by Suetonius, that Caligula tried to pass off some tall Gauls for Germans, by making them redden their hair, is often quoted to prove that the hair of the Gauls differed from that of the Germans. But as the Germans themselves were in the habit of reddening their hair artificially, the force of the argument does not appear.

† Those who have any doubts upon this subject had better consult the great work of Kaspar Zeuss, "Die Deutschen ünd die Nachbarstämme," published thirty years ago; or the excellent discussion, mainly based upon Zeuss, in Pritchard; or the instructive essays of Brandes and De Belloguet.

Teutonic-speaking people is therefore supported and intensified by the linguistic affinities between the Celtic and the Teutonic tongues; and philology concurs with history in testifying to the ethnic unity of the Celtic-speaking people on the left bank of the Rhine, with the Teutonic-speaking * people to the eastward. In their clothing, in their arms, in their houses, in their employment of horses and wheeled carriages, no differences of moment obtain between the Celtic-speaking and the Teutonic-speaking people of old Europe; nor in their fashion of government, their social organisation, their morality,† or their theology, do there seem to be any greater differences than are readily accounted for by the fact that the Teutonic-speaking nations were more remote from the corrupting influences of wealth and civilisation. The Tonga islanders of Mariner's time offered the same contrast to the Tahitians that the Germans of Tacitus do to the Gauls, but no one would dream, on that ground, of declaring them to be of different races.

Hence, there can be no reasonable doubt, that the fair element of the Celtic-speaking population of these islands 1,900 years ago was simply the western fringe of that vast stock which can be traced to Central Asia, and the existence of which on the confines of China in ancient times is testified by Chinese annalists. Throughout the central parts of the immense area which it covers, the people of this stock speak Aryan languages—belonging, that is, to the same family as the old Persian or Zend, and the Sanskrit. And they remain still largely represented among the Affghans and the Siahposh on the frontiers of Persia on the one hand, and of Hindostan on the other. But the old Sanskrit literature proves that the Aryan population of India came in from the north-west, at least 3,000 years ago. And in the Vedas these people portray themselves in characters which might have fitted the Gauls, the Germans, or the Goths. Unfortunately there is no evidence whether they were fair-haired or not.

India was already peopled by a dark-complexioned people more like the Australians than anyone else, and speaking a group of languages called Drawidian. They were fenced in on the north by the barrier of the Himalayas; but the Aryans poured from the plains of Central Asia over the Himalayas, into the great river basins of the Indus and the Ganges, where they have been, in the main, absorbed into the pre-existing population, leaving as evidence of their immigration an extensive modification of the physical characters of the population, a language, and a literature.

Italy is to the Alps what Hindostan is to the Himalayas. The Po is its Ganges. Four centuries B.C. it was peopled mainly by the dark and short stock represented by Ligurians, Etruscans, and old Italians. The Gauls poured into it over the north-western passes, and settled in Cis-Alpine Gaul, modifying the physical characters and the language of the population, but becoming lost eventually in the great Roman nationality. And, doubtless, in more ancient times, the Aryan-speaking ancestors of these Celtæ and Belgæ had similarly made their way through the Hercynian forest or along the shores of the North Sea, into Gaul, and thence into Britain. The correspondence of the names of places in Gaul and ancient Britain fully confirms Cæsar's statement that the Belgic Gauls had, at some comparatively recent time, colonised south-eastern Britain in great numbers. But the primitive colonisation of Britain from the mainland by the fair people is doubtless of extreme antiquity.

I have now, I believe, accounted for the fair Celtic-speaking population of ancient Britain. There remains the problem, Why did Britain contain another Celtic-speaking population, of a totally different type?

The key to this riddle is, I believe with Dr. Thurnam, De Belloguet, and others, afforded by history and philology. History, which tells by the mouths of Cæsar, Strabo, and Tacitus, that the Aquitani, who lived beyond the Garonne, were a small and dark people like the Iberians, who spoke a language different from that of Gaul. Philology, which tells us that this language was the Euskarian, represented by the modern Basque, which is unlike every other European language, and which once covered a vastly greater area than it now occupies—the great majority of the people who once spoke it having acquired other languages.

* I use this phrase without prejudice to the much-debated question, Did the Germans of Cæsar and Tacitus speak "Deutsch" (not 'Dutch,' *pace* Mr. Freeman) or Celtic? and with the greatest respect for the champions of both "Keltenthum" and "Deutschthum." It is enough for me if nobody doubts the "Deutschheit" of the Goths and Alemanni.

† The grossest immorality with which the Gauls are charged may well enough have been imported by the Greeks of Massilia along with other products of Greek civilisation.

Thus, once more, physical and philological ethnology properly viewed, concur. The physically distinct stock turns out to be linguistically distinct—to have, in fact, all the ethnological characters of a distinct race.

In Spain, and within the boundaries of the old Aquitania, the Euskarian language lingers only among a fragment of the population, though the Spaniards and southern Frenchmen retain, to a great extent, the dark complexion and short stature of the Melanochroic stock. In Britain the same process of extinction seems to have been consummated as far back as the time of Tacitus. For from what has been said, it can hardly be doubted that the Silures and the dark type in general were the outliers of the continental Euskarian-speaking dark type, just as the British Belgæ, and the fair type in general, were the offshoots of the continental Celtic-speaking fair type. And just as in Western and Middle Gaul, and in Spain, the Celtic-speaking fair people had, even in the time of Cæsar, largely supplanted and absorbed the dark stock; so, in Britain, it is to be supposed that it had altogether absorbed it, and that the dark stock had given up their Euskarian for the Celtic language.

All these reasonings may be put into the form of a probable hypothesis, as follows:—The chain of the Alps, the densely wooded highlands of Central Europe known in old times as the Hercynian forest, and the broad Rhine in its lower course, form a natural rampart between the vast central plains of Eurasia and Western and Southern Europe. Before England was peopled by the ancestors of its present population, the latter region, including the north shore of the Mediterranean, Spain, and Gaul (and perhaps the shores of the Baltic) were occupied by people of the dark type, who may, by possibility, have been the chief people of the so-called bronze age in those parts. These people occupied the British islands wholly or in part, and were, very probably, at first their sole occupants. And in Spain, France, and Britain they spoke Euskarian dialects.

During this time the fair stock, with its Aryan languages, wandered over the great Eurasiatic plain to the east of the rampart, from Poland to the frontiers of China, and from Siberia to those of Persia and India. But at length the fair people found their vast plains too narrow, or the luxuries beyond its natural barriers too tempting, and they began to overflow—as Celtic-speakers into Western Europe; as Zendic and Sanskritic speakers into Persia and Hindostan. The Celtic-speaking fair people, passing into Gaul, partly extirpated and partly mixed with the pre-existing dark Euskarian-speaking population, imposing their language and habits on all the northern, middle, and eastern parts of Gaul, and extending widely into Spain. From Gaul they passed into Britain, and Celticised it still more completely; so that, though much of the old blood of the dark stock remained, its language vanished.

The Teutonic-speaking people were simply another wave of the same great Aryan ocean of Central Eurasia. They treated the Celtic-speakers exactly as the latter had treated the dark stock, and before another century has passed the Celtic language will probably be as much a thing of the past in these islands as the Euskarian is.

If this is a fair picture of the general course of events, it furnishes the explanation of the fact from which we started, namely, the presence in the British Islands of two distinct ethnical elements—a fair and a dark.

T. H. HUXLEY

ASTRONOMY

Ephemeris of the Satellites of Uranus

By A. Marth, Esq.

Angles of Position at 8^h Greenwich Mean Time

1870 Mar.	Ariel. °	Umbriel. °	Titania. °	Oberon. °	1870 Mar.	Ariel. °	Umbriel. °	Titania. °	Oberon. °
17	250	243	277	159	29	340	283	144	192
18	114	162	229	135	30	191	193	100	169
19	330	71	189	100	31	47	115	51	146
20	181	347	154	75	April				
21	35	257	114	44	1	271	19	11	120
22	255	172	65	18	2	132	302	336	90
23	120	86	22	355	3	345	205	297	58
24	335	357	346	333	4	190	128	249	29
25	180	274	310	303	5	53	31	204	5
26	41	182	263	278	6	278	314	169	343
27	264	101	216	246	7	137	217	132	320
28	126	8	179	216	8	350	141	86	293

The Apparent Distances vary between the Limits.

Ariel	15″	and	12″
Umbriel	21″	,,	16″
Titania	35″	,,	27″
Oberon	46″	,,	36″

BOTANY

Floating Leaves of Marsilea

PROF. HILDEBRAND has noticed that if a plant of *Marsilea quadrifolia* (a species of the genus which furnishes *Nardoo*), is sunk beneath the surface of the water, so that all the leaves are more or less deeply covered, those leaves which are fully developed at the time of immersion, remain unchanged, while those which are not so far advanced, undergo a remarkable change; the petioles gradually lengthening in succession according to their position on the stem, and soon over-topping those which were already formed. At first the four leaflets do not increase, but they soon begin to enlarge, and by the time the surface of the water is reached, they exceed in size the ordinary leaves, forming a four-rayed star on the surface. While the petioles of the ordinary leaves are stiff, so that they stand erect out of the water, these floating leaves are weak and flexible, like those of water-lilies, allowing the leaf to maintain its position on the surface with the rise and fall of the water. Their upper surface is shining and coated with wax, so that the water flows off them. If immersed in deeper water, the petioles will lengthen still further, even to the extent of three feet. In these cases the formation of the organs of fructification appears to be suppressed. In the ordinary aërial leaves, stomata are found on both sides of the leaf in about equal numbers; in the floating leaves, on the other hand, the under side is entirely destitute of stomata, while on the upper surface they are about three times as numerous as in the aërial leaves; thus resembling *Nymphæa, Hydrocharis,* and other plants. (Botanische Zeitung.)

Alternation of Generation in Fungi

M. GAURIEL RIVET records in the *Bulletin de la Société Botanique de France* a remarkable illustration of this phenomenon in some very interesting observations on the "rust" of cereals. He finds that the Fungus which causes one of the common forms of this disease, *Puccinia graminis,* will not reproduce itself, but that if the spores are sown on the leaves of the common berberry, they give rise to the well-known orange spots of *Œcidium Berberidis,* generally considered as a fungus belonging to an entirely different group. The spores of the *Œcidium,* on the other hand, do not reproduce itself, but the *Puccinia,* thus furnishing a striking instance of alternation of generation. The connection of the berberry with the prevalence of rust in wheat was noticed by Sir Joseph Banks as long ago as 1806. In the commune of Genlis (Department of Côte d'Or) a railway company not long since planted a berberry hedge on one of its embankments; immediately the crops of wheat, rye, and barley in the neighbourhood became infested with rust. The remonstrances of the farmers caused the appointment of a commissioner to inquire into the subject, who, after a full inquiry, reported that wherever the berberry is planted the cereals are more or less attacked by rust; where they are absent the crops are free from disease, and that the planting of a single berberry bush is sufficient to produce the rust where it has never appeared before.

PHYSICS

Products of Respiration

PETTENKOFER and VOIT have been making some observations, by the help of their famous dog, on the products of respiration during starvation and during a diet entirely composed of fat. They find the most notable effect of the fatty food to be *a diminution of the oxygen consumed.* Thus in one series, on the 6th and 10th days of a period during which nothing but water was taken, the oxygen consumed amounted to 358 and 302, the carbonic acid given off to 366, 289 grammes respectively. On the 2nd, 3rd, and 8th days of a similar series the quantities were of oxygen consumed 371, 358, 335; of carbonic acid given off 380, 358, 334 grammes. When, on the other hand, 100 grammes of fat were taken daily, the 8th and 10th days of the series gave respectively 262, 226 grammes of oxygen consumed, 302, 312 grammes of carbonic acid exhaled. (Zeitschrift für Biologie, bd. iii., p. 369.)

In these observations Voit finds support of his views on the nutritive influence of fat, and bases on them an explanation of Bantingism. To bring down a fatty body, he says, we must get it to take in a larger supply of oxygen. This can best be done by cutting off all the fat and carbo-hydrates and increasing the quantity of proteids. The effect of increasing the proteids is to augment the metamorphosis taking place in the blood and diminish the storing up of material in the tissues in the shape either of flesh or fat. The store of fat existing in the body is consequently more and more encroached upon, and in spite of the great metamorphosis taking place in the circulation, the body continues to get lean. A very long discussion on the *modus operandi* of fat as food (of which the above forms a small part only) will be found at p. 329.

The same observers have also examined the respiratory products in the case of a man suffering from Leukaemia, a disease in which there is an undue abundance of white corpuscles and scantiness of the oxygen-bearing red ones. They find, however, no marked difference in the respiratory products; in amount these closely approximate the standard of health. (Ibid. p. 319.)

G. Quincke on Specific Cohesion and Capillarity Constants

VARIOUS bodies were formed into drops, which were allowed to fall on a platinum or porcelain plane; after they had acquired the temperature of the surrounding air, certain measurements were made of their dimensions. The square of the vertical distance in millimeters of the upper surface of the drop from the vertical element of its meridian curve is the constant of specific cohesion, from which, by a method of calculation stated by the author, the capillarity constant can be inferred.

Fused substances of similar chemical composition, and at a temperature very near to their melting point, have the same specific cohesion.

Water, carbonates, and sulphates in the liquid state have double the specific cohesion of mercury; the same is true for the nitrates, metallic chlorides, sugars, and fats; metallic iodides and bromides have only half the mercurial value.

Lead, bismuth, and antimony have the same specific cohesion as mercury; platinum, gold, silver, cadmium, tin, and copper twice that amount; zinc, iron, and palladium thrice, and sodium six times the specific cohesion of mercury.

PHYSIOLOGY

Microcephalous Children

DR. BUCHNER has measured lately the *crania* of two *microcephalous* children, and by way of comparison adds the cranial measure of his own healthy infant son.

	Helena Becker.	Sophia S.	W. Büchner.
Age	6½ years.	3 years.	3 years.
Circumference of head.	13½ inches, Rh.	16¾ inches.	20½ inches.
From ear to ear .	6½ ,,	10 ,,	12½ ,,
From root of nose to occipital protuberance	8¾ ,,	10½ ,,	14 ,,

In both cases the size of head has apparently remained stationary from birth, and both children were born with closed *fontanelles.* One of the children is now exhibited at Darmstadt. Her height is 3½ feet; she cannot speak, walk, or stand, or seize hold of anything; in fact she is in a state of complete helplessness, with involuntary action of bladder and rectum. The upper portion of her skull, not larger than a man's fist, roof-like, flattened at the sides; the absence of forehead, a long aquiline nose terminating in a sharp point, an exceedingly diminutive receding chin, and a mouth with irregularly set teeth, with the orbital regions very prominent, give her quite an animal aspect. The mental phenomena are below zero; and the senses, though seemingly active, produce no ideas; her look is staring, vacant, devoid of expression; only bright shining objects and music attract her attention; she does not laugh but utters inarticulate animal sounds. Another characteristic feature is, that her limbs and head are subject to an involuntary unceasing agitation, like the reflex movements of a decapitated frog; she suffers also from a great want of sleep.

DR. OMANZA describes a method of registering photographically the beats of the pulse. The apparatus essentially consists of a small inverted funnel, having a long narrow stem and a caoutchouc base. This instrument is filled with mercury to a certain distance up the stem, and its base is applied to the heart or an artery; the oscillations of the mercurial column are then photographed by well-known processes. It is said that with this apparatus the apparently single stroke of the pulse is shown to consist of three, or even four, in succession.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 3.—The following papers were read: "Results of the monthly observations of dip and horizontal force made at the Kew Observatory from April 1863 to March 1866, inclusive," by Dr. B. Stewart. The author exhibited tabular statements of dip observations during six years, from which was deduced the existence of a semi-annual inequality, in virtue of which the dip is on an average 0′·27 lower in the six months from April to September, and 0′·27 higher in the six months from October to March than is due to its mean value. This result is in the same direction as that found by Sir E. Sabine for the six years ending March 1863, but is less in amount than the latter, that determined from the first six years exhibiting a range of 1′·31, while that determined from last six years only exhibits a range of 0′·54. From the first six years we deduce a mean dip equal to 68° 20′·07, corresponding to middle epoch April 1, 1860, and from the latter six, a mean dip equal to 68° 6′·62, corresponding to middle epoch April 1, 1866, while the secular change deduced from the first series is 2′·00, and that deduced from the last series is 1′·92, the mean of these two values being 1′·96. If we apply this mean value of the secular change to the mean result corresponding to the epoch April 1, 1860, in order to bring it to the epoch April 1, 1866, we obtain—

$$68° \ 20'·07 - 11'·76 = 68° \ 8'·31,$$

whereas that deduced from the second series corresponding to this epoch is 68° 6′·82. The former of these is 1′·69 higher than the latter. As regards the reason of this difference the author does not think it due to any personal equation in the observer. It would appear that the Kew observations present a peculiarity similar to those at Toronto, so that the difference of 1′·69 between the two sets of observations may probably be accounted for by this cause. The probable error of a single monthly determination of the dip, derived from the seventy-two monthly determinations, and after the application of the correction for secular change and annual variation, as derived from the results of these observations, has been made, is ±0′·96. There is, however, reason to believe that this probable error is increased to some extent by periods of disturbance, some of these of considerable duration. In the observations of horizontal force during the first six years, mean value of the horizontal force is equal to 3·8034, corresponding to the middle epoch April 1, 1860, and from the latter six years' observations we have a mean value of horizontal force equal to 3·8360, corresponding to epoch April 1, 1866; also the secular change deduced from the first six years is + ·0053, while that deduced for the second six is + ·0055, the mean of the two being + ·0054. If we apply this mean value of the secular change to the mean result corresponding to epoch April 1, 1860, in order to bring it to epoch April 1, 1866, we obtain 3·8034 + 0·0324 = 3·8358, a value which agrees as nearly as possible with that deduced from the second series, and corresponding to the same epoch which was 3·8360. The coincidence of these two values naturally leads us to imagine that the secular change of the horizontal force does not present the same peculiarity as that observed in the dip. In the observations of total force the mean of the April to September values of the horizontal component of the force in the last six years is 3·8346, corresponding in epoch to January 1, 1866; and the mean of the April to September values of the dip in the same six years is 68° 6′·83. The mean of the October to March values are for the horizontal force 3·8372, and for the dip 68° 6′·41, corresponding to epoch July 1, 1866. We may reduce these to a common epoch by applying to the former dip the correction —0′·96, this being the proportional secular change (as shown by these six years) necessary to reduce the former epoch to the latter. The former dip will therefore become 68°6′·83—0′·96 = 68° 5′·87. Reducing in the same way the horizontal force, we have

$$3·8346 + 0·00275 = 3·83735.$$

The values thus become as follows:—

	Hor. orce.	Dip.
From the April to September observations (reduced to epoch July 1, 1866)	3·83735	68° 5′·87
And from the October to March observations (corresponding to the same epoch)	3·83720	68° 6′·41

The total force derived from the first series will therefore be 10·28717, and that derived from the second series 10·29080, showing thus a difference of 0·00363 in British units as the measure of the greater intensity of the terrestrial magnetic force in the October to March period, than in the April to September period. This is in the same direction, and very nearly of the same amount, as that determined by Sir E. Sabine from the first six years, which exhibited a similar difference of 0·00317 in British units. Thus we find that the two series agree in showing nearly the same semi-annual variation for the total force, while the first period exhibits the greatest semi-annual variation of the dip. It ought, however, to be borne in mind that the two series bear a different relation to the disturbance period, the maximum of disturbances occurring about the middle of the first series, and the minimum near the middle of the second.

"Spectroscopic observations with the great Melbourne Telescope." By A. Le Sueur. The author stated that the spectroscopic observations of the nebulæ of Orion show distinctly that considerable nebulosity exists within and about the trapezium. The author's *telescopic* observations reveal a positive though comparatively faint nebulosity within and about the trapezium; the *spectroscope*, however, shows with much force that this nebulosity not only exists, but is comparable in brightness to that surrounding the trapezium at some distance,—the brightest part of the nebulæ in fact; that, in ordinary observations, therefore, the faintness or apparent complete absence ot nebula is mainly due to the disturbing brightness of the four stars, not to any intrinsic extreme faintness or absolute vacuity.

In the examination of Jupiter, the large size of image is brought into prominent play; with the original Cassegrain image the light is barely sufficient, but with the image condensed (at pleasure within certain limits) fair work becomes possible, the spectrum being considerably bright. The lines G, F, *b*, C, D are seen without the slightest difficulty, and many other lines with attention. A marked feature is a nebulous band between C, D; from measures this turns out to be one of the bands examined by Mr. Huggins, 882 of his scale (C_6 of Brewster ?). With the slit perpendicular to Jupiter's equator and the advantage of a large image, an admirable opportunity is afforded of noting the behaviour ot the lines as they cross the different parts of the surface, a spectroscopic picture of the planet, as it were, being presented beautifully to the eye. The nebulous line C_6 was specially and narrowly watched, but without any satisfactory evidence being elicited;

It is found that the spectrum of η Argo is crossed by bright lines. The mere fact of a bright line spectrum is not very difficult to ascertain on a good night; for although from faintness of the light the phenomenon is necessarily delicate, yet the bright lines occasionally flash out so sharply that the character of the spectrum cannot be mistaken. The most marked lines were made out to be, if not coincident with, very near to C, D, *b*, F, and the principal green nitrogen line. It cannot be determined whether the coincidence is with the magnesium group or the air-band; nothing more definite can be said than that the star line lies within the limits of the group. The comparison spectrum employed does not show F, but the position of the previously adjusted pointer, with reference to air lines in the neighbourhood, leaves little doubt as to the identity of the blue star line with F, due regard being had to the collateral evidence (when such close limits are reached) that C coincides with a red star line. The yellow (or orange?) line in the star has not yet received sufficient attention, it is, however, very near D. With the dispersion employed, D and the bright air line on the less refrangible side of D are well separated; so that, notwithstanding the delicacy of the star line, the author hopes if not to get satisfactory evidence of coincidence with a particular line, at least to eliminate one of the competitors; at present it cannot even be said whether the line may not be slightly more refrangible than D; the limits are, however, very small, placing the bright air group about 1,180 of Mr. Huggins's scale completely outside the possible range. The very faint nebulosity (if any) in the immediate neighbourhood of the star η is incompetent to give a trace of spectral lines with even a wide slit; for a considerable space S and *f* of η no lines at all are visible; the nearest nebula bright enough to show a line (the three usual lines are now easily seen on a good night over the brighter parts) is reached in the direction about 45° N p from η, and even then the distances from η, as judged by the appearance in the spectroscope with η threaded on the thus directed slit, is little less than one minute. This remark is of some importance in connection with the ordinary telescopic observations of the nebula, but is mentioned at this point to relieve any impression which might arise that the nitrogen line seen on the star spectrum is merely the chief nebula line crossing it. In the present state of the inquiry there is little doubt left as to the presence of hydrogen in the star; the other lines may perhaps be accounted for by nitrogen alone, or by nitrogen, magnesium, and sodium. On the whole the weight of collateral evidence will probably be considered to be in favour of the latter combination, with the possibility that for sodium may have to be substituted the substance which produces the line in sun-protuberance spectrum. For although there is no direct evidence as to identity of the line near D, if the coincidence were with the orange nitrogen line, it would be reasonable to expect a line in the star corresponding to the yellow line 1180±, yet none has been made out in that position; again, the second green line has probably less claims for visibility than the orange or yellow lines, yet in the star spectrum this line is not less well seen than that coinciding with the chief nitrogen line; these considerations, though perhaps not entitled to great weight, at least lead in the direction of the above inference. Owing to faintness of the general spectrum no dark lines are made out; one in the red is strongly suspected, and occasionally there is an appearance as if of a multitude over the spectrum generally, but they refuse to be seen separately and certainly. The spectroscope has decided that η in no way influences the configuration as now seen. Is not the presence of nitrogen and hydrogen in the star η a significant fact in connection with these changes, which appear to be nothing less than a destruction of nebula specially in its neighbourhood?

Orion has again been examined with an interesting result; the spectroscope proves that in and about the trapezium nebula exists comparable with the bright surrounding nebula. The stars, sharply focused to give a linear spectrum, being threaded on the slit singly or in pairs, or cautiously removed out of the field, it is seen that the bright lines cross the trapezium with little if at all diminished brilliancy. The ordinary telescopic view is therefore an erroneous one, produced by the disturbing effect of the bright group. Jupiter has been examined (generally on moonlight nights); with this object the original Cassegrain image is too faint for good work, but by interposition of a suitable lens the image is condensed at pleasure within certain limits; with the light thus increased the Fraunhofer lines G, F, *b*, E, D, are always easily seen, C also easily on a clear night; the lines to which special attention has been directed are the telluric lines 914 and 838 (for convenience of reference the numbers in Mr. Huggins's Jupiter and sky diagrams are used throughout.) These are the only lines seen with certainty between C and D. The identity of 914 and 838 rests partly on measures and partly on spark comparison, where, for the identification of 914, it is seen that this line is near to the air band 807 of Mr. Huggins's chemical scale. The line 914 is so easily seen, that having in mind Mr. Huggins's statement concerning the difficulty of discerning it at all, originally very imperfect measures on a bad night, and with the apparatus imperfectly adjusted, misleading in the same direction, this line was at first mistaken for 882, from which, however, it is separated far beyond the limit of error in a proper state of adjustment of apparatus. 882 is not seen at all with Jupiter at considerable altitude. On the night of December 29th, however, between the hours of 12.30 and 1, Jupiter being low, 882 was then seen almost as conspicuous as 914, which did not seem to have perceptibly increased in darkness by the additional absorption of the earth's atmosphere. On the night of December 14th (both objects being near the meridian) the spectroscope was turned on Jupiter and the moon alternately several times. On Jupiter 914 and 838 were easily visible, the former (as usual) the more conspicuous; on the moon no line could be certainly made out between C and D.

March 16.—The following papers were read:—"On the Contact of Conics with Surfaces." By William Spottiswoode, M.A., F.R.S. "Tables of the Numerical Values of the Sine-integral, Cosineintegral, and Exponential Integral." By J. W. L. Glaisher, Trinity College, Cambridge. Communicated by Prof. Cayley, LL.D. "Researches on Solar Physics.—No. II. The Positions and Areas of the Spots observed at Kew during the years 1865–66, also the Spotted Area of the Sun's visible disc from the commencement of 1832 up to May 1868." By Warren De la Rue, Ph.D., F.R.S., F.R.A.S., Balfour Stewart, LL.D., F.R.S., F.R.A.S., Superintendent of the Kew Observatory, and Benjamin Loewy, F.R.A.S. The paper commences with a continuation for the years 1864–66 of Tables II. and III. of a previous paper by the same authors; it then proceeds to a discussion of the value of the pictures of the sun made by Hofrath Schwabe, which had been placed at the disposal of the authors, and the result is that these pictures, when compared with simultaneous pictures taken by Carrington and by the Kew heliograph, are found to be of great trustworthiness. From 1832 to 1854 the pictures discussed are those of Schwabe, who was the only observer between these dates; then follows the series taken by Carrington, and lastly the Kew series, which began in 1862. A list is given of nine values of the sun's spotted area for every fortnight, from the beginning of 1832 up to May, 1868, and also a list of three-monthly values of the same, each three-monthly value being the mean of the three-fortnightly values which precede one of the three which follow it. These three-monthly values are also given for every fortnight. A plate is appended to the paper, in which a curve is laid down representing the progress of solar disturbance as derived from the three-monthly values; and another curve is derived from this by a single process of equalisation, representing the progress of the ten-yearly period. The values of the latter curve, corresponding to every fortnight, are also tabulated. From this Table are derived the following epochs of maxima and minima of the longer period:—

Minimum	Nov. 28, 1833.	
Maximum	....	Dec. 21, 1836.
Minimum	Sept. 21, 1843.	
Maximum	....	Nov. 1, 1847.
Minimum	April 21, 1856.	
Maximum	....	Sept. 7, 1859.
Minimum	July 14, 1867.	

This exhibits a variability in the length of the whole period.

Thus we have between 1st and 2nd minimum... ..	9·81 years.
2nd and 3rd do.	......12·58 „
3rd and 4th do.	......10·81 „
Mean of all the periods	.........11·07 years.

Another fact previously noted by Sir J. Herschel is brought to light, namely, that the time between a minimum and the next maximum is less than that from the maximum to the next minimum. Thus the times from the minimum to the maximum are for the three periods 3·06, 4·14, and 3·37, while those from the maximum to the minimum are 6·75, 8·44, and 7·44 years. In all the three periods there are times of secondary maxima after the first minimum; and in order to exhibit this peculiarity statistics are given of the light-curve of R Sagittæ and of β Lyræ, two variable stars which present peculiarities similar to the sun. Finally, the results are tested to see whether they exhibit any trace of planetary influence; and for this purpose 54 conjunctions of Jupiter and Venus, and 90 conjunctions of Venus and Mercury have been made use of with the following result, exhibiting the united effect of the sun's conjunctions, the unit of spotted area being one millionth of the sun's visible hemisphere.

Angular separation.	Excess or Deficiency. Jupiter and Venus.	Venus and Mercury.
0 to 30	+ 881	+ 1675
30 to 60	− 60	− 139
60 to 90	− 452	− 1665
90 to 120	− 579	− 2355
120 to 150	− 705	− 2318
150 to 180	− 759	− 1604
180 to 210	− 893	− 481
210 to 240	− 752	+ 547
240 to 270	− 263	+ 431
270 to 300	+ 70	+ 228
300 to 330	+ 480	+ 1318
330 to 0	+ 1134	+ 2283

Chemical Society, March 3.—Prof. Williamson in the chair. "On Refraction Equivalents." By Dr. Gladstone. Three distinct lines of research had led up to the discovery of these equivalents. The first was the influence of temperature on the refraction of light by liquids; the second, the refraction of mixtures or combinations as compared with that of their constituents; and the third, the refractive indices of different members of homologous series of organic compounds. As to the first of these it was found by the joint labours of Dr. Gladstone and the Rev. Pelham Dale, that the refraction and the dispersion decrease as the temperature rises. Further examination showed a close relation between the change of density and the change of the refractive index minus unity, which the investigators termed the "refractive energy," and which is expressed in the language of opticians as $u-1$. This energy divided by the density, that is $\frac{u-1}{d}$ is called the "specific refractive energy," and is, in the case of liquids, a constant, not affected by temperature. This conclusion was subsequently confirmed by the experiments of Landolt, Wüllner, and Kühlman. As to the second line of research, that of the refraction of mixtures, solutions, and simple combinations, the conclusion was arrived at that here also the nearest approximation to the truth was given by $\frac{u-1}{d}$, and this conclusion has been fully confirmed by the careful experiments of Wüllner. The same general expression holds good also in the case of a gas or a solid in solution, and, indeed, it was expected to be so, for water, phosphorus, and sulphur have the same energies in the liquid and solid states. The question now presented itself, does an elementary substance retain its specific power of retarding rays when it is combined chemically with other elements? An affirmative reply was suggested by many considerations. It was, for instance, found that bromoform ($CHBr_3$) and bibromide of bromethylene ($C_2H_3Br_3$) have almost the same specific refractive energy as bromine itself. On the other hand, however, the investigators observed that isomeric liquids were not always identical in refractive energy, and that the replacement of hydrogen by oxygen in organic compounds effected a much greater optical change in some instances than in others. Hence the conclusion was drawn that the specific refractive energy of every liquid is composed of the specific refractive energies of its component elements, modified by the manner of combination. The third line of research was that of the refractions of different homologous compounds. The experiments of Delffs, of Landolt, and of Gladstone and Dale, have led to the view that in all the series containing the radicals, methyl and its congeners, the specific refractive energies increase as the series advances, and that the amount of optical change is less between the higher than between the members of the lower series. Landolt, adopting Gladstone and Dale's formula for the specific refractive energy, multiplied it by the atomic weight P; and this $P\frac{u-1}{d}$ he designated the "Refraction Equivalent." According to this representation, the refraction equivalent of a body is the sum of the refraction equivalents of its constituent elements. The great advantage of this kind of expression is, that it permits of the easy comparison of the optical properties of different substances. By making these comparisons, Landolt found that the refraction equivalent of carbon is 5·0; that of hydrogen, 1·3; and that of oxygen, 3·0. Direct experiments have given figures very close to these. The way of calculating the refraction equivalent of a compound from these data may be illustrated by ether. $C_4H_{10}O = 4(5{\cdot}0) + 10(1{\cdot}3) + 3{\cdot}0 = 36{\cdot}0$. The refraction equivalent deduced from observation is 36·26. A great variety of liquids have given the same equivalents by calculation as by direct investigation. Yet there are exceptions to this agreement with theory. The whole group of the aromatic hydrocarbons and their derivatives give refraction equivalents much above the calculated numbers. This anomaly must be due to an erroneous representation of the constitution of their nucleus, which cannot be greater than C_6H_3. However, the above method makes it possible to find the refraction equivalent of bodies, which could not otherwise be taken; for instance, of metals. The refraction equivalents of fifty elements have been determined in this way. It is to be remarked that the figures in the following list represent A of the solar system:—

Aluminium	8·4	Iodine	24·5—27·2
Barium	15·8	Iron	12·0—20·1
Bromine	15·3—16·9	Lead	24·8
Calcium	10·4	Magnesium	7·0
Carbon	5·0	Manganese	12·2—26·2
Chlorine	9·9—10·7	Mercury	21·3—29·0
Chromium	15·9—23·0	Nitrogen	4·1— 5·3
Copper	11·6	Oxygen	2·9
Hydrogen	1·3— 3·5	Phosphorus	18·3
Platinum	26·0	Sodium	4·8
Potassium	8·1	Sulphur	16·0
Silicon	7·5— 6·8	Tin	27·0—19·2
Silver	13·5	Zinc	10·2

It will be seen that some of the elements have a double value, and this peculiarity is in most cases coincident with a change of atomicity. Thus, iron in the ferrous salts has the equivalent 12·0, in the ferric salts 20·1, and since the refraction equivalent of iron in potassic ferridcyanide is 11·7, the view suggests itself that the metal is here in the same condition as in the ferrous salts. Great anomalies, however, present themselves in the case of oxygen. Its equivalent in many compounds is 2·9, but in others it comes down to 2·1, and in some cases, as in sulphates and phosphates, it would seem to be a negative quantity. This points to the conclusion that oxygen has the power of greatly modifying the action on light of those elements with which it is combined in a high proportion. On looking over the above list one is struck by the identity of the equivalents of those elements which have the same, or nearly the same, atomic weight. This property is still more prominent when the specific refractive energies of the elements instead of their refraction equivalents are considered. The following pairs may be noted in this respect:—

Iron,	0·214	Aluminium,	0·307	Bromine,	0·191
Manganese,	0·222	Chromium,	0·305	Iodine,	0·193

But the most suggestive comparison is that between the specific refractive energy and the combining proportions of those metals that form salts not decomposable by water. By combining proportion is meant the actual amount which will combine with a certain quantity of a salt radicle. A few of these metals may be quoted here:—

	Specif. refr. energy.	Combining proportion.
Hydrogen	1300	1
Albuminium	307	9·1
Calcium	260	20
Iron	214	28
Sodium	209	23
Potassium	207	39·1
Copper	183	31·7
Silver	125	108
Lead	120	103·5
&c.		

The regularity in the decrease of the numbers in the first column and the corresponding increase in the second column would suggest that the combining proportions of Silver, Lead, &c. ought to be halved in order to bring those elements to about their right places in the list. There is further a remarkable coincidence between the power of a metallic element to refract the rays of light, and its power to saturate the affinities of other bodies; of course, it must be borne in mind that a small combining proportion means a high saturating power.

The names of the officers proposed by the Council of the Chemical Society for election on the 30th March, are:—President: A. W. Williamson. New Vice-Presidents: E. Frankland, A. Matthiessen. New Members of Council: H. Bassett, F. Field, F.R.S.; M. Holzmann, Ph.D.; W. J. Russell, Ph.D.; R. Angus Smith, Ph.D., F.R.S.; John Tyndall, LL.D., F.R.S.

Entomological Society of London, March 7.—Mr. F. P. Pascoe, vice-president, in the chair. The Rev. R. P. Murray and M. J. C. Puls were elected members. Professor Westwood exhibited a number of old locusts, with a view to determine what is the true *Locusta migratoria* of Linnæus. The Rev. H. S. Gorham sent for exhibition specimens of *Sunius neglectus*, a beetle new to Britain, but probably confused in collections with *S. angustatus*. Mr. Albert Müller exhibited a curious acorn-like gall formed on the mid-rib on the underside of the leaf of a species of *Gnetum*. Mr. Janson exhibited a large number of butterflies collected by his son in Nicaragua in November and December last. Mr. Butler exhibited specimens of *Argynnis Adippe* and *Niobe*, in support of his previously expressed opinion that the two forms are but one species. Dr. Wallace exhibited dark varieties of *Melitæa Athalia*, and specimens of *Herminia derivalis*. Mr. Stainton exhibited *Cosmopteryx Sienigiella*, bred in this country from Russian larvæ which fed in reeds. Dr. Wallace exhibited cocoons and silk of several species of silk-producing moths, and addressed the meeting on the progress and science of Sericiculture in this country and in the colonies. The following paper was read: "Descriptions of twelve new exotic species of the Coleopterous family *Pselaphidæ*," by Professor Westwood.

Ethnological Society, March 8.—Professor Huxley, F.R.S., president, in the chair. Captain Campbell, R.E., was announced as a new member. Colonel Lane Fox read a paper "On the opening of two cairns near Bangor, in North Wales." One was situated on the summit of Moel Faban, and contained a cist in which an urn was found, together with several small dressed stones, probably arrow-heads and flakes, worked not in flint, but in the trap and felspathic rocks of the neighbourhood. Other worked stones were found beneath the cist. Professor Ramsay described the lithological characters of the materials. The second cairn examined by the author was called Carnedd Horvel, and contained fragments of an urn surrounded by particles of burnt human bone, but not protected by a cist. Among the speakers who took part in the discussion on this paper were Sir J. Lubbock, Bart., M.P., Professor Ramsay, Mr. J. Evans, Mr. J. W. Flower, Dr. Nicholas, and Mr. R. Hamilton. A paper was then read "On the earliest phases of civilisation," by Mr. H. M. Westropp. The author sought to show that every race passes through an invariable series of phases in definite sequence. These are the barbarous, the hunting, the pastoral, and the agricultural phases, which the author compared with the respective stages of infancy, childhood, youth, and manhood in the individual man. Numerous illustrations were adduced of different races exhibiting these several phases of civilisation in the successive stages of their development.

MANCHESTER

Literary and Philosophical Society, February 22.—Dr. J. P. Joule, president, in the chair, referred to the observations he had made in former years on the progressive rise of the freezing point of one of his thermometers. He had made a further observation, and found that a rise—unmistakeable, though very small—was still taking place after a lapse of twenty-six years since the bulb was blown.—Dr. F. Crace Calvert gave an account of the progress made during the last few months in the production of artificial alizarine, and expressed his opinion that many years must elapse before it can replace madder and its preparations in all their varied applications in calico printing; but ere long the purity of the substance artificially obtained may prove of great service to the calico printer, by enabling him to produce at a cheaper rate than now certain styles of prints as well as new styles and effects. Dr. Schunck remarked that practical success would in a great measure depend on the price of the raw material, anthracene, and on the amount of colouring matter to be obtained from it. The process of manufacture was, however, as far as he could judge, a very simple and easy one, requiring the use of no costly materials. He was convinced that the artificial product was identical with the natural alizarine of madder, the only difference being that the former was generally contaminated with some impurity which prevented its crystallising easily. Purpurine was not formed along with alizarine, as had been supposed. He also exhibited to the meeting some specimens of Turkey-red dyed with artificial alizarine, which had been sent to him by Mr. Perkin, and stated that the latter had already manufactured several tons of the new product. Dr. Schunck referred to a notice in the last number of the *Chemical News*, giving an account of a process for preparing pure alizarine from Turkey-red dyed cotton; and stated that almost the same process was described many years ago by himself. He also claimed to have been the first to point out that Turkey-red, madder pink, and all the finer madder colours are simply compounds of alizarine and fatty acids with bases.

"On the Organic Matter of Human Breath in Health and Disease," by Dr. Arthur Ransome. The vapour of the breath was condensed in a large glass flask surrounded by ice and salt, at a temperature of several degrees below zero. The fluid collected was then analysed for free ammonia, urea, and kindred substances; and for organic ammonia—the method employed being that invented by Messrs. Wanklyn and Chapman for water analysis. The breath of 11 healthy persons and of 17 affected by different disorders was thus examined, and the results were given in two tables. The persons examined were of different sexes and ages, and the time of the day at which the breath was condensed varied. In both health and disease the free ammonia varied considerably; the variation could not be connected with the time of the day, the fasting, or full condition. Urea was sought for in 15 instances—three healthy persons and 12 cases of disease—but it was only found in two cases of kidney disease, in one case of diphtheria, and a faint indication of its presence occurred in a female suffering from catarrh. The quantity of ammonia, arising from the destruction of organic matter, also varied, possibly from the oxidation of albuminous particles by the process of respiration; but in healthy persons there was a remarkable uniformity in the total quantity of ammonia obtained by the process. Amongst adults the maximum quantity per 100 minims of fluid was 0·45 of a millogramme, and the minimum was 0·35. A rough calculation was given of the total quantity of organic matter passing from the lungs in 24 hours—in adults about 3 grs. in 10 oz. of aqueous vapour, a quantity small in itself, but sufficient to make this fluid highly decomposable, and ready to foster the growth of the germs of disease. In disease there was much greater variation in the amount and kind of organic matter given off. In 3 cases of catarrh, 1 of measles, and 1 of diphtheria, the total ammonia obtained was much less than in health—less than 0·2 of a millogramme—a result probably due to the abundance of mucus in those complaints, by which the fine solid particles of the breath were entangled. In two cases of whooping-cough it was also deficient, but as they were both children, the lack of organic matter may have been due to their age. In cases of consumption also the total ammonia was less than in health; but in one case of this disease associated with Bright's Disease a larger amount of organic matter was given off, a portion of it due to urea. In kidney diseases the largest amount of organic matter of all kinds was found in the breath. The ammonia in one case of Bright's Disease was 1·8 millogrammes in 100 minims of fluid, and urea was largely present. Perhaps this fact might be taken as an indication of the need of measures directed to increase the activity of other excretory organs. In one case of ozona or offensive breath, the total quantity of ammonia obtained was greater than in any healthy subject, but the excess was chiefly due to organic matter. One convalescent case of fever was examined, and the total ammonia was found to be deficient. The air of a crowded railway carriage, after 15 minutes' occupation, was also tested by this method, and in about 2 cubic feet 0·3 millogrammes of ammonia and 3 millogrammes of organic matter were found. With reference to the presence of organic matter in the atmosphere, it was pointed out that the subject was in no way a novel one, and that it had, during the last thirty years, been very fully investigated by many observers, more especially by Schwann, Dusch, Schroeder, Helmholtz, Van den Broeck, Pasteur, and Pouchet, but it was shown that it is to Dr. Angus Smith that we owe the discovery of the readiness with which living organisms are formed in the condensed breath of crowded meetings, and the determination of the actual quantity of organic matter in the air of different localities. Mr. Dancer's calculation of the number of spores contained in the air was noticed, but a source of error was pointed out in the readiness with which organisms are developed in suitable fluids, even in the course of a few hours. Observations upon the organic particles of respired air had at different times been made by the author. 1. In 1857 glass plates covered with glycerine had been exposed in different places and examined microscopically. Amongst others in the dome of the Borough Gaol, to which all the respired air in the building is conducted, organised particles from the lungs and various fibres were found in this air. 2. During a crowded meeting at the Free Trade Hall, air from one of the boxes was drawn for two hours through distilled water, and the sediment examined after 36 hours. The following objects were noted:—Fibres, separate cellules, nucleated cells, surrounded by granular matter, numerous epithelial scales from the lungs and skin. 3. The dust from the top of one of the pillars was also examined, and in addition to other objects the same epithelial scales were detected. 4. Several of the specimens of fluid from the lungs were also searched with the microscope. In all of them epithelium in different stages of deterioration was abundantly present, but very few spores were found in any fresh specimen. On the other hand, after the fluid had been kept for a few hours, myriads of vibriones and many spores were found. In a case of diphtheria, confervoid filaments were noticed, and in two other cases, one of measles, and one of whooping cough, abundant specimens of a small-celled torula were found, and these were seen to increase in numbers for two days, after which they ceased to develope. These differences in the nature of the bodies met with probably show some difference in the nature of the fluid given off; but it was pointed out that they afford no proof as yet of the germ theory of disease. They simply show the readiness with which the aqueous vapour of the breath supports fermentation, and the dangers of bad ventilation, especially in hospitals. Dr. E. Lund and Dr. H. Browne stated that they had also made experiments, the results of which were, in general, confirmatory of those obtained by Dr. Ransome.

Microscopical and Natural History Section, January 31.—Mr. John Watson, president, in the chair. Mr. Charles Bailey read a paper "On the natural ropes used in packing cotton bales in Brazil."—Mr. J. Sidebotham exhibited some photographs of Pholas-bored Rocks, and said in reference to a paper by Mr. R. D. Darbishire on rocks bored by Pholas at the Little Orme's Head, that last spring he found many rocks so bored on both the Great and Little Ormes. The holes are most abundant near the tops of the mountains, and none whatever are met with very low down. At first sight the holes on the surface of the rocks having been weather-worn, and sometimes connected by channels with the natural fissures in the rock, it is difficult to say which or whether any of the holes have been caused by boring shells. —An interesting collection of Australian plants from Dr. Mueller, of Melbourne, was exhibited by Mr. H. A. Hurst.

EDINBURGH

Royal Society, March 7.—William Forbes Skene, vice-president, in the chair. The following communications were read: "On the Rate of Mortality of Assured Lives as experienced by Ten Assurance Companies in Scotland from 1815 to 1863," by James Meikle, actuary to the Scottish Provident Institution, communicated by Prof. Tait. In 1863 ten assurance companies contributed their mortality experience, embracing nearly 12,000 deaths, and published the result in May last. The present paper contained observations on the nature of that experience. After comparing the mortalities of the male population of England and Scotland, in which the mortality of males in Scotland was greater than in England up to about the age of thirty-five, the mortality of assured males was compared therewith, and also with the expectations of the Carlisle and the Actuaries' tables, the most general bases of life assurance computations. Assured life experience was shown to be greatly more favourable than the Carlisle up to about the age of fifty, thereafter less favourable; it was slightly more favourable than the Actuaries' at nearly all ages. Similar comparisons were made of the mortality of females. The whole observations on the lives were then thrown into various forms, so as to exhibit the effects of the selection exercised by the offices in assuring only healthy lives; and, after casting out the experience of the years when selection has its greatest force, comparing the remaining observations with the mortality of the population. The rate of mortality on policies effected "*with* participation in profits" was shown to be very much *higher* than on policies effected "*without* participation." The mortality on imperfect lives (those not assured at ordinary rates) was also discussed, and the amount of annual premium required to assure 100*l*. at death given for several classes of diseased lives. Interesting comparisons were also given of the causes of death of assured lives and of the population. It appears that assured lives have died in greater proportion from zymotic complaints, diseases of the brain, heart, and liver; while the populations have died in greater ratio from tubercular and lung diseases. The paper concluded with a description of the manner in which some of the results were adjusted and interpolated. The whole was very fully illustrated by diagrams, and called forth an interesting discussion.—"Brief Notes on Indian Society and Life in the Age when the Hymns of the Rigveda were composed," by John Muir. After stating that although the religious conceptions of the Indians of the Vedic era were in a comparatively simple and undeveloped stage, it would be a mistake to suppose that they had not made considerable advances in civilisation, the writer proceeded to give some account of the country which they occupied, and of the amount of opulence possessed by their kings, and to adduce a variety of particulars illustrative of their social and domestic relations and manners, their dress, food, drink, professions, relating to the tame and wild animals known to them, to their wars, armies, armour, and weapons, and to their poetry and incipient speculation. Some of the topics treated of were illustrated by metrical translations from the hymns of the Rigveda—(1) in praise of charity and liberality, (2) relating to the variety of men's tastes and pursuits, (3) satirically comparing the Brahmins with frogs reviving at the beginning of autumn, (4) descriptive of the miseries of gambling, (5) in celebration of warlike prowess and its instruments, and (6), containing a specimen of early speculation.

DUBLIN

February 28.—Sir Robert Kane, vice-president, in the chair, Professor J. P. O'Reilly exhibited a model and described a plan of a moveable barometer. The secretary read a note supplementary to their former paper "*Eozoon Canadense*, a mineral Pseudomorphite," by Professors W. King and T. H. Rowney, of Queen's College, Galway.

Natural History Society, March 2.—Rev. Professor Houghton, in the chair. Professor Houghton read a paper on the "Pathological lesions observed in the stomach of a lioness." —Professor Traquair exhibited fine specimens of *Calamoischthys* from Old Calabar, and Professor Macalister exhibited a specimen of *Amœida vulgaris*, from Mangerton, county Kerry.

PARIS

Academy of Sciences, March 7.—M. de Saint-Venant read a memoir on the establishment of the equations of the interior movements effected in solid ductile bodies beyond the limits at which elasticity can restore them to their former state. Papers were also communicated by M. Brioschi on the bissection of hyperelliptical functions, by M. Bourget on the algebraical development of the perturbative functions, and by M. Lucas on the calculation of the physical parameters and principal axes in a certain point of an atomic system.—M. Becquerel communicated a memoir on the electromotive forces of various substances, such as pure carbon, gold, platinum, &c., in the presence of water and of various liquids, in which he described the effects produced by plates of the substances above mentioned in contact with distilled water and various solutions.—M. Dubrunfaut presented some remarks upon the colours of rarefied gases submitted to spectrum analysis. He remarked upon the luminosity of hydrogen in Geissler's tubes at various degrees of tenuity, and stated that at its maximum attenuation a blood-red colour is characteristic of pure hydrogen, and that it communicates a similar coloration to the gas surrounding it. He also noticed the variation in the intensity of coloration of hydrogen, according to the calibre of the tubes through which the current passes. The purest nitrogen was stated to give a yellow tint, but usually the peculiarities of this gas are masked by the presence of water or mercury. The Torricellian vacuum was said to furnish the spectra of hydrogen, nitrogen, and mercury. The author also remarked upon some recent communications to the Academy on this subject.—A note by M. J. M. Gaugain on the electromotive force developed by platinum when in contact with various liquids was presented by M. E. Becquerel. The author stated that when one of two plates of platinum is taken out of acidulated water, washed in distilled water and restored to its place, a current is developed, which he ascribed to the presence of the water. He discussed the probable modes of action of this water, and inclined to the opinion that the plate still plunged into acidulated water forms a coat more positive than the platinum itself, which combination is destroyed by the water. He stated, however, that the electro-motive force is greatly increased by the exposure of the washed plate to a temperature of 150° C (=302° F.)—In a note on the illumination of transparent bodies, M. Soret adduced a further evidence in favour of his opinion that the presence of suspended particles takes a preponderant part in these phenomena.—M. Leroy de Boisbandeau communicated some remarks, illustrated by sketches, upon some curious icicles observed by him on the sides of a stone tank.—M. Aug. Houzeau noticed the absence of oxygenated water in the snow which fell at Rouen on several days during the past winter.—A note by Mr. Thudichum was presented, in which the author described an acid which, he stated, exists normally in the urine, and which he proposed to name *Kryptophanic acid*.—M. Jouglet communicated a note on the action of ozone upon nitro-glycerine and other explosive compounds. He found that nitro-glycerine, dynamite, iodide and chloride of nitrogen and some other bodies exploded when put into a vessel containing ozone, whilst picrate of potash was slowly decomposed, and gunpowder was sensibly altered in six weeks.—A note by M. Sacc on the distillation of tartaric acid was presented.—Notes on earthquake shocks observed at Lima and Ancona were communicated by the Minister of Public Instruction.—M. H. Sainte-Clair Deville presented a note by Father Denza, giving an account of a storm of sand accompanying rain and snow, which occurred in various parts of Italy on the 13th and 14th of February. The author remarked upon the periodicity of the phenomenon, and noticed its occurrence in various places; the sand, in all cases, appeared to be identical, and was considered by the author to come from the African deserts. —A note by M. H. Magnan on the cretaceous formation of the French slope of the Pyrenees and of Corbières, and especially on the Neocomian, Aptian, and Albian strata of that region, was presented by M. Daubrée.—MM. A. Roujou and P. A. Julien communicated a note on striæ observed on blocks of Fontainebleau sandstone and other rocks imbedded in the diluvium of the neighbourhood of Paris. These were stated to be the first striated blocks observed near Paris. M. Elie de Beaumont made some remarks upon these blocks.—M. A. Trécul communicated the fourth part of his remarks upon the position of the tracheæ in the ferns and on the ramification and radicular propagation of the rhizomes of some of those plants.—M. Duchartre presented a note by M. E. Prillieux on the influence of blue light upon the production of starch in chlorophyll. The author remarked that the production of starch was generally supposed to be due to the action of the yellow rays, and that blue light had no such effect. He considered that the results upon which this opinion was founded were due to the greater brilliancy of the yellow light, and by exposing a plant of *Spirogyra* deprived of starch to a more brilliant blue light, he found that formation of starch took place.—M. Duchartre also communicated a note by M. C. Cave on the free central placenta of the *Primulaceæ*, in which the author adduces as a further proof of the axial nature of that organ, that, on examination, the parts of recent formation are found to be outside the medullary sheath.—M. Auguste Duméril described some peculiar organs of the branchial apparatus in the Rays belonging to the genus *Cephaloptera*. These organs are the *prebranchial appendages* discovered by M. P. Panceri in *C. giorna*, which M. Duméril had detected in the large Indian *C. Kuhlii*. He stated that they occurred in no other fishes.—M. Pouchet noticed a transformation of the nests of the house martin (*Hirundo urbica*), and maintained that the nests of birds, instead of being, as generally supposed, constructed in the same way from century to century, really undergo certain progressive modifications of structure. In the case of the house martin, he stated that within the last forty years that bird has adopted a new form for its nests. The old nests are in the form of the quarter of a hemisphere, with a very small circular aperture for entrance. The improved nests, according to M. Pouchet, are in the form of the quarter of a hemi-ovoid with the poles much elongated, and the entrance is by a long transverse slit.—A second note on the tracheæ and differential characters of the lungs in birds, by M. Campana, was presented by M. C. Bernard. The author described the various modes of interbronchial communication, the mode of insertion of the pneumatic receptacles upon the lung, and the structure of the parenchyma of the organ.—M. Milne-Edwards communicated an extract from a letter from the Abbé David, giving the diagnosis of a new species of *Crossoptilon* (*C. cærulescens*) discovered by him at Sse-tchuaro.—A note by M. Demarquay, on the reproduction and union of divided tendons was communicated by M. J. Cloquet. The author maintained that the regeneration of a divided tendon is effected by the proliferation of the elements on the inner surface of its sheath, in a manner analogous to the reproduction of bone by the periosteum. M. Dupuis presented some remarks on the confusion which has often occurred between the physicist, J. A. C. Charles, and the geometrician, J. Charles, and communicated some particulars relating to the biography of the two Academicians.

SYDNEY

Royal Society of New South Wales.—Mr. F. B. Miller, F.C.S., one of the assayers of the Sydney Royal Mint, described the practical results of his method for separating silver and gold directly by the use of chlorine gas, a process of which an account was given to the Chemical Society rather more than a year ago. At the Sydney Mint 6,820,198 ounces of gold have been received for coinage from the date of its establishment in May 1855 to December 31, 1868. The average composition of this gold would be about 94⅓ per cent. of gold, 5 per cent. of silver, and ⅔ per cent. of base metals; the gross amount of silver contained in the gold would be about 334,190 ounces, so that about 24,750 ounces of silver per annum have been lost to the colony for the want of a simple process of refinage. The gold now obtained in Queensland, as also that now brought from New Zealand, contains a much larger proportion of silver, so that the present loss to the colony is more nearly 42,000 ounces per year. The experience of the Sydney Mint proves that on the average there is a marked deterioration in the gold proceeding from Victoria, where the fineness is 96 per cent., northwards through New South Wales, where the average is 93½ per cent., to Queensland, average 87¼ per cent. The silver can now be readily separated by passing a stream of chlorine gas into the melted gold for about an hour and a half, as it lies in a crucible heated in an ordinary melting furnace. The chlorine is at first rapidly absorbed, and the process is completed when a brownish yellow vapour appears. The chlorine is conveniently evolved from a self-acting generator, and 2,000 ounces of gold are readily refined in five hours, by three melting furnaces, 98 per cent. of the gold being delivered ready for coinage on the same day. The gold thus refined is perfectly tough, and contains only about one-half per cent. of alloy. The ultimate loss of gold is found to be only 19 parts in 100,000; the loss of silver is 240 in 100,000. The cost of refinage, including the above loss, but excluding rent of premises and expenditure, is five farthings per ounce. The silver is obtained in the form of fused chloride, and is reduced to the metallic state by plates of zinc combined with slabs of the chloride into a galvanic arrangement, devised by Dr. Leibriss. In twenty-four hours the chloride is completely reduced to the state of spongy silver, and 1,400 or 1,500 ounces could thus be readily treated in a day. No acid is required, and the zinc consumed is only 25 per cent. of the chloride reduced. The whole process, having been thoroughly tested at the time, is to be brought into active operation at once. It is already employed by some of the banks in Australia and New Zealand.

DIARY

THURSDAY, MARCH 17.

ROYAL SOCIETY, at 8.30.—On the Law which Regulates the Relative Magnitude of the Areas of the Four Orifices of the Heart: Dr. Herbert Davies.—On the Estimation of Ammonia in Atmospheric Air: H. T. Brown.
ROYAL INSTITUTION, at 3.—Chemistry of Vegetable Products: Prof. Odling.
LINNEAN SOCIETY, at 8.—The Flora and Fauna of Isle Ronde, near Mauritius: Sir Henry Barkly.—On Algæ found in the North Atlantic Ocean: Dr. Dickie.
ZOOLOGICAL SOCIETY, at 4.
CHEMICAL SOCIETY, at 8.—On Artificial Alizarine: W. H. Prekin, F.R.S.—On the Combination of Carbonic Anhydride with Ammonia and Water: Dr. Divers.
NUMISMATIC SOCIETY, at 7.
SOCIETY OF ANTIQUARIES, at 8.30.—On Ancient Round Barrows: Dr. Thurnam.

FRIDAY, MARCH 18.

PHILOLOGICAL SOCIETY, at 8.15.
ROYAL INSTITUTION, at 8.—On the Subway to France; J. F. Bateman, F.R.S.

SATURDAY, MARCH 19.

ROYAL INSTITUTION, at 3.—The Sun: J. Norman Lockyer, F.R.S.

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ROYAL MEDICAL AND CHIRURGICAL SOCIETY, at 8.30.

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SOCIETY OF ARTS, at 8.—On Surface Decoration: W. Pitman.
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THURSDAY, MARCH 24.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

NO. 21] THURSDAY, MARCH 24, 1870

Registered for Transmission Abroad]

THURSDAY, MARCH 24, 1870

THE TRANSITS OF VENUS IN 1874 *AND* 1882

A PARLIAMENTARY paper issued at the close of last session gives some information on what is intended to be done in the matter of the great approaching astronomical events of 1874 and 1882, which will interest many readers of NATURE. The correspondence on this subject between the Astronomer Royal and the Hydrographer of the Admiralty, and between the Hydrographer and the Secretary to the Admiralty, is given at full length, and together with the appended remarks of Captain Toynbee, Admiral Ommaney, Commander Davis, Mr. Stone, and Mr. Warren De la Rue, well merits careful perusal. On the whole it seems to be at least doubtful whether the requisite Antarctic station for the observation of the transit, which in the opinion of the Astronomer Royal should, if possible, be in the neighbourhood of Mounts Erebus and Terror, can be attained, or if, when attained, it is likely to be possible to make observations from it. But this Antarctic station is only required for the transit of 1882, and there is ample time to make a preparatory Antarctic expedition to ascertain the doubtful point. In the meantime, however, let us see what has been settled about the transit of 1874. For the proper observation of this event the Astronomer Royal informs us that it will be necessary, after making allowance for all the aid that may be expected from foreign and colonial observatories, to organise expeditions to the following five stations:—(1) Oahu (Sandwich Islands), (2) Kerguelen's Island, (3) Rodriguez, (4) Auckland (New Zealand), (5) Alexandria. At the first three of these stations—namely Oahu, Kerguelen's Island, and Rodriguez—it will be necessary to make preparatory observations for twelve months, in order to ascertain the absolute longitudes of these places, which are not exactly known. The total cost of these proposed observing expeditions for the transit of 1874 is estimated by the Hydrographer at 10,404*l.*, a sum which, it must be admitted, is moderate for work of such surpassing importance, and, as the Lords of the Treasury state that they have "no objection to offer" to the proposed expenditure, we may take it for granted it will be so far carried out. But what I wish to call attention to at the present moment is the valuable opportunity thus offered for still further augmenting the importance of this event to the progress of science generally, by converting these proposed astronomical expeditions into expeditions for general scientific observation. At three of the spots to be visited it will be necessary to keep up an observing party, more or less extensive, for upwards of twelve months. Now, it so happens that the three spots thus selected for astronomical observatories are also of very great interest for biological studies. The Sandwich Islands are well known to be the seat of a most peculiar indigenous flora and fauna, which has been hitherto very incompletely explored, rivalling perhaps even that of the Galapagos in eccentricity. They are likewise the seat of some of the most stupendous volcanic phenomena known on the globe. Who can doubt that one or more zoologists, botanists, and geologists would find ample work during a twelvemonth's sojourn in these islands, and would reap a rich harvest of results? The little island of Rodriguez was formerly the residence of a bird allied to the Dodo, and probably of other extinct forms o life. Professor Newton and his brother have, it is true, already made us tolerably well acquainted with the osteology of *Pezophaps*, as this gigantic ground-pigeon is termed. But there is no doubt that a careful exploration of the bone-caves of Rodriguez will lead to still further discoveries as regards *Pezophaps*, and most probably result in bringing to light other unknown extinct inhabitants of the submerged continent, which was the ancient focus of Didine life. Kerguelen's Island, the third point selected for a temporary astronomical observatory, is also in many points worthy of renewed investigation. Although we may probably believe Dr. Hooker, who visited it during Sir James Ross's Antarctic Expedition, left but few plants for future botanists to discover, the seals and whales that frequent its shores, together with the sea-fowl and other inhabitants of the coast, would well occupy the attention of zoologists. It is, moreover, of especial importance that the "abundant fossil remains" of its now extinct forests should be thoroughly investigated, in order to obtain more knowledge of the former distribution of land and water in the South Pacific. I have mentioned only some of the principal and most noticeable points for biological inquiry in each of these three localities. But, as every naturalist knows, in the case of such isolated land-areas as these marine islands, it is of especial importance to the progress of our knowledge of general geographical distribution to have a complete account of every branch of their faunas and floras, both recent and extinct. I beg leave, therefore, to urge upon all who are interested in the progress of science, the importance of not losing the opportunity that now presents itself. The additional expense of attaching two or three qualified Natural History observers (or at any rate collectors) to these three expeditions could not be very great. The numerous American and Russian exploring expeditions are invariably accompanied by zoological and botanical collectors, nor is the money required to publish the results obtained by them grudged by the Governments of these countries. Even poverty-stricken Austria did not send the *Novara* round the world without a competent corps of naturalists, and we are now reaping the fruits of the abundant harvest which they gathered in. Far from lagging behind, wealthy England ought to take the lead in such cases, and instead of its being necessary, when an opportunity of the sort occurs, to take all kinds of extraordinary steps in order to induce the Government to take advantage of it, such things should be done as matters of course.

P. L. S.

PHILOLOGY AND DARWINISM

[The following paper was written nearly half a year ago, before the translation into English of Prof. Schleicher's two pamphlets, by Dr. A. V. W. Bikhers. After reading the article on Dr. Bikhers' translation, by Prof. Max Müller, in a previous number of NATURE, it struck me that many readers might be glad to have some further account of Schleicher's views. F. W. F.]

THE relations of the science of language to the Darwinian hypothesis have been touched upon by one of the most acute and learned of modern scholars, Prof. August Schleicher, of Jena, whose lamented death a year ago,* at the early age of forty-eight, is a severe loss to European science, was an ardent supporter of the doctrine of variability of species. Besides being a most eminent linguist, he had long been interested in practical botany; and as a cultivator of ferns he had enjoyed many opportunities of observing the apparent transformation of natural subdivisions. It was not, however, as a botanist that Mr. Darwin's book was mainly interesting to him, but far more from the light which his theories seemed to throw on the phenomena of language. The first edition of the "Origin of Species" appeared in November 1859, and Prof. Schleicher, three years before he had met with Brown's German translation of it, had in his book, "Die Deutsche Sprache" (pp. 43, 44), called attention to the struggle for existence among words, the disappearance of primitive forms, and the immense development and differentiation which may be produced by ordinary causes in a single family of speech. On receiving Mr. Darwin's book from his friend Prof. Häckel, he wrote him a letter, which has since been published, on "Die Darwinsche Theorie und die Sprachwissenschaft;" and in answer to the objection that he had, in this letter, assumed that languages were material existences, having a real natural life, he wrote a second pamphlet on the "Importance of Language for the Natural History of Mankind."

The general line of illustration which he adopts had probably struck others, and it had certainly struck me before I read or heard of Prof. Schleicher's pamphlet; but as that little work is as yet but slightly known in England, it will probably be interesting to some readers if I sketch the outline of his arguments. There was nothing fanciful or precipitous in Schleicher's writings. He was one of the most strenuous supporters of the strictly scientific character of all true linguistic inquiry; one of the most severe opponents of those vague fancies, imaginative theories, hazardous etymologies, and *à priori* inferences which have thrown suspicion on philological work. He had owed much, even in the study of language, to such books as Schleiden's "Scientific Botany," and the "Physiological Letters" of Carl Vogt; and he wished to found linguistic science on the structure of the organs of articulation and on recognised vital laws. He regarded languages as natural organisms which, in accordance with definite physical influences, and independently of human will, are produced and developed, grow old and die, and therefore manifest the series of phenomena to which we give the name of "life." Hence he regarded Comparative Philology, not as an *historical*, but as a *natural* science; and we think that his views will be shared by all who have added to their linguistic inquiries some sound knowledge of either zoology or botany.

The researches of Sir Charles Lyell have shown that the present condition of the earth's surface is due, not to cataclysms and conflagrations, but to the slow result of natural laws continuing to act during thousands of years. Similarly, Mr. Darwin showed that the existing conditions of species might have been originated by continuous insensible modifications, working for an indefinite period of time. It was the main object of Prof. Schleicher to show that in all essential particulars the working of similar laws accounted for the existing phenomena of languages. The principles of classification apply to language no less than to animal and vegetable organisms. A genus corresponds to a linguistic stem; classes to linguistic families; subspecies to dialects; varieties to minor dialectic peculiarities; and, finally, individuals to those special modes of varying utterances which distinguish man from man.

* He died on Dec. 6, 1868.

Mr. Darwin has constructed an ingenious diagram* to illustrate the immense scope which must be allowed for gradual divergence of characters in animal and vegetable species derived by natural selection from an original genus. Schleicher has made an exactly similar table to serve as a genealogical tree for the Aryan Families of language. But here the philologist has a distinct advantage, and the study of his results may be most suggestive to the naturalist: for the Darwinian diagram is to a great extent ideal and hypothetical; while the table of languages is merely an expression of indisputable discoveries. Any one who has clearly understood the certainty of the fact, that languages at first sight so different as Greek and French, Icelandic and Portuguese, Sanskrit and Lithuanian, are yet connected with each other by close bonds of union, and that the phenomena they exhibit are due to gradual differentiation from a single stock, will undoubtedly be more able to conceive the possibility of Newfoundlands, and Greyhounds, and King Charles's Spaniels, and Wolves being lineal representatives of a common type.

And further than this, the philologist has another very positive advantage over the naturalist. The ethnologist can not only *prove*, where the naturalist must be content to *conjecture*, but can also more easily exemplify the birth of new forms out of anterior ones, and can carry out his examination on a greater scale. There are some languages and families of languages which have been under close observation for two thousand years, and which furnish us with written specimens of forms which have undergone immense subsequent modification. In comparing modern French with the Latin of the XII. Tables, or Mahratti with the Sanskrit of the Vedas, we have a sure and solid basis of observation, in which, by the aid of records incapable of falsification, we can observe the corroding and modifying influence of time on human speech. The effects of foreign influences on different languages even furnish us with some analogy to *crossing*, which is so important an element in all zoological inquiries. In point of fact, the possession of written materials extending over many ages led philologists to be among the first to deny the sudden origin of separate species. The Science of Language offers the most demonstrable and instructive examples of the gradual growth of species from common primitive forms, although it is as impossible in language as it is in zoology to draw certain and definite lines of demarcation between genera, species, and varieties.

It may be asked whether the science of language is able at present to demonstrate the growth of all families from one primitive mother-tongue? The answer must be frankly in the negative, and perhaps one reason for this may lie in the fact that there is not any linguistic family except the Aryan, of which the archetypal forms have been reconstructed from their derivatives.† But, on the other hand, as regards the *morphology* of language, we are

* Origin of Species, p. 130. (4th edition.)
† To effect this was the object of Prof. Schleicher's *Compendium des Vergleichende Grammatik.*

perfectly in a position to show that the rudest forms of the most developed language have sprung, by insensible derivation, from phonetic signs as vague, simple, and monosyllabic as those of Chinese itself. These signs left the mutual *relations* of ideas unexpressed. There were at first no special vocal expressions, no *organs* for the fulfilment of grammatical functions, or the interdistinction of nouns and verbs, much less of conjugation or declension. Such words as *That, gethan, Thuer, Thäter, thätig*, all point back to a root *dha*, which contained in itself the undeveloped germ of all sorts of verbal, nominal, and adverbial modifications. And in this respect the ultimate roots of the Aryan languages closely resemble in character the actual words of those languages which have remained to this day as nearly as possible in their primitive condition. Such roots may without fancy be called speech-cells, in which the rudiments of all special organs are implicitly *involved*, but in which they are as little *developed* as in the germinal vesicles which represent the earliest forms of animal and vegetable life. There may have been multitudes of such sound-cells, as it were, from which different families of language have sprung by special lines of development, just as, according to the Darwinian hypothesis, many primordial cells, presenting a close similarity, may have been the earliest rudiments of all living organisms.

In speaking of the extinction of species and the struggle for existence, Mr. Darwin uses language which may be literally applied—applied without even verbal modification—to the phenomena of languages. Here, no less than in the animal and vegetable kingdom, the dominant forms of the prevailing groups tend to leave many modified descendants, while the imperfection of the weaker groups leads to their gradual disappearance. But the complete extinction of a linguistic type is a slow process, and just as extinct animal forms may leave behind them a few decaying representatives in inaccessible or solitary places, so in the mountain-valleys of the Pyrenees and the Caucasus, we find isolated dialects which may be the fragmentary relics of tongues once spoken in immense districts. But a language once extinct, like an extinct species, can never under any circumstances reappear; and its place is occupied by the nearly related but greatly modified groups of predominant families, which are precisely those which undergo the completest differentiation in the course of their gradual victory over less happily constituted forms. And in consequence of the extinction of languages many *intermediate* forms have perished; the primitive relationships of languages have been disturbed by all sorts of external influences, and consequently languages radically different are now found existing side by side. All this, as every naturalist is well aware, represents a condition of things precisely similar to that which prevails in animated nature.

Mr. Darwin, in his great work, devotes a few words to the classification of languages as affording a confirmation of his theories. It does so to an extent of which probably he was not at first aware. In two capital points, viz., (1), the immense changes which can be effected by infinitesimally gradual modification; and (2) the preservation of the best and strongest form in the struggle for life, Mr. Darwin's hypothesis may be confirmed and verified by the entirely independent researches of the comparative philologist. These are the two points to which Prof. Schleicher wished to draw attention in the pamphlet which I have here epitomised. They do not indeed represent the whole of the linguistic facts which might be adduced on this side of the question, and they leave out of sight others which might be alleged with great force in favour of an opposite view. Some of these I have endeavoured to set forth elsewhere,* and possibly there may be some future opportunity of again bringing this subject before the reader. My present object was to make the views of Prof. Schleicher more widely known than they have yet become among English naturalists and scholars.

F. W. FARRAR.

THE PRIVATE LIFE OF GALILEO

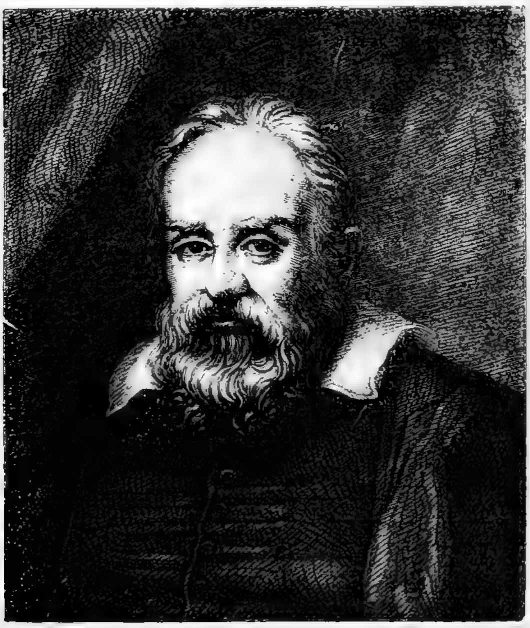
The Private Life of Galileo. Compiled principally from his correspondence and that of his eldest daughter, Sister Maria Celeste, nun in the Franciscan convent of S. Matthew at Arcetri. 307 pp. (London: Macmillan and Co. 1870.)

THE numerous works which have appeared with Galileo for their theme may be divided into three classes. Firstly, those which relate more particularly to his persecution by the Church, the position and influence of the Sacred College in his day, and its attitude towards science. Secondly, those which treat of his scientific labours apart from himself, their nature and character, and their influence on the propagation of truth, the advancement of modern philosophy, and the downfall of Aristotelianism. Thirdly, those which discuss his private life. The first and last of these are often blended, more or less, and of necessity, but we know too little of his scientific labours. M. Parechappe has well remarked, "Le savant s'est effacé dans le martyr." The works of Galileo, if much talked of, are certainly little read—"Il Saggiatore" and the "Dialoghi" are even less read than the "De Augmentis Scientiarum" and the "Novum Organum;" while the "Principia" of Descartes occupies a position of notoriety midway, perhaps, between "Il Saggiatore" and the "Novum Organum," and we have a little difficulty in placing the writings of Hobbes. Yet it is undeniable that the works of these four men have produced a more profound and permanent influence upon human thought than any which preceded them. There is but one epoch in the history of the world to be compared with their epoch; it is that of Aristotle.

The work before us belongs both to the first and third of the above divisions, it relates mainly to the private life of Galileo, and resembles Arduini's "Primogenita di Galileo Galilei," more than any other work on the subject. The account of the private life of Galileo, unlike many such accounts, does not give us much insight into the manners and customs and conditions of society at the time of which it treats, both because Galileo had so little real domestic life, and because the main correspondence which furnishes these private details took place between a nun (who of all persons can know least of the external world) and Galileo himself, and her letters to him have been preserved, while his answers to them have perished. Your great philosopher as a rule is exceedingly

* See a paper on "The Growth and Development of Language" in the *Cambridge Journal of Philology*.

undomestic, and the proofs of this are so common that we need not quote a single example ; the petty details of home weary them, and prevent the abstraction requisite for their labours : so the ancient Brahmans, who reasoned as profoundly as any light of Western civilisation, lived in the solitudes of the forests of Ancient India ; so Descartes withdrew himself from the world, and remained

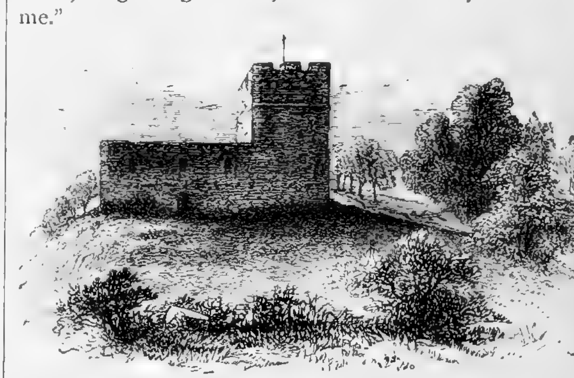


GALILEO
(*From Ramsey's picture in Trinity College, Cambridge*)

buried in the quiet of his country house while he produced his "Meditations."

Galileo also was by no means domestic. Of his three natural children, his son Vincenzio was a constant thorn in his side. He was a lazy fellow, who was always writing to his father for money, and who, Italian-like, preferred to idle away his life in singing and lute-playing, to adopting any profession or attempting to get his own livelihood. We cannot find one good quality in Vincenzio Galileo ; he was mean, selfish, inconsiderate and unnatural in his behaviour towards his father. One example of this is sufficient. He had quartered himself on his father, together with his wife and children, when the plague broke out in the neighbourhood ; whereupon Vincenzio deserted the old man, and went to a more healthy locality, leaving his father to take his chance with the other inhabitants of the district. Galileo's daughters Polissena and Virginia were placed in the Convent of S. Matthew, at Arcetri, in 1614, when the eldest was only thirteen years old ; henceforth they became Sister Maria Celeste and Sister Arcangela. Of the latter we hear but little, but Sister Maria Celeste constantly corresponded with her father, and the greater number of her letters have been preserved, and are now in the Palatine Library at Florence. These letters contain some interesting details of convent life of the period, but of necessity they do not bear upon many of the doings of the outside world ; their general tenor is the same throughout ; they are full of her love for Heaven and for her "dear lord and father," as she was wont to call Galileo, and they almost invariably pass to an opposite extreme of matters exceedingly of the earth, earthy—the baking of cakes, the mending of linen, the getting up of his collars and so on. She tells her father all the minute details of her work, as : "I have been extremely busy at the dinner-napkins. They are nearly finished ; but now I come to putting on the fringe, I find that of the sort I send as a pattern a piece is wanting for two dinner-napkins : that will be four *braccia*." The last paragraph of this desultory letter begins, "These few cakes I send are some I made a few days ago, intending to give them to you when you come to bid us adieu ;" and ends, "I thank Him for everything, and pray that He will give you the highest and best felicity ;" and a postscript immediately follows this—"You can send us any collars that want getting up."

Galileo's villa was very near the convent, and a constant interchange of courtesy seems to have taken place; Galileo sent money and presents of meat and wine, while Sister Maria Celeste sent him plums, and baked pears, and candied fruits, and cakes, and mended his linen and kept his wardrobe in order. Her love for him amounted almost to worship, at least to veneration. When at length, worn out by watching in the convent infirmary, by ill health, and by the many privations inseparable from a convent life, she felt her end approaching, Galileo was in confinement at Siena, and she feared she should see him no more; but he was allowed to retire to his own house, and arrived at Arcetri in time to see his daughter before her death. Writing of this time (1634), Galileo says : "Here I lived on very quietly, frequently paying visits to the neighbouring convent, where I had two daughters who were nuns, and whom I loved dearly; but the eldest in particular, who was a woman of exquisite mind, singular goodness, and most heartily attached to me."



GALILEO'S TOWER

There is much in this "Private Life of Galileo" of great interest in connection with his scientific work, his books, his persecutions and trial by the Sacred College, and his condemnation; but we have preferred to keep strictly to his more private life, as the theme is so large, that if we once touched upon his scientific work and its results, we should require far more space than could be placed at our disposal here.

Galileo continued actively employed to within a few years of his death, in January 1642. During his latter years he was a great sufferer. "I have been in my bed for five weeks," he writes to Diodati, in 1637, "oppressed with weakness and other infirmities, from which my age, seventy-four years, permits me not to hope release. Added to this, *proh dolor!* the sight of my right eye, that eye whose labours (I dare say it) have had such glorious results, is for ever lost. That of the left, which was and is imperfect, is rendered null by a continual weeping." Thus the poor old man complained, until finding that his blindness was incurable, and that his many ills were increasing, he ceased repining, and begged his friends to remember him in their prayers, till his unhappy chequered life was closed by death.

G. FARRER RODWELL.

OUR BOOK SHELF

Reptiles and Birds. A Popular Account of their various Orders, with a Description of the Habits and Economy of the most interesting. By Louis Figuier. Illustrated with 307 woodcuts. Edited and adapted by Parker Gillmore. 1870. (London: Chapman and Hall.)

A VERY pretty book for a drawing-room table. The description of the several families of both reptiles and birds is filled with anecdotes culled from all sorts of writers, some of them sufficiently amusing, others, to say the least, of doubtful accuracy; witness the following in reference to the stork:—"The inhabitants of Smyrna, who know how far the males carry their feelings of conjugal honour, make these birds the subject of rather a cruel amusement. They divert themselves by placing hen's eggs in the nest of the stork. At the sight of this unusual production the male allows a terrible suspicion to gnaw his heart. By the help of his imagination he soon persuades himself that his mate has betrayed him; in spite of the protestations of the poor thing he delivers her over to the other storks who are drawn together by his cries, and the innocent and unfortunate victim is pecked to pieces." We should like to see this cruel amusement played out once to the bitter end, and should then, but not till then, believe it.

The drawings and woodcuts are as excellent as they are numerous.

Beiträge zur Lehre von den Functionen der Nervencentren des Frosches. "Essays on the Functions of the Nerve-centres in the Frog." By. Prof. D. Fried. Goltz, of Konigsberg. pp. 130. (Berlin, Hirschwald, 1869.)

THIS little brochure, which, though small, contains the result of much work, is divided into four sections. 1. On the reflectorial excitation of the voice in frogs. 2. On the physiology of generation in the frog. 3. On the inhibitory influence which can be exerted on the reflex actions; and 4. On the seat of the mind (Seele) in frogs; beside investigations on the centre for the maintenance of equipoise, and the centre for locomotion. It may be observed that notwithstanding the experiments were all undertaken in frogs, those little martyrs to science, yet that some of the results at least have a direct bearing on the functions of the centra in the higher animals, and even on man himself. The results of his experiments in reference to the seat of the mind are at variance with those of Pflüger and others, who hold that the spinal cord participates with the brain in its possession. M. Goltz maintains, on the contrary, that the brain is the *exclusive* seat of all intellectual processes, and consequently, that a frog from which the whole encephalon has been removed, is an organism presenting only a complex series of reflex processes. The removal of the *cerebrum* alone deprives the animal of all voluntary movement, and of all those faculties which are included under the general head of consciousness; it still retains, however, certain powers of co-ordination. If the corpora quadrigemina are then removed, it no longer possesses the power of preserving the equipoise of its body or the accommodation of its movements. The corpora quadrigemina therefore, he concludes, constitute the centre for the maintenance of the equilibrium of the body. The cerebellum, on the other hand, is the centre for locomotion of the whole body.

Schriften der Naturforschenden Gesellschaft in Danzig Neue Folge, Zweiten Bandes, Zweite Heft, 1869.

THE Danzig Natural History Society publishes annually a part of its Transactions, which, although but little known in this country, often contain valuable papers. In the part for 1869, which we have just received, we find an elaborate memoir by Dr. Bail, on the epizootic fungi which affect the caterpillars injurious to forests, and it is some comfort to think, that while these vegetable parasites do nothing but mischief among the silk establishments of the south of Europe, they are regarded as serviceable in other quarters. This part also contains the continuation of M. A. Menge's valuable monograph of the Prussian spiders, of which the author has now described and figured 157 species. This memoir is indispensable to the archæologist, and is in itself a wonderful result of the most minute research—research so minute, in fact, that the author is unfortunately led to magnify the importance of slight differences, and thus to establish a great number of new genera upon very slight grounds. M. Menge also describes and figures a species of scorpion and two species of spiders from amber; each of the latter forms the type of a new genus. Dr. Bail contributes a short but interesting paper on the occurrence of androgynous flowers in monœcious and diœcious plants. Besides some minor communications on subjects connected with natural history, the part contains two memoirs which one would hardly expect to find in the Transactions of a society of naturalists, namely, a description of the construction and theory of a marine distance-measurer, and an investigation of the moon with reference to its ellipsoidal form, by M. E. Kayser, who describes himself as "Astronomer to the Natural History Society of Danzig." The former of these papers is illustrated with three folding plates.

Notes on Microscopic Crystals included in some Minerals. By Isaac Lea. From the Proceedings of the Academy of Natural Sciences of Philadelphia. Read February 16 and May 11, 1869.

IN these two papers the author gives an account of the minute crystals included in sapphire, garnets, and several other minerals, which in some cases are arranged in a number of definite planes, so as to give rise to the appearance seen in the so-called "star sapphires." The essays are illustrated by a plate, which shows the character of the crystals in a very satisfactory manner. The author is, however, not quite correct in thinking that such included crystals had not been previously described by several authors. Söchting, in his excellent work,* gives an account of some facts similar to those observed by Mr. Lea; and Messrs. Sorby and Butler, in their paper on the microscopical structure of rubies, sapphires, &c.† describe "the small plate-like crystals, often triangular in form, with an angle very acute. They are very thin, and arranged parallel to three principal planes of the sapphire," and are thus precisely like those now figured by Mr. Lea. There can be no doubt that the study of the minute crystals included in minerals often throws much light on their origin, and they play a far more important part than is often supposed, and serve to explain some of the discrepancies met with in their chemical composition.

* Einschlüsse von Mineralen u. s. w. Freiberg, 1860.
† Proceedings of the Royal Society, vol. xvii., p. 291.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Rotation of a Rigid Body

My previous communication about the rotating ellipsoid to this journal, has attracted the attention of M. Radau. "One touch of *Nature* makes the whole world kin." In a note addressed to me full of true dignity, this gentleman has made much more than sufficient reparation for his previous trifling act of inadvertence, and states that to his great regret he had misunderstood my meaning, in the passage of my memoir in question, and that "sa critique n'est pas fondée." I, on my part, deeply lament the unnecessary tone of acerbity in which my reference to this criticism was couched, and wish I could recall every ungracious expression which it contains. "When I spoke that, I was ill-tempered too."

I will pass over this, to me, painful topic, to say two or three words on the mode in which the rotating ellipsoid may be supposed to roll or *wobble* on a rough plane, with its centre fixed. My solution may remind the reader of Columbus's mode of supporting an egg on its point—or, rather, of a fairer mode which Columbus might have employed, and which would not have necessitated the breaking of the shell, viz., by resting the blade of a knife or rough plate on the upper end of his egg.

So, to make an ellipsoidal or spheroidal top roll, with its centre fixed—say, upon a rough horizontal plane—imagine a second horizontal plane in contact with the upper portion of its surface; then the line joining the two points of contact will pass through the centre of the top. We may conceive a slight perforation in either or each plane at its initial point of contact with the top, and a screw wire introduced through this, and inserted into a female screw in the body to be set rolling (a mode of spinning which Sir C. Wheatstone recommends as the most elegant in any case, and in this case evidently the most eligible). On withdrawing the wire with a jerk, the top may be set in motion about its centre, in such a direction as to remain in contact with the two planes, and if these be sufficiently rough the motion will eventually be reduced to one of pure rolling between them, the axis (*i.e.*, the line joining the two points of contact) continually shifting, but the centre remaining absolutely stationary: for, vertical motion this point cannot have, so long as the top continues to touch both planes, and any slight horizontal motion (if it should chance to take on such at the outset) would be checked and ultimately destroyed by the friction, which would also keep the two points of contact stationary (like the single point of contact of a wheel rolling on a rail), in each successive atom of time. Thus the motion upon the lower plane would in the end be precisely the same as if the upper plane were withdrawn, and the centre of the top kept fixed by some mechanical adjustment. If the spin were not sufficiently vigorous, after a time the rolling top might quit the upper plane, and of course sooner or later by the diminution of the *vis-viva* due to adhesion, resistance of the air, imperfection or deformation of the surfaces, and other disturbing causes, this would take place, but abstracting from these circumstances the principal axes of the spheroidal or ellipsoidal top would move precisely in place and time like the "axes of spontaneous rotation" of any free body of which the top was the "Kinematic Exponent."

I do not pretend to offer an opinion what materials for the planes and rolling body (ground glass and ebony or roughened ebonite have been suggested to me) it would be best to employ, or whether the "wobbling top" could easily be made to exhibit its evolutions. It is enough for a non-effective, unpractical man (as unfortunately I must confess to being) to have shown that there is no intrinsic impossibility in the execution of the conception.

With regard to the friction and pressure: if W be the weight of the body, F and P the friction and pressure in the case of a single plane (the values of which are set out in my memoir, pp. 764—766, "Philosophical Transactions," 1866), it may easily be proved that eventually the friction at each point of contact will be $\frac{F}{2}$, the pressure upwards at the lower point $\frac{P+W}{2}$, and downwards at the upper one $\frac{P-W}{2}$, so that if P should become equal to W the top would quit the upper plane and the experiment come to an end. At p. 766 of my memoir the factor $\sqrt{MA}$ has accidentally dropped out of the expression for P which I mention here, in case any one should feel inclined to consult the memoir in consequence of this note. Mr. Ferrers has taken up my investigations, and given more compendious expressions than mine for F and P; with the aid of these it would probably be not difficult to determine the maximum value of $\frac{F}{P}$ so as to assign the necessary degree of roughness of the confining planes, and also to ascertain under what circumstances P — W would become zero, but I do not feel sufficient interest in the question, nor have I the courage to undertake these calculations with the complicated forms of P and F contained in my memoir. Mr. Ferrers' results are contained in a memoir ordered to be printed in the "Philosophical Transactions," and will shortly appear.

In my memoir will be found an exact kinematical method of reckoning the time of rotation by Poinsot's ellipsoid when the lower surface is made to roll on one fixed plane at the same time that its upper surface is shapened off in a particular way (therein described) so as to roll upon a parallel plane which turns round a fixed axis; this upper plane is compelled to turn by the friction, and acts the part of a moveable dial in marking the time of the free body imaginarily associated with the ellipsoid. I have also shown there that the motion of any free body about a fixed centre may be regarded as compounded of a uniform motion of rotation and the motion of a disc, or, if one pleases, a pair of mutually bisecting cross-wires left to turn freely about their centre. But I fear that NATURE, used to a more succulent diet, has had as much as it can bear upon so dry a topic, and, although having more to say, deem it wiser to bring these remarks to an end.

J. J. SYLVESTER

"Dutch" or "Deutsch"

THERE is a short note in Mr. Huxley's lecture in the last number of NATURE, which I have read several times in the vain hope of finding out its meaning. Mr. Huxley speaks of "the much debated question, did the Germans of Cæsar and Tacitus speak 'Deutsch' (not 'Dutch,' *pace* Mr. Freeman) or Celtic." What has my "peace," or anybody else's peace—save, perhaps, the *Pax Romana*—to do with it?

I do not see why Mr. Huxley brings in my name. He can hardly suppose that I do not know that *Deutsch* is the German form—I can hardly suppose that he does not know that *Dutch* is the English form—of the name otherwise written *Tütsch*, *Teutonicus*, *Theotonicus*, *Theotiscus*, and endless other ways. He can hardly think that I have never opened a modern German book: I can hardly think that he has never opened an English book of the sixteenth or seventeenth century. If he has opened any such book in which matters of this kind are likely to be touched upon, he must surely know that the words *Dutch* and *Dutchman* were then used in a very wide sense. A "Dutchman" might be a native of Holland; he might be a native of Bavaria. And the division into *High Dutch* and *Low Dutch*, or *Nether Dutch*, was then perfectly well understood.

I do not know what Mr. Huxley's objection is. I use the word as one ready made, as more convenient than the Latin for *Teutonic*, and as more easily admitting the addition of the qualifying syllables *High* and *Low*. I should not use *Deutsch* in this sense for two reasons. First, it is not an English form, and I should no more, in writing English, say that certain people talked "Deutsch," than I should say that they talked "Français." Secondly, the word *Deutsch* (like the word *German*) would to most people convey the idea of one particular Teutonic tongue, while I am probably speaking of Teutonic tongues in general. Mr. Huxley's question, "Did the Germans of Cæsar and Tacitus speak *Deutsch?*" may mean either "Did they speak a Teutonic tongue of any kind?" or "Did they speak the particular Teutonic tongue which to most peoples' minds would be suggested by the words *German* or *Deutsch*, namely, the *High-Dutch?*" Which Mr. Huxley means I do not know. For my own part I believe that they spoke Dutch or Teutonic, but *Low* Dutch and not *High*.

EDWARD A. FREEMAN

Somerleaze, Wells, March 21

The American Eclipse

WILL you grant me space for a few words on my spectroscopic observations of the American eclipse, and what seem to me the inferences to be drawn from them? I make the request the more freely because I have met from time to time allusions to them in your journal, and remarks, some of which seem to require my notice, if only to express my appreciation of the considerate courtesy with which they have been treated by gentlemen who differ very widely from my conclusions.

1. Regarding the use of the spectroscope in the observation of "contacts."

I think the language of Mr. Stone and some others in a discussion of the matter at a meeting of the Astronomical Society, reported in your columns in December last, implies a misapprehension. What I have proposed (and executed in the case of the moon) is to use the extinction of the bright C line in the spectrum of the chromosphere as a criterion of contact with the limb of the *photosphere*, not with the upper surface of the chromosphere, which would, of course, as indicated by Mr. Stone, be a perfectly worthless observation.

The advantage of the method lies in this, that it furnishes an easily apprehended phenomenon to be watched for, and gives every advantage of preparation to the observer.

With an instrument of moderate dispersive power, the slit must be normal to the sun's limb, and an accurate knowledge of the expected point of contact is required: with a more powerful instrument the slit can be placed tangential, opened somewhat widely, and thus all difficulty on this score avoided, as I have pointed out in my report. I see by a paper of Mr. Proctor's in the December number of the "Monthly Notices," that Mr. Huggins suggests the same plan.

Perhaps I may remark in passing that the idea of using the spectroscope in this manner to observe the contact of the moon with the sun's disc, was conceived before the event, so that the observation was made deliberately and by pre-arrangement—not at all accidentally, as would rather seem to be implied by one of the opening sentences in the article of Mr. Proctor's above referred to. To M. Faye, however, belongs whatever merit there may be in the method, for he proposed essentially the same thing in January 1869. But I knew nothing of this at the time of the eclipse, nor indeed till long after.

2. The self-luminosity of the Corona.

It is not impossible that the so-called corona may be complex. Some portion of its radiance may *perhaps* originate in our own atmosphere, although I do not yet find myself able to accord with the conclusions of Dr. Gould and Mr. Lockyer in this respect, and am strongly disposed to believe that the *whole* phenomenon is purely solar.

This much appears certain, however, that there exists outside of the chromosphere properly so called (*i.e.*, the envelope of *red hydrogen*), and as distinct from *it*, as it is from the *photosphere*, an immense atmosphere of self-luminous substance, extending to a distance of from 5′ to 8′ from the sun's surface, and probably much further in places—phosphorescent dust or fog in a glowing gas.

In support of this idea I adduce the photograph of Mr. Whipple, taken at Shelbyville, Ky., with an exposure of 40^s. On this, the *photolytic corona* (if I may use the expression to distinguish it from the *visible corona*, whose points of maximum brilliance were, according to Dr. Gould, entirely different), reaches a height of 6′. Prof. Harkness observed the 1474 line in the spectrum of the corona at a distance of nearly 5′ from the sun's limb, and not near to any prominence. I do not know the precise elevation at which I saw it, but it was not less than 3′ or 4′.

Indirectly, also, the idea is confirmed by the spectroscopic observation of Prof. Pickering, who used a single prism instrument, with the slit simply directed towards the sun, not attached to a telescope. He saw only three or four lines, the brightest in the green near E. Now, since this line, when observed by throwing a large image of the sun on the slit, is very faint as compared with C, D_3, and F, its intensity, as seen by him, can only be accounted for by supposing that the luminous area from which it was derived far exceeded that of the chromosphere and prominences.

I have noticed also that some of the observers of the Indian eclipse (Rayet and Pogson) speak of the intensity of the green line. Did they observe in the same manner as Prof. Pickering?

I need hardly add that Prof. Pickering's observation of the non-polarisation of the corona concurs with what has been said.

As to the faint continuous spectrum, I am sure that the reported absence of dark lines was not the result of insufficient observation.

I could not have failed to see D, E, *b*, 1961, F and G had they existed, for in a spectrum of similar brightness formed by a light from a cloud, not only these but many other lines are visible in my instrument. Now, the absence of some of these might, perhaps, be accounted for on the ingenious hypothesis proposed by Mr. Lockyer, and reported in your No. of February 3; but this would not apply to D, E, or G.*

But if we admit the existence of faintly luminous solid or foggy matter near the sun, either meteoric or arising from the cloudy condensation of a non-permanent gas, the whole is at once easy of comprehension.

3. The Auroral Theory of the Corona.

The objection pressed by Mr. Lockyer that the bright line 1474 is only occasionally visible, is, I think, unfounded. At any rate I have never failed to see it myself when looked for, and very seldom to make it visible to others when I have wished to exhibit to them. It is faint, and, like a difficult microscopic object, requires management to bring it out with five prisms; but by placing the slit tangential to the sun's disc, and giving the instrument a slight jar, it is seen to flash out as the limb passes off the slit. It is worth noting too, that it is often especially plain at portions of the limb where the chromosphere is unusually shallow and faint.

But while I think it probable that this line coincides with the aurora line reported by Prof. Winlock at 1550 of Mr. Huggins' scale, I am by no means sure of it. I understand its assigned position rested upon a single observation with a chemical spectroscope, and the probable error of such a determination cannot well be less than ten divisions of Kirchhoff's scale. I have naturally made many attempts to determine its position for myself, but have never seen it except thrice, and then not long enough at a time to complete a measurement. I am only sure that its position lies between 1460 and 1490 of Kirchhoff.

For this reason, although I do not at all abandon the hypothesis, which appears to have other elements of probability in the general appearance of the corona, the necessity of intense electrical disturbances in the solar atmosphere as the result of the powerful vertical currents known to exist there, as well as the curious responsiveness of our terrestrial magnets to solar storms; yet I do not feel in a position to urge it strongly, but rather await developments.

As to the substance which causes this line, I observe that Father Secchi, in a recent communication to the French Academy, is disposed to think it hydrogen; while Mr. Lockyer still believes it to be iron. I am in hopes that experiments now in progress may throw some light on the subject.

May I suggest, in closing this long communication, that it seems to me that valuable observations might be made at the Eclipse of next December, by fitting up telescopes with a ground glass sliding screen, upon which an image of the corona two or three inches in diameter should be thrown; the ground glass having the roughened side next the observer, so that he could sketch upon it with a lead pencil the outlines of the image, the glass being made long enough to allow of several such sketches.

The comparison of a series of such outlines would decide the question of changes in the coronal streamers, as the sketches, being simple tracings, could not but be accurate in their indications of position.

Dartmouth College, N.H., March 1 C. A. YOUNG

P.S.—I think that the position of the line reported by me as 2602 should have been 2581·5, an error of one revolution of the micrometer screw having been made. At any rate on two occasions since the eclipse I have seen a bright line in the latter position, and I have never been able to find one in the former.

Professor Huxley's Address

MAY I be permitted to advert to one view in connection with that part of Professor Huxley's admirable address to the Geological Society, which treats of distributional provinces inhabited by the terrestrial vertebrata, and the subsequent incorporation of these provinces into one another at different periods.

The view to which I refer is that wherein Mr. Huxley attributes the origin of the eocene types to their evolution *during the Mesozoic epoch* in some province which then was isolated from the European area, and their introduction by geographical changes into the European area in the interval between the Mesozoic and Tertiary epochs.

Having brought forward ten years ago the view that the Australian province was an actual and isolated remnant of the Triassic continent and of its mammalian fauna; and that the geographical distribution of organised beings pointed to the inference that other portions of the land tracts of the Mesozoic period, with their more ancient faunæ, had at different times

* Why not? [ED.]

become incorporated with the post-cretaceous continent,* it is with much satisfaction that I find views for the most part so similar developed by Professor Huxley with the ability which marks all his work. Nevertheless, I venture to submit that the view I then advanced as to the period of the origin of the Eocene types is more in accordance with the facts, as far as we know them, than the hypothesis of their origin in a detached province *during* the Mesozoic period.

The view I advanced was that great changes in the distribution of the continents and seas took place at the close of the Palæozoic, and again at the close of the Mesozoic epoch; and so far I am at one with Professor Huxley: but I inferred that the geographical changes taking place at the close of the Mesozoic epoch were accompanied by the formation of a continent extending over all the *geologically known* parts of the globe, whose endurance was so prolonged as to have afforded the necessary time for the evolution upon it of the Eocene types.

In support of this inference I dwelt upon the entire disappearance of the orders *Pterosauria*, *Enaliosauria*, and *Dinosauria* among vertebrates, and of the *Ammonitidæ* among invertebrates; as well as upon the great extinction that took place in various other forms of life. Such a process as the one suggested by Mr. Huxley would lead us to look in Eocene strata for an intermingling of these distantly evolved types with forms belonging to the several orders just named; however much these forms might in their specific, or even in their generic characters, have been changed during the interval in which these distantly evolved types were introduced. But instead of this we find an absolute disappearance of several important orders of life, of which, from their *habitat*, some—especially the *Pterosauria*—would seem to have been independent of geographical changes simply.

Mr. Huxley intimates that he is led to his view by arguments which he had previously used to demonstrate the necessity of the existence of all the Eocene types in some period antecedent to the Eocene; but may we not suppose that the interval thus marked by the disappearance of so many great orders was vast enough even for this evolution? Indeed so much did this great extinction weigh upon me that even the intervention of a vast lapse of time seemed scarcely sufficient; and I felt driven to suppose that these geographical changes in some degree altered the general conditions under which life had previously existed; and that this alteration, while stimulating evolution on the newly-formed continent, contributed to the great extinction which marks the intra-cretaceous and Tertiary epoch.

Subtle as are the causes which have brought into existence the various types of being, those which have produced their extinction are not less so; though they have not yet received that attention which has been directed to the origin of species. I feel how crude were the suggestions I offered in 1860 to explain this great extinction, and how wide a field of conjecture upon the subject is left open; for these orders of life were not only various in their *habitat*, but equally various in their food. We may imagine the extinction of a species to take place from failure of its food, from destruction by enemies, or—and I think this may be a cause more potent than any other, especially with forms possessing great fecundity—by a failure of the reproductive function; just as among men families diminish and eventually leave no descendants. Be the causes, however, what they may, this great extinction requires us, I submit, to suppose the occurrence of an interval of time as great, and accompanied by changes of conditions as complete, as any that we can urge as necessary for the evolution of the Eocene types. Moreover, the cretaceous period itself, whose terrestrial fauna is as yet unknown, may, so far as we yet know to the contrary, have witnessed in the European area the commencement of, or even some progress in, the evolution of the Eocene types.

Brentwood, March 10 SEARLES V. WOOD, Jun.

* "On the probable events which succeeded the close of the Cretaceous period;" read before the Geological Society on February 1st, 1860. The publication of the paper, beyond a brief abstract, having been denied by the Council, the desideratum was kindly supplied by Dr. Francis; and the paper in extenso is given in the *Philosophical Magazine* of March, April, and May, 1862; the title having been changed to "The form and distribution of the Land Tracts during the Secondary and Tertiary periods, &c."

Transactions of the Royal Society of Edinburgh

WITH reference to G.'s letter in the last number of NATURE, I have merely to observe that (as you will see by the accompanying list) the Transactions of the Royal Society of Edinburgh are *regularly* sent to no less than twenty-three different societies, institutions, or museums in London alone—besides being sent to many Honorary and Ordinary Fellows residing there. As regards the special case of the British Museum, I have in my possession at this moment their acknowledgments of receipt of the successive parts of our Transactions up to March 1869, and expect immediately to hear that they have received our last published Part. J. H. BALFOUR, *Sec. R. S. Edin.*

Euclid as a Text-Book

"THE first four books of Euclid: or the principal properties of triangles, and of squares and other parallelograms treated geometrically: the principal properties of the circle and its inscribed and circumscribed figures treated geometrically." Such is the wording of the programme put forth by the University of London, of the Mathematical portion of the examination for matriculation candidates. Whether the papers have ever been drawn up in accordance with it I cannot say, but certainly my experience for the last four or five years has led me to believe that the alternative side has, of late, at least, been altogether ignored.

The slightest inspection of recent papers will show that they are constructed on the Euclidean type, and so long as Euclid was generally taught in schools, I think rightly so. But that such a course should now be persisted in (with such latitude as the programme provides) is hard upon those establishments which have taken up the modern views of the subject, such as those so ably advocated by Professor Hirst,* and Mr. J. M. Wilson of Rugby.† It can hardly be thought that so advanced an examining body as the London University will continue to act as an obstructive—for non-encouragement is almost tantamount to tabooing the subject; and the practical result of persistence, I fear, will be this, that the course pursued will press unfairly upon those schools in which (as in University College School, where Wright's Geometry is now the text-book) Euclid has been almost ‡ discarded. Boys are required to study in their school work this modern geometry, founded on French mathematical works; and yet, seeing what value is set upon the same in the examination papers I am discussing, feel themselves constrained to read Euclid that their prospects of good places may be enhanced.

I am disposed to believe that "something will shortly be done," but the reform, though it ought rightly to commence here, ought not to stop here. Every examining body, if a fair field is to be given to the students of modern geometry, should put forth a scheme similar to that which heads my letter, and not merely put it forth "as a sop to Cerberus," but act upon it and let it be a reality.

University College School R. TUCKER

MECHANICAL PROPERTIES OF ICE, AND THEIR RELATION TO GLACIER MOTION

A FEW weeks ago I prepared for the February number of the *Alpine Journal* a review of the contributions made by the Rev. Canon Moseley to the theory of glacier motion, which have appeared at various times during the last fifteen years in the *Proceedings of the Royal Society* and the *Philosophical Magazine.* Some new facts having come to my knowledge since the publication of my paper, I venture to recur to the subject, and to invite discussion upon those memoirs of Canon Moseley in which he endeavours to prove that the descent of glaciers by their weight alone is a mechanical impossibility.§ The arguments he advances in support of this conclusion may be epitomised as follows:—

If a transverse section of a glacier were to be made, the ice would be found to be moving differently at every point of it. The velocity is greater at the surface than deeper down, at the centre of the surface than the edges. There is a constant displacement of the particles of ice over one another, and alongside one another, to which is opposed the resistance known as *shearing force.* By the property of ice called regelation, where a surface so sheared is

* In his college lectures, and lectures to ladies at St. George's Hall, &c.

† "Euclid as a text-book of Elementary Geometry" (read before the London Mathematical Society, and printed in the *Educational Times*, Sept. 1868), and in his "Elementary Geometry."

‡ *Almost.* In consequence of pressure from without, arising from the circumstances with which my letter deals, Euclid is again read in one class.

§ Proceedings of the Royal Society, Jan. 7, 1869. Philos. Mag., May 1869. Philos. Mag., Jan. 1870.

brought into contact with a similar surface, it unites with it so as to form one continuous mass. Between the resistance to shearing and the force which tends to bring the glacier down there must be a mechanical relation, so that if the shearing resistance were greater, the force would be insufficient to cause the descent. By a series of experiments upon cylinders of ice inserted in a cylindrical hole bored through two pieces of wood perpendicularly to the surface along which the one was made to slide upon the other, it was found that the force necessary to part the ice along the sliding surface varied from 75 to 119 lbs. per square inch. Canon Moseley has calculated that for the Mer de Glace to descend by its own weight, its shear per square inch cannot exceed 1·3193 lbs., and that to produce the actual motion with a shear of 75 lbs. per square inch, a force in aid of the weight and thirty-four times as great must be called into existence, and applied in the direction of motion. For such a force to be produced by the weight of the glacier alone the density of ice would require to be increased more than 400 times.

In this reasoning Canon Moseley has neglected, as it appears to me, the capability of ice when in a state of deliquescence to slide along a surface of small inclination, as demonstrated by the well-known experiment of William Hopkins. It is, however, not the motion of a block of ice as a whole, but the differential motions of its particles that we have now to consider. It occurred to me that the Canon's arguments upon this branch of the question might be put to an easy practical test by subjecting a block of ice to a strain produced by its own gravitation, and observing its behaviour under this condition, and I was fortunate in obtaining the assistance of my friend Mr. A. F. Osler, F.R.S., in carrying out the experiment.

A plank of ice 6 inches in width and $2\frac{3}{8}$ inches in thickness was sawn from the frozen surface of a pond, and supported at each end by bearers exactly six feet apart. From the moment it was placed in position it began to sink and continued to do so until it touched the surface over which it was supported, drawing the bearers with it, so as to make their upper ends converge. At its lowest point it appeared bent at a sharp angle, and it was rigid in its altered form. The total deflection was 7 inches, which had been effected in about as many hours under the influence of a thaw, during which the plank diminished slightly in width and thickness. On observing the under surface of the plank near the point of flexure, I noticed a number of very minute fissures extending a short distance into the ice, but they certainly were not sufficient to account for the flexure of the plank.

The question at once suggested itself, was the change of form in the ice plank due to fracture and regelation? I did not think it was, but the experiment was not decisive. Some weeks afterwards an opportunity occurred of trying it under other conditions. During the last frost we cut out another ice-plank. Its length was 6 feet $9\frac{1}{2}$ inches, its width varied from $6\frac{1}{4}$ to $6\frac{1}{2}$ inches, and its thickness was $1\frac{7}{8}$ inches. Two large bricks, of a width exceeding that of the plank, were set up on end, on a horizontal surface, exactly 6 feet apart, and the plank was laid upon them at five p.m. on the 12th of February. At 3·15 p.m. on the 13th it was continuously curved from end to end, so that it only rested on the edges of the bearers, and the middle point of its upper surface was deflected $1\frac{3}{4}$ inches below the line joining its two extremities. The temperature was 26° F. The curved plank was perfectly rigid, as was proved by taking it off the bearers and inverting it. I examined it again on the two subsequent days with the following results:—

Feb. 14th, 9.30 A.M. Temp. 29° 5 F.
Deflection of upper surface below chord . $2\frac{3}{8}$ inches
,, of lower surface below its original horizontal position . . $2\frac{1}{4}$,,

Feb. 15th, 9.30 A.M. Temp. 30° 0 F.
Deflection of upper surface below chord . $3\frac{5}{8}$ inches
,, of lower surface below its original horizontal position . . $3\frac{1}{8}$,,

During the whole of this interval, in which the temperature never rose above the freezing point, there was no indication of fracture in the plank, nor did the optical continuity of the ice suffer the slightest interruption. On the 15th it began to thaw, and the bearers having become frozen to the ground, and the plank to the bearers, the suspended portion was unable to yield to the strain produced by its gravitation; and when I re-visited the plank on the afternoon of the 15th, it was broken into half-a-dozen pieces.

These experiments were very rough and imperfect; we intend to renew them on some future occasion, and to conduct them with much greater care and proper mechanical appliances, when we hope to be able to bend an ice-plank double, without destroying its continuity.

The following conclusions may fairly be drawn from them:—

1.—A mass of ice may change its form under strains produced by the gravitation of its particles, without becoming fractured, and without returning to its original form when the strain ceases.

2.—The change of form takes place at temperatures both below and above the freezing point, but is greatly accelerated in the latter case.

I shall not now attempt to discuss the nature of the molecular displacements to which the change of form is due. Their occurrence is indisputable; whether or not they are to be dignified by the name of shearing is a mere verbal question of little moment. In a very able paper in the *Philosophical Magazine* for March 1869, Mr. James Croll adduces good reasons for believing that when a mass of ice has a deliquescent surface, its molecules may experience repeated momentary losses of their shearing force. While, therefore, he admits the conclusiveness of Canon Moseley's reasonings for temperatures below freezing, he conceives that ice at all higher temperatures may shear by its own gravitation. It is evident that the former concession in Canon Moseley's favour cannot now be maintained, and that the point to which our experimental researches should be directed is not what amount of force will suddenly rend asunder the molecules of ice beyond the sphere of their mutual attractions, but what amount of force will produce molecular displacement within that sphere, with time allowed for its operation.

If we conceive an ice-plank, instead of being placed horizontally between bearers, to be laid with its narrowest face upon a plane of small inclination, with its upper edge horizontal, and its ends confined between vertical walls converging in the direction of motion, with its under surface deliquescent, so that friction would almost be annihilated; and if we further imagine the diminution of gravity due to resolution along the plane to be compensated by increasing the length or diminishing the thickness of the plank, the plank would alter its form in a way presenting a striking resemblance to the actual movement of a glacier. Its central portions would move more rapidly than its lateral ones; its surface more rapidly than its base; and when the strain upon its particles exceeded their cohesive power, it would fracture obliquely to the axis of the channel.

If the conclusions drawn from the experiments above described are legitimate, plasticity must be admitted by the side of sliding, and fracture and regelation as one of the constituent elements of the theory of glacier motion, and a more important place in that theory must be assigned to the views of the late Principal Forbes than has for some years been conceded to them.

WM. MATHEWS, Jun.

THE INDIAN TOTAL ECLIPSE

THE 37th volume of the memoirs of the Royal Astronomical Society, containing Major Tennant's report on the total eclipse of the sun of August 17th and 18th, 1868, has just been issued, and we are enabled, by the courtesy of the Council of the Society, to lay an illustrated notice of it before our readers.

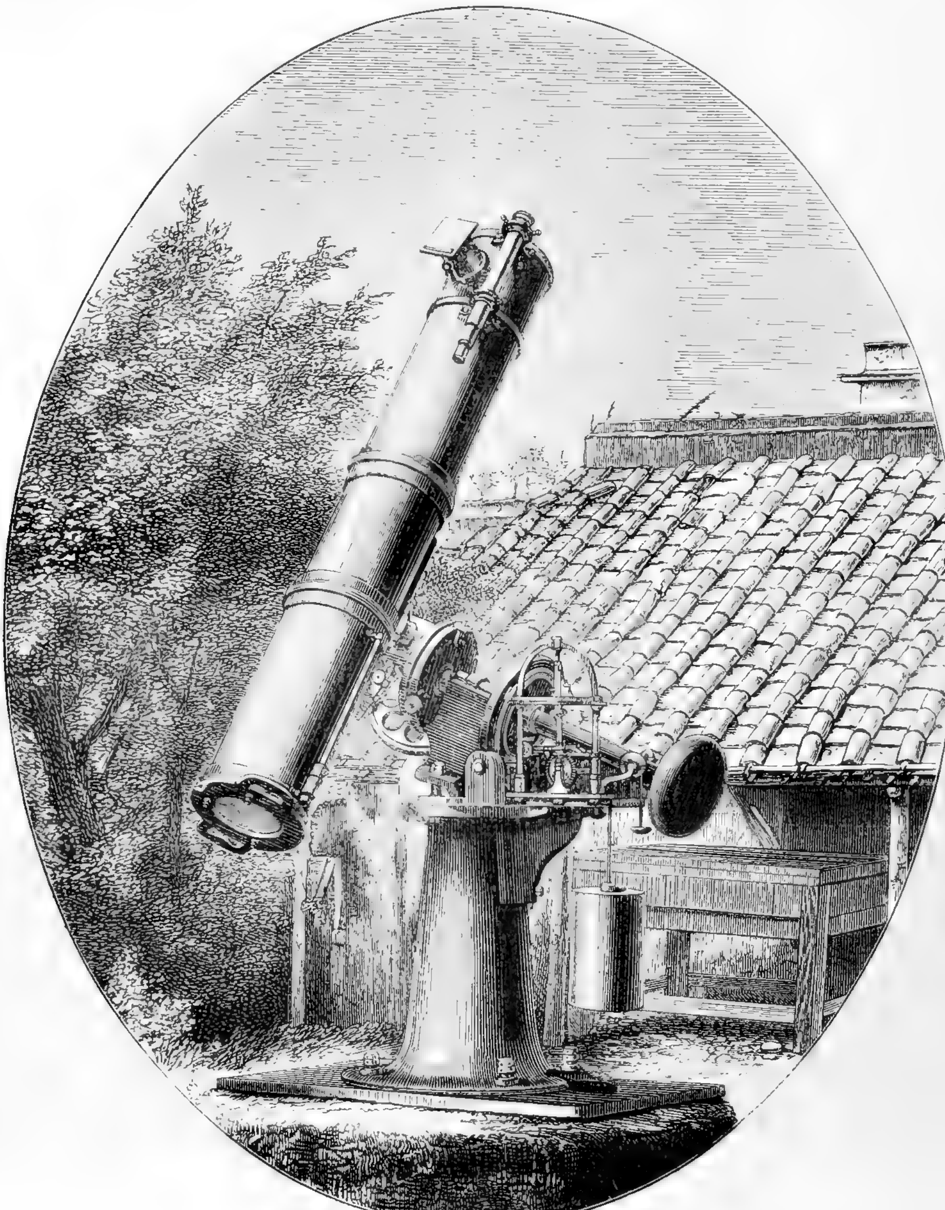


FIG. 1.—THE SILVER GLASS EQUATOREAL

The Indian eclipse was a notable one in the history of astronomy, for as the eclipse of 1860 endorsed the notion that the prominences were solar, so that of 1868 set at rest the gaseous nature of the red flames or red protuberances—so that we have two successive eclipses "settling" two important problems.

Thanks to the care of Mr. De la Rue, Major Tennant was fully provided with the means of photographing the eclipse as well as of determining by means of the spectroscope the nature of the spectrum of the prominences and of the corona. In our notice we may pass over the preface and the narrative of operations which includes the astronomical determination of the position of the observatory, and come to the spectroscopic observations.

We first have the spectrum of the corona. Major Tennant writes:—

Directly I saw the whole moon in the finder I set the cross-wires immediately outside its upper limb. By the time I got to the spectroscope, the cloudy range, seen in the photographs, had vanished from the slit, and I saw a very faint continuous spectrum. Thinking that want of light prevented my seeing the bright lines, which I had fully expected to see in the lower strata of the corona, I opened the jaws of the slit, and repeatedly adjusted by the finder, but without effect. *What I saw was undoubtedly a continuous spectrum, and I saw no lines.** There may have been dark lines, of course, but with so faint a spectrum and the jaws of the slit wide apart, they might escape notice.

We next have the spectrum of the Great Horn :—

One line in the red was so beautiful that it needed an effort to turn my attention to anything else; there was a line in the orange not so well defined, and one in the green which seemed multiple (it must be remembered that I had not time to adjust the jaws of the slit accurately, and that the brilliancy of these lines made them broader by irradiation); beyond, I saw a line just defined, which, as will be seen from the measures before given, must have been near to F, and still further off in the blue I saw a hazy light probably beyond G.

. . . .

The red and yellow lines were evidently C and D, the reading of the green line coincides with that of the brightest line in *b*, instead of the mean of the three, which I read as a verification; the line near to F was in all probability F itself; E was certainly not seen by me. The line in the blue it is useless from my data to speculate upon, I must hope that some one else has identified it.

* In the instructions for Lieut. Herschel his attention was first drawn to the protuberances. I therefore had resolved to attend first to the corona, lest each of us should have only the same partial tale.

It is pleasing to point out how very nearly Major Tennant's observations, as now given, approximate to the true state of the case, which we can now determine any day that the sun shines. He must be entirely congratulated on the degree of success of his spectroscopic observations—observations made, according to his report, under difficulties which he ought not to have encountered. Major Tennant's evidence in favour of the continuous spectrum of the corona has been entirely confirmed by the observations since made in America.

The photographic results we may introduce by a woodcut of the observatory and of the instrument, with speculum of nine inches aperture, mounted by Mr. Browning, with which the photographs were taken.

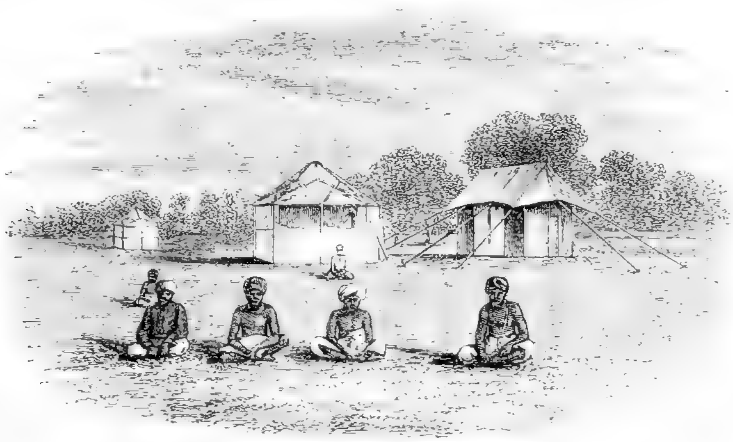


FIG. 2.—OBSERVATORY TENTS

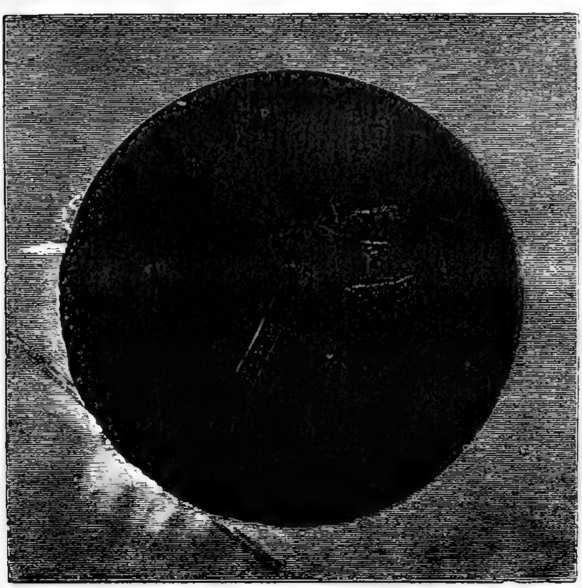


FIG. 3.—ONE OF THE FIRST PHOTOGRAPHS, SHOWING THE GREAT HORN

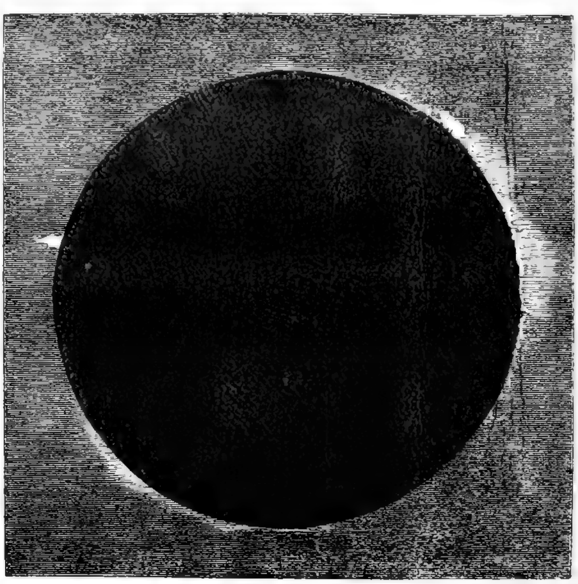


FIG. 4.—THE LAST PHOTOGRAPH TAKEN, SHOWING THE ANIMAL-LIKE PROMINENCE AND THE ECLIPSE OF THE GREAT HORN

The most notable phenomenon visible during the Indian eclipse was the Great Horn visible in Fig. 3, the structure of which was extremely curious. Below it in the drawing we have a part of the chromosphere, including a "flaring," which has been since called a "radiance" by the American astronomers. Fig. 4 was the last photograph taken, and here it is seen that the Great Horn is nearly eclipsed, and that the chromosphere on the opposite side of the sun is now exposed, including a strange animal-like form, which much struck the observers. An examination into the structure of the Great Horn is not the least interesting part of the report.

Major Tennant thus sums up his results :—

First.—The corona is the atmosphere of the sun not self-luminous, but shining by reflected light. It is evidenced both by the spectroscope and polariscope that this is the case, but there is one reservation to be made. The polariscope has shown clearly that the light of the brightest part of the corona is mainly reflected ; but, looking to the flare which is seen in photographs No. 2 and 3, it seems impossible to doubt that in those places there must have been some inherent luminosity in the corona ; unless indeed we consider the flare as a modified form of protuberance. It is, I think, now certain that luminous gas issues from what is more strictly the sun, and I apprehend this flare to be some of this.

Secondly.—The Great Horn certainly was composed of incandescent vapours, and probably all the brilliant protuberances are the same. In the Great Horn these vapours were hydrogen, sodium, and magnesium. It seems to me perfectly certain that the ignited hydrogen issued from the sun itself, and that it carried up with it the light vapours of sodium and magnesium far above the level at which they would naturally lie ; hydrogen naturally would be the very highest of the gaseous vapours, and consequently the coolest ; if, however, it were set free at the surface of the sun it would be intensely hot, and seek, with great violence, to ascend, in which process, if there be a stratum of heated vapours, such as is usually believed to exist round the sun, the hydrogen would partly displace and carry up these vapours, and the lighter would be taken in preference. In fact, in this case it has carried the two lightest, and that of iron, which is so much heavier (I think we may presume this from the absence of the line corresponding to E), was either displaced or dropped sooner than the height at which I observed. Photograph No. 1 shows that there were two jets of vapour concerned in forming this Horn. One, the largest and most northerly, is seen nearly perpendicularly to the limb, and seems also to have been the most luminous ; the other issues about 20,000* miles towards the south, and at an angle. They met at a height of some 16,000* miles, and the result was the rapid vorticose motion, which is evidenced in all the photographs as having existed in the upper portion. I believe I have the good fortune to be the first person to recognise such a phenomenon.

. . . .

I think that gases or vapours issuing quietly from the solar surface would tend locally to raise the superincumbent ignited vapours. In places where they were most abundantly given out the elevation would be greatest, everywhere the gas would leak through in streams, producing occasionally such phenomena as the flare I have spoken of in Nos. 2 and 3. For a time the ignited vapour might, I think, form, as it were, a case for the light included gas, which would be to all appearance inflated like the animal figure in No. 6. Soon, however, the slightly coherent casing would be burst and the gaseous contents would issue freely ; the heavier vapours would, of course, to some extent be carried off by the gas, but would mainly settle down in small masses. Such, I think, is the state depicted in the southern protuberance of No. 1.

I would now draw attention to Plate No. 1, and the glare and luminous stratum. If that glare be from sunlight, it must, I think, be acknowledged that the remaining ray was but small. The luminous nearly even stratum then is not the sun ; but it is intensely bright, so much so, that nowhere is it lost in the solar glare. Its height is but small (I estimate it at 7,200 miles), and I believe it to be the mass of heavy luminous vapours, to whose elective absorption we owe the Fraunhofer lines in the solar spectrum. At the north end of this stratum near the Great Horn, it is broken into beads of light ; † and I am disposed to think these are the veritable Baily's beads, of which I have always felt that the description would be difficult to apply to sunlight ; I mean the statement which has been made of the light being silvery, &c. If these beads are really phenomena of the absorbing stratum, one can well understand the use of such terms.

* These dimensions refer to the projections on a plane perpendicular to the visual ray.

† This is the same place where Captain Branfill saw beads.

In an addendum, in which the author's theory is attempted to be maintained, Major Tennant refers to the work which has been done in this country between the eclipse and the issue of the report. He considers that the sun is surrounded by an atmosphere sufficiently dense to reflect the solar light, but it is not explained why a continuous spectrum and not the solar spectrum is actually reflected; and that the hydrogen is enveloped in a denser atmosphere, resisting its diffusion and expansion, but why the spectrum of this atmosphere is so simple is not explained.

The author concludes by acknowledging the services rendered by Mr. De la Rue in the preparation of the report.

FALL OF A METEORITE

THE Director of the Meteorological Office has forwarded the following extract from a letter from M. Coumbary, Director of the Imperial Meteorological Observatory at Constantinople for publication :—

Constantinople, 9 mars, 1870

Mon cher Monsieur,—Je saisis l'occasion qui m'est offerte pour vous transmettre la communication que vient de nous faire M. Carabella, Directeur des Affaires Etrangères du Vilayet de Tripoli de Barbaru.

" Tripoli, 2 février, 1870

" Le Mutasserif de Mourzouk (Fezzan), latitude 26° N., longitude 12° E. de Paris, nous fait savoir que vers le 25 décembre, 1869, il est tombé à l'est de la ville, vers le soir, un immense globe de feu, mésurant un mètre à peu près de diamètre, et qu'au moment où il a touché terre il s'en est détaché de fortes étincelles qui, en se produisant, claquaient comme des coups de pistolet, et exhalaient une odeur que l'on n'a pas specifiée. Cet aërolithe est tombé à peu de distance d'un groupe de plusieurs arabes, parmi lesquels se trouvait le Chiok-el-Veled de Mourzouk. Ceux-ci en ont été tellement éffrayés qu'ils ont immédiatement déchargé leurs fusils sur ce monstre incompréhensible. Son Excellence Ali Riza Pacha a écrit à Mourzouk pour faire transporter ici l'aërolithe ; au cas probable où il soit trop pesant on le mettra en pièces ; nous vous enverrons tout cela. Il y a un mois de voyage d'ici à Mourzouk. Ce n'est donc que dans deux mois à peu près que nous pourrons vous faire cette expédition. S'il peut vous être de quelque intérêt de le savoir, je vous dirai que quelques voyageurs du Waddad que j'interrogeais m'ont dit que le Sultan du Waddad et tous les grands personnages de sa cour ont des poignards, des sabres et des lances faits avec du fer tombé du ciel, et qu'il en tombe de grandes quantités dans ce pays-là. (Sd.) " L. CARABELLA "

Je crois devoir vous informer qu'au reçu de cette lettre et à la suite des démarches nécessaires, S.A. le Grand Vizir a bien voulu faire donner ordre immédiatement par télégraphe à Tripoli, pour que l'on prenne les mesures nécessaires afin que ce météorite nous parvienne intact.—Recevez, cher monsieur, &c.,

(Sd.) ARISTIDE COUMBARY

NOTES

ON the 5th of March died at Vienna, Joseph Redtenbacher, Professor of Chemistry at the University. He was born in 1810, and studied under Eichig, conjointly with whom he published a determination of the atomic weight of carbon, and several other memoirs. His principal merit consists in the discovery of acrolein and acrylic acid. Most of his papers were published between 1839 and 1848. With his death chemistry in Austria passes entirely into younger hands ; his colleague, Professor Schröber, the discoverer of amorphous phosphorus, having lately been nominated Master of the Mint, and replaced in his chair by Illasiwetz. The succession of Redtenbacher will be divided into two parts, and the building of a new laboratory on the largest scale will open a vast field to the activity of his successors.

THE African traveller, Dr. Nachtigal, writing from Mursuk to the *Cologne Gazette*, on the 29th January last, gives some further particulars relative to the murder of Miss Tinné. He says that Sultan Omur, of Bornu, has sent a *meheri* (courier) to Mursuk, in order to make inquiries respecting the murder. The deceased lady's effects and servants have at length been despatched to Tripoli, though the former have not yet arrived. Yehenouchen, the Tuareg chief, has written to Europe, disclaiming all responsibility for the murder, as he had not promised his protection to Miss Tinné, or urged her to undertake the journey to Rhat. He is ninety years old, says Dr. Nachtigal, and has a great reputation for uprightness in his own country, but on the other hand, it is a fact, that his own nephew, Hadji el Schich, who attacked the unfortunate lady and her caravan, and murdered her after receiving her presents and other marks of friendship, is still living with Yehenouchen, and that the latter had directed the Marabout Hadji Ahmed Bu-Slah, who witnessed the murder without attempting to prevent it, either by word or deed, to provide Miss Tinné with an escort to Rhat.

THE chair of chemistry at Königsberg has been accepted by Dr. Gräbe of Leipzig, known through his papers on chinone and alizarin.

WE regret to announce that Professor Magnus of Berlin has been suffering for several months from a painful disease, which will, most likely, oblige him to interrupt his lectures for some time to come.

WE learn from the *Journal of the Society of Arts* that by the death of Mr. William Gibbs, which took place on the 28th ult., the South Kensington Museum acquires the collection of Roman and Anglo-Saxon antiquities collected by him.

MISS GARRETT has been admitted as a member of the medical staff of the East London Hospital for children, and was appointed one of the physicians on Wednesday last. This is the first hospital in Great Britain which has recognised in this manner the female medical movement.

IN the *Monthly Microscopical Journal* for March is an obituary notice by Mr. Joseph Lister, F.R.S., Professor of Clinical Surgery in the University of Edinburgh, of his father, the late Mr. J. J. Lister, F.R.S., to whom science is so much indebted for improvements in the microscope.

THERE is a project for the establishment of a Scientific College at Perth, intended to combine, on a small scale, the advantages of the *Ecole des hautes Etudes* and *Ecole Normale Supérieure* of Paris.

THE thirty-seventh session of the *Congrès Scientifique de France* will be held at Moulins in August next.

THE *Society of Arts Journal* reports that an International Exhibition of Agricultural Machines will be held at Arnheim, in June, July, and August.

THE *Scientific American* calls attention to an excellent improvement applied to the passenger car of the Beach Pneumatic Transit Company. The car, in size, is about the same as an ordinary street car, and a single zircon light illuminates its interior with brilliancy. Two small cylinders of compressed oxygen and hydrogen are carried on the car, from which pipes extend to a small burner that supports a piece of zircon, not more than a quarter of an inch long and one-eighth of an inch in diameter. Against this little piece of zircon the two gases impinge, and heat it so intensely as to make it glow with a clear and steady light. Those who fancy that underground railway riding in New York is likely to be a dark and dismal affair will receive new impressions on the subject when they enter the premises connected with the Broadway tunnel. One of the great advantages of the zircon light is that it burns like any other light without requiring adjustment. The light carried on the car before mentioned, burns steadily for seven hours without being touched. The zircon pencil lasts for three months, and is, in effect, the wick of the light.

THE annual meeting of the Cotteswold Naturalists' Field Club was held at Gloucester on Feb. 23rd. It was stated that the forthcoming volume of the "Transactions" would contain a most valuable and elaborate paper by Mr. Lucy, F.G.S., which attempts to unravel the intricate history of the distribution of the erratic boulders, boulder drift, quaternary gravels, &c., of the Severn valley, over a given area; a contribution of the highest value to science, and one full of facts of the greatest importance, in elucidating the old physical geography and geology of the Severn valley since the close of the Pliocene epoch. The Transactions would also contain an admirable paper from the pen of Dr. Wright, F.R.S.E., on the "Correlation of the Jurassic beds of France and Switzerland with those of Gloucestershire and Wilts." These papers, both splendidly illustrated by maps and woodcuts, many of which were exhibited to the meeting, were highly eulogised by the president, and referred to as fully maintaining the already high scientific reputation of the "Transactions of the Cotteswold Club." The field meetings for the year have been fixed to take place at Cirencester, Ross, Painswick Hill, Moreton-in-Marsh, and a "foreign meet" at Watchett in Somerset, later in the season, if the weather permit.

A SOMEWHAT violent shock of earthquake was felt at Trieste on the 28th of February, at 12·20 p.m. The oscillatory movement from east to west lasted from two to three seconds. The following day at 8·56 p.m. the motion was repeated with greater violence. There was a loud rolling noise, and articles of furniture were thrown down in the houses.

DR. WILHELM HAMM, an official of the Austrian Ministry of Agriculture, and well known as author of the "Weinbuch" (Leipzig, J. Weber), has constructed a Weinkarte, published by Costenoble, Jena, exhibiting at a glance the topography, climatology, and statistics of wine-growing in Europe and the islands of the Atlantic. The habitats, climates, and quantities produced; the various growths and qualities of each; and the wine measures, &c., are all indicated in this map.

SIR WILLIAM THOMSON, having had his attention directed to the very great differences that exist in the conducting quality of copper wire professing to be of the "highest conductivity," had a large number of specimens carefully tested and the following are some of the results obtained—the quality is indicated by the resistance of a metre length weighing one gramme. The best specimen was one supplied by M. Bréguet, Paris, of which the resistance was ·153 of an ohm per metre weighing one gramme. Specimens from English manufacturers varied as follows:—·165, ·169, ·171, ·178, ·206, ·213, ·221. Seven specimens labelled "highest conductivity," stood as follows:—·156, ·182, ·201, ·205, ·223, and ·258. As it is to the interest of all scientific men that the copper wire used in electrical instruments shall be of the best quality, there should be general co-operation to discourage as much as possible the use of inferior copper. Variations in conductivity like those in the samples of copper mentioned above would produce instruments varying to the extent of 40 per cent.

THE publishers of the *Canadian Naturalist* announce that the periodical is in future to appear quarterly instead of six times a year as heretofore, but the quantity of matter, 480 pages, is not to be diminished. Another and an important particular is, that "the basis of the magazine has been so extended as to include a larger field of popular scientific scope than formerly. Especially with regard to the technology of geological, mining, chemical and agricultural science, new materials will be made available while a general summary of scientific facts and discoveries will form an important feature." An editorial committee, comprising some of the foremost scientific men in Canada, has been appointed and the publication remains, as before, under the "auspices" of the Natural History Society of Montreal. The number just received in this country contains, in addition to a batch of articles on different subjects in natural history, one on the partial eclipse of the sun in August last, as observed at Montreal, by Dr. Smallwood.

AN interesting report on the ravages of the Borer in Coffee estates has just been published by George Bidie, M.B., F.R.G.S. The coffee plant, as is well known, is not indigenous to Southern India, but was first introduced into India upwards of two centuries ago, by a Mussulman pilgrim, Bababooden, who on his return from Mecca brought a few berries in his wallet, and taking up his abode in the hills of Mysore, planted them near his tent, and from these the greater portion of the coffee now growing in Southern India has been derived. It is a native of Caffa in Southern Abyssinia. It is now largely cultivated in Mysore, Cuddoor, Coorg, and other parts along the crests and slopes of the Ghauts. It is a remarkably hardy plant, thriving at various elevations, and under the most different conditions of moisture, soil, and temperature. It is, however, liable to the attacks of certain insects, amongst which the Borer is the most formidable. This is shown by Dr. Bidie to be the larva of a beetle belonging to the Cerambycidæ, and termed the *Xylotrechus quadrupes*. The female lays its eggs in the bark of the plants, hot sunshine favouring their hatching. The larva immediately pierces the bark, and derives its nourishment from the more juicy layers, producing, by the damage it causes, exhaustion of the tree and loss of the crop. The whole duration of the life of the animal from the deposition of the ovum to the death of the beetle does not exceed twelve months. The animal appears to be indigenous, and the causes that have led to the great increase in its ravages during the last few years are drought, want of shade, bad culture, destruction of forest trees in which the insect used to live, and departure of some of its enemies.

THE following changes are announced in the arrangements of the staff of St. Bartholomew's Hospital. One assistant-physician is to have charge of the casualty department; three casualty physicians are to act with him; and one casualty surgeon is to superintend the surgical side. The house-surgeons will have charge of casualty patients.

THE Geographical Society of St. Petersburg has decided to send a scientific expedition into Manchouria and Eastern Mongolia, for the purpose of making archæological and ethnographical researches in those countries. The expedition is to start next April, under the direction of the Archimandrite Palladiy, chief of the Russian mission at Pekin. It is said that the Emperor has contributed 5,000 roubles towards the expenses of the expedition.

THE rainfall of the year ending December 31, 1869, as taken in the neighbourhood of Charing Cross, is registered as follows:—

Height of gauge above ground.	Number of inches fallen.
6 feet	23·760
64 „	22·110

MR. E. W. HILGARD, in his Geological Reconnaissance of Louisiana, finds reason for the assumption that "the Gulf coast has in late quaternary times suffered a depression to the extent of at least 900 feet—perhaps more—and during the terrace epoch a contrary motion to the extent of about half that amount." Elsewhere he remarks, "the age of the great gypsum formation has been the subject of much discussion. It has always seemed to me that the great extent of the area over which the cretaceous beds and underlying gypsum are known to be co-extensive, went far to prove that they belonged substantially to the same epoch. Whatever weight may attach to this argument it is greatly enhanced when we find the crystalline limestone and underlying gypsum not only reappearing in northern Louisiana, but actually accompanying each other beneath the waters of the Gulf of Mexico. Whether the volcanic agencies which even now so frequently disturb that great basin, have been instrumental in reducing the sulphur, distilling the petroleum and crystallising the rock salt of southern Louisiana, may be more profitably discussed when more extensive excavations shall have given us an opportunity of closer inspection of the facts."

IN reference to the electro-deposition of nickel, M. Bouilhet states that Jacobi published a method of obtaining thick coatings of nickel by using perfectly neutral solutions. *Cosmos* points out that nickel is especially abundant in Spain.

*ON THE TEMPERATURE AND ANIMAL LIFE OF THE DEEP SEA**

II.

DURING the first and second cruises of the *Porcupine*, the temperature of the eastern border of the great North Atlantic basin was examined at various depths between from 54 to 2,435 fathoms, and in widely different localities, ranging from lat. 47° to lat. 55°. The bottom-temperature was ascertained at thirty stations, and serial soundings were taken at seven stations; making the total number of observations eighty-four. (Table II., p. 20.) Amongst all these the coincidence of temperatures at corresponding depths is extraordinarily close; the chief differences showing themselves in the temperature of the surface and of the stratum immediately beneath it. A decided superheating is observable in this superficial stratum, not extending to a depth of much more than 70 or 80 fathoms, and more considerable at the southern than at the northern stations. Whether this "superheating" is entirely due to the direct influence of solar heat, or depends in any degree on an extension of the Gulf Stream as far as the southern part of the area examined, is a question which can only be resolved by the determination of its relative amount at different seasons. Between 100 and 500 fathoms, the rate of decrement is very slow, averaging only about 3° in the whole, or three-fourths of a degree for every 100 fathoms; and this body of water has a temperature so much above the isotherm of the northern stations at which the observations were made, as decidedly to indicate that it must have found its way thither from a southern source. Between 500 and 750 fathoms, however, the rate of decrease becomes much more rapid, the reduction being 5·4°, or above 2° per 100 fathoms; while between 750 and 1000 fathoms it amounts to 3·1°, bringing down the temperature at the latter depth to an average of 38·6°. Beneath this there is still a slow progressive reduction with increase of depth, the temperature falling a little more than 2° between 1000 and 2,435 fathoms; so that at the last-named depth, the greatest at which it was ascertained, it was 36·5°.—Thus it is obvious either that the vast body of water occupying the deeper half of the Atlantic basin has been itself derived from a colder region, or that its temperature has been reduced by the diffusion through it of frigid water from a Polar source. The latter supposition best accords with the gradual depression of temperature exhibited between 500 and 1000 fathoms, which corresponds with the "stratum of intermixture" of the cold area.

The temperature soundings recently taken by Commander Chimmo, R.N., and Lieutenant Johnson, R.N., at various points in the North Atlantic basin, when the requisite corrections are applied for the influence of pressure on the bulbs of the unprotected thermometers employed by them, give results which are remarkably accordant with our own; so that it may be stated with confidence that the temperature of the deeper parts of the North Atlantic sea-board is but a very few degrees above the freezing-point.

Now a glance at the North Polar region, as laid down either on a globe, or any projection of which the Pole is the centre, shows that the Polar basin is so much shut in by the northern shores of the European, Asiatic, and American continents,

* A Lecture delivered at the Royal Institution (continued from p. 490).

that its only communication with the North Atlantic basin—besides the circuitous passages leading into Hudson's and Baffin's Bays—is the space which intervenes between the eastern coast of Greenland and the north-western portion of the Scandinavian peninsula. If, therefore, there be any such general interchange of Polar and Equatorial water as that for which we have argued, the Arctic current must flow through the deeper portions of this interspace, at the north of which lies Spitzbergen, whilst Iceland and the Faroes lie in the middle of its southerly expanse. Now in the channel that lies between Greenland and Iceland, the depth is such as to give a free passage to such a frigid stream; but between Iceland and the Faroe Islands there is no depth so great as 300 fathoms at any part, except in a narrow channel at the south-east corner of Iceland; so that an effectual barrier is thus interposed to any movement of frigid water at a depth exceeding this. A similar barrier is presented, not merely by the plateau on which the British Islands rest, but also by the bed of the North Sea; the shallowness of which must give to such a movement a not less effectual check than would be afforded by an actual coast-line uniting the Shetland Islands and Norway. Consequently, it is obvious that a flow of ice-cold water, at a depth exceeding 300 fathoms from the surface, down the north-eastern portion of this interspace, can only find its way southwards through the deeper portion of the channel between the Faroe and Shetland Islands; which will turn it into a W.S.W. direction between the Faroe Islands and the north of Scotland, and finally discharge such part of it as has not been neutralised by the opposing stream coming up from the south-west, into the great North Atlantic basin, where it will meet the Icelandic and Greenland currents, and unite with them in diffusing frigid waters through its deeper portion. In thus spreading itself, however, the frigid water will necessarily mingle with the mass of warmer water with which it meets, and will thus have its own temperature raised, whilst lowering the general temperature of that mass; and hence it is that we do not find the temperature of even the greatest depths of the Atlantic basin nearly so low as that of the comparatively shallow channel which feeds it with Arctic water.

It may be questioned, however, whether the whole body of Arctic water that finds its way through the channels just indicated, could alone maintain so considerable a reduction in the temperature of the enormous mass which lies below 1,000 fathoms in the Atlantic basin; subject as this must be to continual elevation by the surface-action of the sun on its southern portion. And as the few reliable observations on deep-sea temperatures under the equator indicate that even there a temperature not much above 32° prevails, it seems probable that part of the cooling effect is due to the extension of a flow of frigid water from the Antarctic Pole, even north of the Tropic of Cancer. Of such an extension there is evidence in the temperature-soundings recently taken in H.M.S. *Hydra* between Aden and Bombay, where the cooling influence could scarcely have been derived from any other source than the Antarctic area.*

The unrestricted communication which exists between the Antarctic area and the great Southern ocean-basins would involve, if the doctrine of a general Oceanic circulation be admitted, a much more considerable interchange of waters between the Antarctic and Equatorial areas, than is possible in the Northern hemisphere. And of such a free interchange there seems adequate evidence; for it is well known to navigators that there is a perceptible "set" of warm surface-water in all the Southern oceans towards the Antarctic Pole; this "set" being so decided in one part of the Southern Indian Ocean, as to be compared by Captain Maury to the Gulf Stream of the North Atlantic.† Conversely, it would appear from the application of the necessary pressure-correction to the temperatures taken in Sir James Ross's Antarctic expedition, the voyage of the *Venus*, &c., at depths greater than 1,000 fathoms, that the bottom-temperature of the deepest parts of the Southern Oceanic basin really approaches the freezing-point, or is even below it. And if the temperature of the deeper portion of the North Pacific Ocean should be found to exhibit a depression at all corresponding to that of the North Atlantic, it must be attributed entirely to the extension of this Antarctic flow; since the depth

* The lowest temperature actually observed in these soundings was 36½°. The temperature of 33½° given in the previous discourse, as existing below 1,800 fathoms, proves to have been only an estimate formed by Capt. Shortland under the idea that the rate of reduction observed at smaller depths would continue uniform to the bottom, which the serial soundings of the *Porcupine* prove to be by no means the case.

† "Physical Geography of the Sea," §§ 748-750.

of Behring's Strait, as well as its breadth, is so small as to permit no body of Arctic water to issue through that channel.

If further observations should substantiate the general diffusion of a temperature not much above the freezing-point over the deepest portions of the ocean-bed, even in Intertropical regions, as a result of a general deep movement of Polar waters towards the Equator, forming the complement of the surface-movement of Equatorial water towards the Poles, it is obvious that such diffusion must exert a very important influence on the distribution of animal life; and, in particular, that we may expect to meet with forms which have hitherto been reputed essentially Arctic, in the deep seas of even the Intertropical region, and again in the shallower water of the Antarctic area. Such, there is strong reason to believe, will prove the case. In his recent annual address as President of the Royal Society, Sir Edward Sabine cites observations on this point made by Sir James Ross in his Antarctic expedition, as confirmatory of the view entertained by that distinguished navigator, "that water of similar temperature to that of the Arctic and Antarctic seas exists in the depths of the intermediate ocean, and may have formed a channel for the dissemination of species." The "similar temperature" believed by Sir James Ross to have had this general prevalence, seems to have been 39°; whereas the observations made in the *Porcupine* expedition distinctly prove that a temperature even below 30° may be conveyed by Polar streams far into the temperate zone, and that the general temperature of the deepest part of the North Atlantic sea-bed has more of a Polar character than he supposed.

Again, the deep-sea dredgings of the *Porcupine* expedition have shown that many species of mollusks and crustacea previously supposed to be purely Arctic, range southwards in deep water as far as those dredgings extended—namely, to the northern extremity of the Bay of Biscay; and it becomes a question of high interest whether an extension of the same mode of exploration would not bring them up from the abysses of even intertropical seas.

Now, as there must have been deep seas at all geological epochs, and as the physical forces which maintain the oceanic circulation must have been in operation throughout, though modified in their local action by the particular distribution of land and water at each period, it is obvious that the presence of Arctic types of animal life in any marine formation cannot be accepted as furnishing evidence *per se* of the general extension of glacial action into temperate or tropical regions. How far the doctrines now current on this point may need to be modified by the new facts now brought to bear on them, it will be for geologists to determine; the question may be left in their hands with full assurance of a candid reception of the fresh evidence now adduced.

The general results of the dredging operations carried on during the *Porcupine* expedition will now be concisely stated.

In the first place they show conclusively that there is no limit to the depth at which animal life may exist on the ocean-bed; and that the types found at even the greatest depths may be not less elevated in character than those inhabiting shallower waters. It would even be premature yet to affirm that the higher types occur in less abundance and variety than at more moderate depths; for it is by no means impossible that the use of the improved method of collection devised by Captain Calver,* which was employed with extraordinary success in the third cruise, may make as large an addition to our knowledge of the life of the sea-bottom explored by the dredge in the first and second cruises of the *Porcupine*, as it has done in the case of the cold area, where it revealed the astonishing richness of the bottom, which the *Lightning* dredgings of the previous year had led us to regard as comparatively barren.

Secondly, they confirm our previous conclusion that temperature exerts a much greater influence than pressure on the distribution of animal life. Not only have we found the same forms presenting themselves through an enormous vertical range—no amount of fluid pressure being incompatible with their existence—but we have also, by a more complete survey of the relations of the warm and cold areas, established the very marked difference between the faunæ of two contiguous portions of the sea-bed lying at the same depth, which was indicated by the *Lightning* dredgings. It is remarkable, however, that this difference showed itself more in the crustaceans, echinoderms, sponges,

* This consists in the attachment of "hempen tangles" to the dredging apparatus, by which the floor of the ocean is *swept* as well as *scraped*. These tangles often came up loaded, when the dredge was empty.

and foraminifera, than it did in the mollusca, of which a considerable proportion were common to both areas. The abundance and variety of animal life on a bottom of which the temperature is at least 2° (Fahr.) below the freezing-point of fresh water, is a fact which has all the interest of surprise; and it is scarcely less remarkable that the forms of mollusks, echinoderms, and sponges, which seem to be the characteristic inhabitants of this cold area, should attain a very considerable size. The precise limitation of the Globigerina-mud and of the vitreous sponges to the warm area, was a very striking manifestation of the influence of temperature, and has very important geological bearings.

Thirdly, they have largely added to the number of cases in which types that had been regarded as characteristic of earlier geological periods, and to have long since become extinct, prove to be still existing in the depths of the ocean; and greatly increase the probability that an extension of the like method of research to more distant localities would produce even more remarkable revelations of this character.

The doctrine propounded by Professor Wyville Thompson, in the report of the *Lightning* expedition, as to the absolute continuity of the cretaceous formation with the deposit of globigerina-mud at present in progress on the North Atlantic sea-bed, has received such striking confirmation from the discovery of the persistence of numerous cretaceous types, not merely in our own explorations, but also in those carried on by the United States Coast Survey in the Gulf of Mexico, that it may be fairly affirmed that the *onus probandi* rests upon those who assert that the formation of true chalk has ever been interrupted since the cretaceous period. That period is usually considered to have terminated with the elevation of the cretaceous deposits of the European area into dry land. But according to the accepted doctrines of geology, it is highly probable that, coincidently with the elevation of the European area, there was a gradual subsidence of what is now the Atlantic sea-bed; so that the *Globigerinæ* of the former area, with many accompanying types of animal life, would progressively spread themselves over the latter, as its conditions became favourable to their existence. And there seems no reason why they should not have maintained themselves in its deepest parts, through the comparatively small changes of level which took place in this portion of the earth's crust during the Tertiary epoch.

Fourthly, the *Porcupine* explorations have enormously extended our knowledge of the British marine fauna; alike by the discovery of new types, and by the addition of types previously known only as inhabitants of other localities.—The mollusca alone have as yet been fully examined; and Mr. J. Gwyn Jeffreys, whose authority upon this part of the subject is not second to that of any other naturalist, reports as follows:—The total number of species of marine mollusca enumerated in his recently completed "British Conchology" (excluding the Nudibranchs) is 451; and to these the *Porcupine* expedition has added no fewer than 117, or more than one-fourth. Of these as many as fifty-six are undescribed, whilst seven were supposed to be extinct as Tertiary fossils. Sixteen genera, including five which are undescribed, are new to the British seas. "All that I can do," he says, "by continual dredgings in comparatively shallow water during the last sixteen years was to add about eighty species to the number described by Forbes and Hanley. I regard the present (although a large) addition as merely an earnest of future discoveries. In fact the treasury of the deep is inexhaustible." The complete examination of the crustacea, which are in the hands of the Rev. A. M. Norman, and of the annelids, which have been undertaken by M. Claparède and Dr. Macintosh, will probably yield results scarcely less striking. It is, however, in the echinoderms and sponges, which are being examined by Professor Wyville Thomson; in the stony corals, which have been referred to Dr. P. M. Duncan; and in the foraminifera, which constitute the speaker's own speciality, that the most interesting novelties present themselves.

W. B. CARPENTER

SCIENTIFIC SERIALS

THE February number of the *American Naturalist* (Vol. iii. No. 12) contains only three original articles, and of these the first and most important is really a reprint of Professor Wyman's observations on the development of the thornback, with a few introductory remarks on the natural history of the skates, by Mr. F. W. Putnam. The other two are the continuation of Mr. J. A. Allen's notes on the rarer birds of Massachusetts, and a paper on common fresh-water shells, by Mr. E. S. Morse. Professor Williamson's article on *Bathybius* is reprinted from the *Popular Science Review.*

A SHORT paper appears in the last number of Tröschel's *Archiv für Naturgeschichte* from the pen of Dr. A. A. Krohn, on the earliest development of the Botryllus stock, which, as most of our readers are probably aware, constitutes one of the Tunicate Molluscs analogous to the misshapen bodies found so commonly on our sea coasts, and known as "dead men's fingers." Hitherto certain processes found at the anterior end of the larva have been regarded as the germs or buds of new individuals which subsequently become completely differentiated, but M. Krohn shows that these are clavate processes, constituting the first rudiments of the blood-vessels which make their appearance soon after the metamorphosis of the larva. After a short time the vessels begin to branch, each branch terminating in a dilated cœcal enlargement resembling the calyx of the common *Erica tetralix* in form, and at this time a round projection appears on the right side of the body, near the heart, into which a stream of blood from the mother sets, and having circulated around it returns to its starting point. It now, curiously enough, begins, together with the mother animal, to shrink, and finally disappears, and in its place a daughter Botryllus is developed. The daughter Botryllus forms two buds, a right and a left, while itself passes through the same stages as the original mother, becoming also fluid and disappearing. The two buds of this third generation, when fully developed, have their cloacal apertures opposed, and each gives off two buds which are arranged with the parents in a circular manner, and these four buds may again give off others, and so regularly arranged systems of the animals are produced, the vascular system undergoing corresponding development and extension. The blood contains colourless corpuscles, and under certain circumstances a number of dark pigment granules present in the bodies of the successive generations, on undergoing atrophy appear to gain entrance into the circulating fluid.

THE *Revue des Cours Scientifiques* for the 19th inst. contains a report of a lecture by M. Claude Bernard on the history of medical science and its actual condition; of one by M. Harny, on human remains in the tertiary deposits in America, and on the theories of multiple centres of creation; and of one by Dr. Bertillon on the mortality of different departments of France.

IN the just published *Proceedings of the Royal Society of Edinburgh* for the session 1868-69, Professor Allman gives a description of Rhabdopleura, a new genius of Polyzoa. The cœnæcium or common stem consists of a branched tube partly adherent and partly free, the free portion forming tubes of egress through which the polypides move in the acts of exsertion and retraction. In the walls of the adherent portion a rigid chitinous rod is developed along their attached side, from distance to distance, each by a flexible cord or funiculus. The polypides are hippocrepian, and each carries a shield-like process on the hæmal side of its lophophore, external to the tentacular series. In development the polypide at an early stage is included between two fleshy plates on the right and left sides respectively, and which are partially united. For some time the two plates keep pace with the general development of the bud, but ultimately they cease to increase in size, and then remain as the shield-like processes carried by the lophophore of the polyzoon. Professor Allman regards these plates as representing the right and left lobes of the mouth in a Lamellibranchiate Mollusk, from which it follows that the relations of the Polyzoa are more intimate with the Lamellibranchiata than with the Brachiopoda, with which of late years they have been associated, but whose mantle lobes lie dorsally and vertically, instead of lying right and left as in the Lamellibranchiata. The lophophore of the Polyzoa he considers to have its representative in the labial palps of the Lamellibranchiata. The animal was obtained by the Rev. A. Norman and Mr. J. Gwyn Jeffreys in the course of deep-sea dredging in Shetland.

THE *Journal of the Chemical Society* for February is mainly occupied by a long paper by Mr. F. A. Abel, entitled "Contributions to the history of explosive agents," abstracted from the Philosophical Transactions for 1869. There are also shorter articles on nontronite, and on a new chromium oxychloride, by Dr. T. E. Thorpe, and observations on the solution of gases in water by Dr. Williamson.

THE *Monthly Microscopical Journal* for March contains the President's Address, an obituary notice of the late J. J. Lister, F.R.S., and articles on the structure of the stems of the arborescent *Lycopodiaceæ* of the coal measures, by Mr. Carruthers, and on the mode of examining the microscopic structure of plants.

SOCIETIES AND ACADEMIES

London

Royal Society, March 10.—The following paper was read: "On some elementary principles in animal mechanics. No. 3—On the muscular forces employed in parturition," by the Rev. S. Haughton.

March 17.—Papers were read as follows:—"On the law which regulates the relative magnitude of the areas of the four orifices of the heart," by D. H. Davies; and "On the estimation of ammonia in atmospheric air," by Mr. H. T. Brown. The process recommended is by the absorption of the ammonia by extremely dilute sulphuric acid, and the results obtained are said to be far more concordant than those procured by other means.

The Royal Astronomical Society, March 11.—Mr. W. Lassell, president, in the chair. Sixty-three presents were announced as having been received since the third meeting, and the thanks of the society were voted to their respective donors. A communication from Mr. Marsh was then read, in which that observer records the position-angles and apparent distances of the satellites of Uranus. It was ordered that this paper be printed forthwith.—The next paper was by Lieut. Herschel. In a letter to his brother, Prof. Alexander Herschel, the writer remarked on certain singular objects seen to traverse the sun's disc on October 17th and 18th, 1869. He was about to apply his spectroscope to the observation of a solar prominence when his attention was attracted to certain shadows traversing the disc of the sun, which became bright streaks when they had passed beyond it. At first he thought these appearances were due to sparks in the tube of the telescope, but the phenomenon lasted too long for this explanation to be available. He next thought that perhaps a system of meteors might be in transit, and prepared to subject the phenomenon to careful scrutiny. The equatorial was set in motion, the sun's disc being projected on a screen. The shadows were seen persistently traversing the solar disc, but at different velocities, the larger ones travelling most swiftly. There appeared to be two streams. He noticed that when the sun was in focus the objects were indistinct, and that they appeared very distinctly when he focussed on a distant cloud. At length, while he was attentively scrutinising the phenomenon he saw one of the objects come suddenly to a standstill, and then whisk off in a different direction; and then he perceived that the phenomenon he had been examining with such anxious care was not in reality an astronomical phenomenon at all, but consisted merely of a flight of locusts. He considered, however, that not only was the existence of so enormous a swarm of locusts as the duration of the stream indicated, an interesting fact in itself, but that we might find in the occurrence the explanation of many statements which had been made respecting meteors supposed to have transited the sun, and also of some peculiarities noticed by astronomers in America during the total eclipse of last year. Mr. Stone said that it was important when appearances of this sort were noticed that the observer should examine, as Lieut. Herschel had done, whether the objects seen in transit required the same focus as the sun. This was the best way of determining whether the objects were terrestrial or not.—Capt. Noble communicated three short papers to the society. The first had reference to occultations of stars by the moon. The second referred to the visibility of Venus near her inferior conjunction. He could detect only an arc of light less than a semicircle, and saw the body of the planet projected on the sky beyond, the planet appearing sensibly darker than the sky. On March the 3rd he saw the Zodiacal Light for the first time. He was struck by the fact that instead of appearing nearly coincident with the ecliptic, the light seemed inclined at an angle of about twenty degrees to that circle. It seemed, in fact, almost perpendicular to the horizon.—Mr. Browning exhibited some more drawings of Jupiter, remarking on the changes of form and colour which the belts on the planet had exhibited during the past few months. The president inquired whether a picture by Mr. Browning, in which the equatorial belt appeared twice as wide as usual, was not slightly exaggerated; but Mr. Browning remarked that it presented the planet exactly as he had seen it.—Mr. Procter then read a paper entitled "Notes on the Corona and the Zodiacal Light, with suggestions respecting the modes of observation to be applied to the Eclipse of next December." He remarked that if we have in reality sufficient evidence to determine whether the corona is or not a solar appendage, it would be a misfortune, and in a sense discreditable, to science, were the short time at the disposal of observers wasted in futile observations directed to settle a point determinable beforehand. He then expressed his conviction that the corona cannot be a terrestrial phenomenon. He pointed out that the very blackness of the moon as compared with the corona showed that the coronal light is behind the moon. The moon is, in fact, projected on the corona as a background, he urged, whereas the theory that the light is due to atmospheric glare requires that the corona should be a foreground. But passing over this argument, which is liable to the fatal objection of being too simple, he proceeded to inquire whether air which lies between the observer and the corona is in reality illuminated. He showed that all round the sun, for a distance of many degrees, there should be perfect darkness if the illumination of the atmosphere by direct solar light were in question. As to the atmospheric glare due to the chromosphere and prominences, he argued that it must be relatively small because it could bear no higher proportion to the actual light of the chromosphere, than ordinary atmospheric glare bears to actual sunlight, and we know this proportion is very small indeed. Again, as to light reflected from the atmosphere outside the shadow-cone, or from the surface of the earth, he urged that that also must be small, since not any part of the atmosphere above the observer's horizon was illuminated by more than a half-sun, while all the parts near the shadow-cone were in nearly total shadow. But a fatal objection to the view that the corona could be due to either the glare from the prominences or to light reflected from the surrounding air consisted in the fact that such glare ought to cover the moon's disc. He then referred to a number of observations confirming the view that the coronal light is not terrestrial; as the appearance of glare during partial eclipses, this glare always trending on the moon's disc; the relatively greater darkness of the central part of the moon's disc in annular eclipses; the visibility of that part of the moon's disc which lies beyond the sun in partial eclipses, the limb being seen dark on the background of the sky; the visibility of the corona in partial eclipses, even its most distinctive peculiarities having been recognised when the sun's disc is not wholly covered; and several other phenomena. He then adduced evidences to show that a solar appendage which one would expect to appear during total eclipses, actually does exist. First the Zodiacal Light shows that the sun is surrounded by such an appendage. Dr. Balfour Stewart's theory of this object, however physically sound, was opposed, he urged, by too many astronomical objections to be accepted for a moment: an object which exhibits no appreciable parallax, which rises and sets as the celestial objects do, and maintains a position in the heavens having a nearly constant relation to the ecliptic, cannot by any possibility be due to any peculiarity of the earth's atmosphere. Then Leverrier has shown that the motion of Mercury's perihelion indicates the presence of a ring of bodies in the sun's neighbourhood; and Mr. Baxendell has drawn a similar conclusion from the meteorological records of well-known observatories. Lastly, judging of the meteor systems according to the laws of probability, we have every reason to believe that for each one our earth encounters there must be millions whose perihelia lie within the earth's orbit. Since the earth encounters fifty-six such systems, it will be seen how enormous must be the total number. These should be visible during total eclipses, and since they would shine in part by reflected light, and in part through their intrinsic light (for those which come as near the sun as some comets have been observed to do, must be melted or even vaporised by the sun's heat) we have an explanation of the contradictory accounts given by those who have applied the polariscope and the spectroscope to the solar corona. Mr. Stone remarked that there ought to be three sets of observations made with the polariscope next December, since if there were but two the result would probably be contradictory, as was the case with regard to the observations made in India in 1868, and in America last year. Different parts of the corona ought also to be examined.

Zoological Society, March 10.—John Gould, F.R.S., V.P., in the chair. The secretary spoke of the additions to the society's menagerie during the month of February, amongst which were particularly noticed a collared fruit-bat (*Cynonycteris collaris*), born in the society's monkey-house on the 25th inst., being the first instance on record of a birth amongst these animals in captivity, and a kangaroo, believed to belong to a new species, for which the name *Macropus erubescens* was proposed.—Prof. Flower exhibited a drawing of a Cetacean animal lately captured in a mackerel-net off the coast of Cornwall, which he identified with *Globiocephalus rissoanus*—a species hitherto only known to occur in the Mediterranean. The specimen was stated to be an adult female, about eleven feet long.—Mr. Sclater gave some additional details as to the correct locality of Amherst's pheasant (*Thaumalea Amherstiæ*), in reference to Mr. Swinhoe's communication on the same subject at the previous meeting.—Prof. Owen read a memoir containing descriptions of various bones of *Aptornis defossor*, *A. otidiformis*, *Notornis Mantelli* and *Dinornis curtus* obtained from deposits in different parts of New Zealand, and forming the fifteenth part of his series of memoirs on the extinct birds of the genus *Dinornis* and their allies.—Mr. R. Swinhoe read three papers on new or little known birds obtained by him in different parts of the Chinese Empire. The first of these related to new species obtained during a recent voyage up the Yangtze, amongst which were species of *Parus*, *Lanius*, *Ægithalus*, and other genera of *Passeres*. The second contained supplementary remarks on the pied wag-tails (*Motacillæ*) of China, in continuation of a former paper on the same subject. The third paper contained a notice of the different species of shore-plovers (*Ægialitis*) found in China, amongst which was a conspicuous new species obtained on the Yangtze, and proposed to be called *Ægialitis Hartingi*.—Mr. H. B. Sharpe read the second of a series of papers on the birds of Angola, containing an account of collections forwarded from that couutry by Mr. Monteiro. Amongst these was a bush-shrike belonging to the genus *Laniarius*, supposed to be new, and proposed to be called *Laniarius Monteiri*.—Dr. Günther read a note on the locality of the Batrachian recently described by him as *Megalixalus robustus*, which was stated to be from the Seychelles.—Dr. Günther read a paper on the genus *Prototroctes*, which contains two species of fishes from the fresh waters of Southern Australia and New Zealand. In general appearance these fishesr esemble *Coregonus*, but their internal structure had led Dr. Günther to constitute them along with the South American genus *Haplochiton*, a distinct family, *Haplochitonidæ*, which appeared to be the representative of the Salmonoid group in the southern hemisphere.—A communication was read from the Rev. O. P. Cambridge, containing descriptions of three new species of the Arachnida of the genus *Idiops*, in continuation of a former paper on the same subject.

Mathematical Society, March 10.—Professor Cayley, president, in the chair. Mr. E. Bradshaw Smith was elected a member, and Messrs. A. and W. M. Ramsay were admitted into the society. Mr. Tucker (hon. sec.) then read two communications by Mr. Clerk Maxwell, F.R.S.; the one on topographical geometry, which led to a discussion in which Mr. Archibald Smith, F.R.S., and the president took part; the other a note on a case of fluid motion. "In most investigations of fluid motion we consider the velocity at any point of the fluid as defined in magnitude and direction as a function of the coordinates of the point and of the time. We are supposed to be able to take a momentary glance at the system at any time, and to observe the velocities, but are not supposed able to keep our eye on a particular molecule during its motion. This method therefore properly belongs to the theory of a continuous fluid alike in all its parts, in which we measure the velocity by the volume which passes through unit of area rather than by the distance travelled by a molecule in unit of time. The molecular theory, as it supposes each molecule to preserve its identity, requires for its perfection a determination of the position of each molecule at any assigned time. As it is only in certain cases that our present mathematical resources can effect this, I propose to point out a very simple case with the results. Let a cylinder of infinite length and of radius a move with its axis parallel to z, and always passing through the axis of x with a velocity v, uniform or variable in the direction of x through an infinite homogeneous incomprehensible perfect fluid." The solution of the problem involved work hardly suited for the columns of NATURE.—Mr. S. Roberts then discussed the following problem which occurred in his paper on the pedals of conic sections. If two circles are given, one of which passes through the centre of the other, and if a line equal in length to the radius of the latter circle moves with an extremity on each, the locus of any point rigidly connected with the moving line will be composed of a circle and a bicircular quartic having a finite double point. His account of the communication closed with a discussion of the following problem, intimately connected with the subject-matter of the paper:—Given the paths of two points of an indefinite plane, moving in plane space, to find the path of an arbitrary point of the plane. If $F(x,y)=0$, $\phi(x,y)=0$ are the equations of the given path, we have to eliminate θ from

$$F(l\cos\theta + p\sin\theta + X, l\sin\theta - p\cos\theta + Y) = 0$$
$$\phi(l\cos\theta - q\sin\theta + X, l\sin\theta + q\cos\theta + Y) = 0$$

The president, Professor Hirst, Mr. Cotterill, and the author, took part in a discussion on the paper.—Mr. Archibald Smith then made some remarks on the scale for compensation in the Irish Land Bill.

MANCHESTER

Philosophical Society, March 8.—Dr. J. P. Joule, president, in the chair. Sir James Cockle, President of the Queensland Philosophical Society, was elected a corresponding member of the society. A letter was read from Mr. Dancer, on Dr. A. Ransome's paper "On the Organic Matter of Human Breath." Mr. E. W. Binney called the attention of the meeting to the frightfully high death-rate of Manchester and Salford, which continued to increase, notwithstanding the appointment of officers of health, and the doings of the councils of the two towns. A paper was read, "On the Suspension of a Ball by a Jet of Water," by Osborne Reynolds, Professor of Engineering, Owens College.

Microscopical and Natural History Section, February 28.—A paper was read "On some Shell Deposits at Llandudno," by Mr. Joseph Sidebotham.

Physical and Mathematical Section, January 4.—Mr. E. W. Binney, president of the Section, in the chair. A paper was read "On the Rainfall of 1869, at Old Trafford, Manchester," by Mr. G. V. Vernon.

March 1.—Mr. E. W. Binney, president of the Section, in the chair.—A paper was read "On the Results of Rain-gauge and Anemometer Observations made at Eccles, near Manchester, during the year 1869," by Mr. Thomas Mackereth.

HEREFORD

Woolhope Naturalists' Field Club, February 22.—Annual meeting; Mr. James Rankin in the chair. After the usual club business had been transacted, and a committee appointed to report upon the practicability of establishing a local museum, the Rev. F. T. Havergal detailed the progress that had been made with reference to the publication of the *Mappa Mundi*, one of the chief curiosities of the Cathedral. It has been satisfactorily established that the date at which the map was executed was the very commencement of the fourteenth century. It is drawn in accordance with the prevailing notions of geography at that period; the habitable earth is represented as a circular island with the "ocean-stream" flowing around it. Jerusalem is placed in the centre. Asia occupies nearly the whole upper (or eastern) half of the circle, while Europe holds the lower quarter on the left hand, and Africa that on the right. The Hereford map is distinguished from most mediæval maps not only by its great size, but also by its illustrations of objects in natural history, and its numerous inscriptions. It is proposed to publish a fac-simile (obtained by photography) in colours, accompanied by an exhaustive account of the history of the map, and of the legends upon it. The price has been limited to two guineas, and Mr. Stanford, of 6, Charing Cross, London, has been empowered to receive orders.—A paper upon the Reproducton of the Mistletoe, by the Rev. R. Blight, was read, and drawings exhibited which showed the gradual penetration of the parasite through the bark of the Magnolia in search of the sap.—A new *Clavis agaricinorum*, by Mr. Worthington Smith, F.L.S., was also exhibited. Its principle of classification is based on the colour of the spores, and the book is divided into sections respectively coloured white, pink, brown, purple, and black. In each of these sections the typical forms of the different agarics are given, and the identification of any species is thus the work of a moment.—Dr. Bull communicated the discovery of an Agaric entirely new to Britain, the *Cortinarius russus*, which he had met with in several woods near Hereford. He had also collected specimens of the rare *Asarum Europæum*, or *Asarabacca*, near the ruins of Limebrook Priory, a habitat which confirms the belief in its having been a cultivated plant.—At the evening meeting the President reviewed in his address the progress of science during the past year, and referred to the contributions made by different members of the club to various branches of natural history and archæology.—Dr. Bull read an interesting paper upon Deerfold Forest which, when published, will form a very valuable addition to the topography of the county.—The Rev. H. Cooper Key was elected president for the ensuing year.

EDINBURGH

Edinburgh Botanical Society, January 13.—Mr. Robert Brown, V.P., in the chair. The following communications were read:—

1. "Note on the embryo of *Ruscus aculeatus.*" By Professor Dickson.

2. "Notice of plants collected in Spitzbergen and Nova Zembla in the summer of 1869." By William Livesay.

3. "Notice of some botanical excursions with pupils during the summer of 1869." By Professor Balfour.

At the last meeting of the Edinburgh Botanical Society, Dr. Balfour stated that during the course of last summer he made several botanical trips with his pupils, the results of which seemed not unworthy of notice. On 12th June, a party visited Manuel, Woodcockdale, Carriber Glen and Castle, Bowdenhill, Cockleroy and Linlithgow. On 19th June, a party visited Denny, and proceeded up the banks of the Carron as far as the Hermitage. On 26th June, a party of 94 proceeded to Cleghorn, and walked along the banks of the Mouse as far as Cartland Crags, dividing then into two parties, one of which visited Stonebyres and the other Corra Linn. On 3rd July, a party of 50 proceeded by Stirling to Dollar, and thence to the Ochils. On 17th July, an excursion was undertaken to Perth and Dunkeld, and some of the party visited Methven bog. On 22nd July, a party proceeded by Perth and Forfar to Kirriemuir, and thence to Clova, and next day visited Loch Brandy and the mountains above it. In the course of two days a large number of the rarer alpine plants of Scotland was gathered, and in all the other excursions many interesting and rare plants were gathered.

4. "On the botany of the Dominion of Canada and adjacent parts of British America (Part I., *Ranunculaceæ*)." By Professor Lawson, Dalhousie College, Halifax, Nova Scotia.

5. "On the introduction of Ipecacuanha plant (*Cephælis Ipecacuanha*)." By Mr. M'Nab.

6. "Notice of *Sicana odorifera*, Naudin (*Cucurbita odorifera*, Velloso, Flor. Flum.") By Senhor Joaquim Correa de Mello, Camprinas, Province of St. Paulo, Brazil. Communicated by Mr. Daniel Hanbury.

7. Hints for Collecting Cryptogamia. By Prof. Dickie.

8. Miscellaneous communications.—*Ruscus aculeatus.*—*Cones of Abies.*

GLASGOW

Philosophical Society of Glasgow—*Chemical Section*, January 31.—Dr. William Wallace, F.R.S.E., F.C.S., vice-president, in the chair. A paper was read by Mr. John Christie, on "the history of Madder, the various investigations relating to its character and composition, and the proposed sources of Artificial Alizarine." After giving an elaborate account of the progress of the art of dyeing, by the use of the two madder plants, *Rubia cordifolia*, or munjeet, of Bengal, and *Rubia tinctorum* of various European countries, the author proceeded to mention the various persons who had undertaken scientific investigations with a view to determine the number and nature of the colouring ingredients of madder-root. He stated that these investigations commenced about the end of last or beginning of the present century. Watt, Bartholdi, and Haussmann were amongst the earliest investigators. Kuhlman, in 1823, published a complete approximate analysis of madder. He obtained two colouring matters, his *matière colorante rouge*, and a fawn colour, which he did not consider worthy of investigation. Robiquet and Colin published the results of their researches on Alsace madder in 1826. The particular colouring matter of madder they named *alizarine*, and another body, which they considered to be a modification of alizarine, they termed *purpurine.* Gautier de Clanbry and Persoz obtained two colouring matters in the following year—*matière colorante rouge* and *matière colorante rose.* They were the first chemists to prepare madder extract, or *garancine*, a substance which was first manufactured largely at Avignon in 1829. Dr. Schunck obtained no fewer than seven substances from madder, two of them being colouring matters, having the composition indicated by the formulæ $C_{14}H_{10}O_4$, and $C_{32}H_{22}O_{10}$. His results were published in 1848. Debus, by treating Zealand madder, obtained two colouring bodies, which he called Lizaric acid and Oxylizaric acid. Wolff and Strecker obtained alizarine and purpurine; the latter they regarded as oxide of alizarine. The author next enlarged on various series of researches made by Strecker, Schützenberger, and Lanth, P. and E. Depouilly, Dr. Anderson (Glasgow), Rochleder (Prague), and Graebe and Laubermann, which seemed to indicate an approximation towards the accomplishment of a long-wished-for desire—namely, the production of artificial alizarine. Anthracene, one of the coal-tar products, came to be regarded as the starting-point. Graebe and Laubermann obtained a product closely allied to alizarine, and in December 1868 they obtained provisional protection for their process in this country. They employed anthracene ($C_{14}H_{10}$), converting it into anthrachinon ($C_{14}H_8O_2$) by using bichromate of potash. They transformed that body into bibromanthrachinon, ($C_{14}H_6Br_2O_2$), a substitution product; and, by subsequent treatment with potash and an acid, they obtained from it a body which they termed artificial alizarine. In the course of last year other patents were secured by Brönner and Gulzkow, of Frankfort-on-the-Maine, and by W. A. Perkins, F.R.S.; and recently Messrs. Lucius & Co., of Hoechst, near Frankfort, have prepared artificial alizarine by a secret. Mr. Christie concluded his paper by giving an account of numerous investigations which he had made with commercial artificial alizarine in order to test its colorific and other properties, and stated his reasons for regarding the natural and artificial compounds as not being identical. In the discussion which followed, Mr. Hogg and other speakers mentioned facts in support of the identity of the two products, one of the facts being that mordanted cloth dyed with pure artificial alizarine stands soaping better than that dyed with garancine.

PARIS

Academy of Sciences, March 14.—M. Faye presented a memoir on the photographic observation of the transits of Venus, and on an apparatus of M. Laussedat's.—The author noticed the imperfection of Halley's method of observation, which has already been recognised by the German astronomers, suggested the employment of photography as a means of observing the transit of Venus which will take place in 1874, and communicated a letter from M. Laussedat, describing an arrangement by which photographic observations may be taken.—A letter from M. Wolf, of Zurich, accompanying a printed memoir, was read. The author stated that the invention of the bubble-level was to be ascribed to a Frenchman named Capotos, and suggested that a search should be made in France for documents relating to this subject, and to some others to which he referred.—A memoir was read by M. Phillips on the changes of condition of a mixture of a saturated vapour and of its liquid, according to an adiabatic line.—A note by M. Zaliwski was communicated, on the selection of the bodies which should be placed in contact with carbon as the positive pole of a battery. The author stated that these should be oxydising bodies, and among these such as are impressionable by light, such as nitric acid and the manganates of potash, seem to be most efficacious. He described a battery in which the carbon is impregnated with an ammoniacal solution of chloride of silver, dried and treated with nitric acid to remove the excess or ammonia; with pure water this forms a battery of great intensity.—M. de Saint-Venant communicated a note by M. F. André, containing an account of experiments on the velocity of propagation of sound in water in a cast-iron conduit of 0·80M. in diameter. The author found the velocity of propagation to be only 897·80 M. per second—M. H. Sainte-Clair-Deville communicated a second memoir on the "nascent state," in which he discussed the phenomena observed when zinc is brought in contact with a mixture of sulphuric or hydrochloric and nitric acids.—M. E. J. Maumené read a second memoir on a general theory of chemical action.—M. Combes presented a note by M. L. Gruner on the mechanical properties of phosphuretted steels. The author referred to the statements of Sir. W. Fairbairn as to Heaton's steel, and showed by analysis that it contains from 0·002 to 0·003 of phosphorus. He remarked that the favourable character of this steel under the ordinary tests was negatived when the test of a shock was applied to it. M. Boussingault supported the opinions of M. Gruner.—M. A. Milne-Edwards communicated a note on the Ornithological fauna of the Bourbonnais during the middle Tertiary period, in which he stated that the birds of the Miocene deposits of that district possessed a tropical, and especially an African character. He noticed remains of a parrot, a trogon, a sand-grouse, a swift of the group of the Salanganes, a Marabou stork, and a Secretary bird.—M. Leveillé presented a note on the discovery of remains of quaternary man in the manufactories of stone implements at Grand-Pressigny; and M. Richard noticed the discovery of instruments of the Stone age in Arabia and Egypt. The author stated that he has found worked stones at the foot of Mount Sinai, near Cairo, and at Thebes.—M. C. Wœstyn presented a memoir on the means of destroying the contagious miasmata of hospitals, upon which MM. Dumas and Bouillaud made some remarks.—M. Wurtz presented a note by M. Verneuil on the cure of tracumatic tetanus by chloral.—Several other communications were made of which the titles only are given.

BERLIN

German Chemical Society, March 14.—M. Schultz-Sellak has obtained a liquid modification of sulphuric anhydride, which, under ordinary circumstances, speedily passes into the solid form.—M. Tiemann has converted trinitrotoluol into toluylendiamide. The same, conjointly with Mr. Judson, has studied several isomeric dinitrobenzoic acids.—Mr. Genz reported on some derivatives of xylidine.—Dr. Rüdorff showed large crystals of carbonate of ammonium deposited from coal gas.—M. Bornemann exhibited glass tubes which had for some months been exposed to the action of steam under a pressure of eleven atmospheres. The glass showed deep notches and furrows where acted upon by the steam, but was not attacked in those parts which had remained immersed in the water of the boiler.—A curious transformation of forged iron into large crystals has been observed by M. Egelts. A cylinder used in a cotton-mill proved to consist of crystals apparently affecting the form of pentagonic dodecahedra of two or three millimetres in diameter.—Prof. Hoppe Seyler reported on the colouring matter of blood. He has found that hæmato-globulin does not pass directly into hæmatine, as has been supposed until now, but that the latter product derives by oxidation from hæmatochromogen discovered by the author.—Prof. Kekulé and Hideck have converted diazo-amidobenzol into azobenzol.—Dr. Köhler attacked the views lately published by Wanklyn, on the atomicity of sodium.—Dr. Schaer reported on the presence of ozone in the fluor spar of Wölberndorf, Saxony.

PHILADELPHIA

Academy Natural Sciences, January 11.—Professor O. C. Marsh, of Yale College, exhibited a series of specimens of the remains of birds from the Cretaceous and Tertiary of the United States, which showed that this class was well represented during these periods, although no species have yet been described from these formations in this country, and none indeed from older rocks, since it now appears to be well established that the bird-like footprints in the Connecticut Valley were made by Dinosaurian reptiles. Among the specimens shown were the remains of at least five species of Cretaceous birds, although but one or two species have hitherto been described from strata of this age in Europe. The present Cretaceous specimens were all found in the greensand of New Jersey, and with one exception in the middle marl-bed. They are all mineralised, and in the same state of preservation as the bones of extinct reptiles found with them in these deposits, and hence are readily distinguished from the remains of recent birds which have occasionally been found near the surface in the marl excavations of New Jersey. The most interesting of the specimens exhibited was the distal portion of a large and robust tibia, apparently of a swimming bird, about the size of a goose. It was found in the greensand at Birmingham, New Jersey, in the pits of the Pemberton Marl Company. For this new genus and species Professor Marsh proposed the name *Laornis Edvardsianus*. Two species of small wading birds, which appear to have been allied to the Curlews, were also represented each by the distal end of a tibia, and probably by some other less characteristic portions. The larger of these species, which was found in the greensand of the middle marl-bed at Hornerstown, New Jersey, was named *Palæstringa littoralis*. The smaller species, which was called *Palæstringa vetus*, was founded on the specimen mentioned by Dr. Morton in his "Synopsis of Cretaceous Fossils," p. 32, which has since, however, been generally regarded as a recent species. The specimen was found in the lowest marl-bed at Arneytown, New Jersey, and is now in the collection of the Academy. Portions of the humeri of two small and closely-related species, apparently of the Heron family, were part of the series shown. They were found deep in the greensand of the middle marl-bed near Hornerstown, New Jersey, in the pits of the Cream Ridge Marl Company. For the species thus represented the names *Vetardea elegans* and *Vetardea affinis* were proposed. The remains of several species of Tertiary birds were also exhibited by Professor Marsh. Among these was the lower extremity of tibia, closely resembling that of some of the Cranes. It was found in the Miocene o the Niobrara River, by Dr. F. V. Hayden, and is interesting as the only representative of a fossil bird yet detected in the Tertiary deposits west of the Mississippi. This specimen, which belongs to the Academy, indicated a new species, which was named *Grus Haydeni*. Another species of extinct birds was represented by portions of a humerus and radius, also in the collection of the Academy; they were found many years since in the Miocene of Maryland by Mr. T. A. Conrad. This species, which appears to be closely related to the Gulls, was named *Larus Conradii*. Several other interesting specimens of bird remains were shown, but most of them were not sufficiently characteristic to admit of determination. With the exceptions already mentioned, the fossils exhibited belonged to the museum of Yale College.

DIARY

THURSDAY, March 24.

Royal Society, at 8.30.—On the Madreporia dredged up by the expedition in H.M.S. *Porcupine*: Prof. Duncan.
Royal Institution, at 3.—Chemistry of Vegetable Products: Prof. Odling.
Zoological Society, at 8.30.—On the Birds of Veragua: Osbert Salvin.—Exhibition of a metamorphosed Axolotl: W. B. Tegetmeier.—On two rare species of Pheasants recently added to the Society's Collection: Mr. Sclater.
London Institution, at 7.30.—Geology: Dr. Cobbold.
Society of Antiquaries, at 8.30.—On the Greek Inscriptions found at Autun: Rev. W. B. Marriott.

FRIDAY, March 25.

Royal Institution, at 8.—Anglo-Saxon Conquest: Prof. Rolleston.
Quekett Microscopical Society, at 8.30.

SATURDAY, March 26.

Royal Institution, at 3.—The Sun: J. Norman Lockyer, F.R.S.

MONDAY, March 28.

Royal Geographical Society, at 8.30.
Royal Institute of British Architects, at 8.
Institute of Actuaries, at 7.
London Institution, at 4.—Chemistry: Prof. Bloxam.

TUESDAY, March 29.

Royal Institution, at 3.—Nervous System: Prof. Rolleston, M.D., F.R.S.
Institution of Civil Engineers, at 8.—Description of the St. Pancras Station, Midland Railway: W. H. Barlow, M.I.C.E., F.R.S.

WEDNESDAY, March 30.

Society of Arts, at 8.
Chemical Society, at 8.—Anniversary Meeting.

THURSDAY, March 31.

Royal Society, at 8.30.
Society of Antiquaries, at 8.30.

BOOKS RECEIVED

English.—The State, the Poor, and the Country: R. H. Patterson (Blackwood and Sons).—Quarterly Journal of the Geological Society (Longmans).—Photographic Art Journal, No. 1; illustrated (S. Low, Son, and Marston).—Choice and Chance: Rev. W. A. Whitworth (Bell and Daldy).—The Arts in the Middle Ages; illustrated: Paul Lacroix (Chapman and Hall).—United States Geological Survey of Colorado and New Mexico: F. D. Hayden (Washington).—Introductory Text-book to Physical Geography: D. Page (Blackwood and Sons).—Mrs. Loudon's First-book of Botany. Edited by D. Woosten (Bell and Daldy).—Principles of the Science of Colour: W. Benson (Chapman and Hall).

Foreign.—Handbuch der Lehre von den Geweben: S. Stricker.—Für Baum und Wald: M. F. Schleider.—Die Eiszeit der Erde: A. Braun.

CONTENTS

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH

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THURSDAY, MARCH 31, 1870

THE SIZE OF ATOMS

THE idea of an atom has been so constantly associated with incredible assumptions of infinite strength, absolute rigidity, mystical actions at a distance, and indivisibility, that chemists and many other reasonable naturalists of modern times, losing all patience with it, have dismissed it to the realms of metaphysics, and made it smaller than "anything we can conceive." But if atoms are inconceivably small, why are not all chemical actions infinitely swift? Chemistry is powerless to deal with this question, and many others of paramount importance, if barred, by the hardness of its fundamental assumptions, from contemplating the atom as a real portion of matter occupying a finite space, and forming a not immeasurably small constituent of any palpable body.

More than thirty years ago naturalists were scared by a wild proposition of Cauchy's, that the familiar prismatic colours proved the "sphere of sensible molecular action" in transparent liquids and solids to be comparable with the wave-length of light. The thirty years which have intervened have only confirmed that proposition. They have produced a large number of capable judges; and it is only incapacity to judge in dynamical questions that can admit a doubt of the substantial correctness of Cauchy's conclusion. But the "sphere of molecular action" conveys no very clear idea to the non-mathematical mind. The idea which it conveys to the mathematical mind is, in my opinion, irredeemably false. For I have no faith whatever in attractions and repulsions acting at a distance between centres of force according to various laws. What Cauchy's mathematics really proves is this: that in palpably homogeneous bodies such as glass or water, contiguous portions are not similar when their dimensions are moderately small fractions of the wave-length. Thus in water, contiguous cubes, each of one one-thousandth of a centimetre breadth, are sensibly similar. But contiguous cubes of one ten-millionth of a centimetre must be very sensibly different. So in a solid mass of brickwork, two adjacent lengths of 20,000 centimetres each, may contain, one of them nine hundred and ninety-nine bricks and two half bricks, and the other one thousand bricks: thus two contiguous cubes of 20,000 centimetres breadth may be considered as sensibly similar. But two adjacent lengths of forty centimetres each might contain, one of them one brick and two half bricks, and the other two whole bricks; and contiguous cubes of forty centimetres would be very sensibly dissimilar. In short, optical dynamics leaves no alternative but to admit that the diameter of a molecule, or the distance from the centre of a molecule to the centre of a contiguous molecule in glass, water, or any other of our transparent liquids and solids, exceeds a ten-thousandth of the wave-length, or a two-hundred-millionth of a centimetre.

By experiments on the contact electricity of metals made eight or ten years ago, and described in a letter to Dr. Joule, which was published in the Proceedings of the Literary and Philosophical Society of Manchester, I found that plates of zinc and copper connected with one another by a fine wire attract one another, as would similar pieces of one metal connected with the two plates of a galvanic element, having about three-quarters of the electro-motive force of a Daniel's element.

Measurements published in the Proceedings of the Royal Society for 1860 showed that the attraction between parallel plates of one metal held at a distance apart small in comparison with their diameters, and kept connected with such a galvanic element, would experience an attraction amounting to two ten-thousand-millionths of a gramme weight per area of the opposed surfaces equal to the square of the distance between them. Let a plate of zinc and a plate of copper, each a centimetre square and a hundred-thousandth of a centimetre thick, be placed with a corner of each touching a metal globe of a hundred-thousandth of a centimetre diameter. Let the plates, kept thus in metallic communication with one another be at first wide apart, except at the corners touching the little globe, and let them then be gradually turned round till they are parallel and at a distance of a hundred-thousandth of a centimetre asunder. In this position they will attract one another with a force equal in all to two grammes weight. By abstract dynamics and the theory of energy, it is readily proved that the work done by the changing force of attraction during the motion by which we have supposed this position to be reached, is equal to that of a constant force of two grammes weight acting through a space of a hundred-thousandth of a centimetre; that is to say, to two hundred-thousandths of a centimetre-gramme. Now let a second plate of zinc be brought by a similar process to the other side of the plate of copper; a second plate of copper to the remote side of this second plate of zinc, and so on till a pile is formed consisting of 50,001 plates of zinc and 50,000 plates of copper, separated by 100,000 spaces, each plate and each space one hundred-thousandth of a centimetre thick. The whole work done by electric attraction in the formation of this pile is two centimetre-grammes.

The whole mass of metal is eight grammes. Hence the amount of work is a quarter of a centimetre-gramme per gramme of metal. Now 4,030 centimetre-grammes of work, according to Joule's dynamical equivalent of heat is the amount required to warm a gramme of zinc or copper by one degree centigrade. Hence the work done by the electric attraction could warm the substance by only $\frac{1}{16120}$ of a degree. But now let the thickness of each piece of metal and of each intervening space be a hundred-millionth of a centimetre instead of a hundred-thousandth. The work would be increased a millionfold unless a hundred-millionth of a centimetre approaches the smallness of a molecule. The heat equivalent would therefore be enough to raise the temperature of the material by 62°. This is barely, if at all, admissible, according to our present knowledge, or, rather, want of knowledge, regarding the heat of combination of zinc and copper. But suppose the metal plates and intervening spaces to be made yet four times thinner, that is to say, the thickness of each to be four-hundred-millionth of a centimetre. The work and its heat equivalent will be increased sixteen-fold. It would therefore be 990 times as much as that required to warm the mass by 10 cent., which is very much more than can possibly be produced by zinc and copper in entering into molecular combination. Were there in reality anything like so much heat of combination as this, a mixture of zinc and copper powders would, if melted in any one spot, run together, generating more than heat enough to melt each throughout; just as a large quantity of gunpowder if ignited in any one spot burns throughout without fresh application of heat. Hence plates of zinc and copper of a three-hundred-millionth of a centimetre thick, placed close together alternately, form a near approximation to a chemical combination, if indeed such thin plates could be made without splitting atoms.

The theory of capillary attraction shows that when a bubble—a soap-bubble for instance—is blown larger and larger, work is done by the stretching of a film which resists extension as if it were an elastic membrane with a constant contractile force. This contractile force is to be reckoned as a certain number of units of force per unit of breadth. Observation of the ascent of water in capillary tubes shows that the contractile force of a thin film of water is about sixteen milligrammes weight per millimetre of breadth. Hence the work done in stretching a water film to any degree of thinness, reckoned in millimetre-milligrammes, is equal to sixteen times the number of square millimetres by which the area is augmented, provided the film is not made so thin that there is any sensible diminution of its contractile force. In an article "On the Thermal effect of drawing out a Film of Liquid," published in the Proceedings of the Royal Society for April 1858, I have proved from the second law of thermodynamics that about half as much more energy, in the shape of heat, must be given to the film to prevent it from sinking in temperature while it is being drawn out. Hence the intrinsic energy of a mass of water in the shape of a film kept at constant temperature increases by twenty-four milligramme-millimetres for every square millimetre added to its area.

Suppose then a film to be given with a thickness of a millimetre, and suppose its area to be augmented ten thousand and one fold: the work done per square millimetre of the original film, that is to say per milligramme of the mass, would be 240,000 millimetre-milligrammes. The heat equivalent of this is more than half a degree centigrade of elevation of temperature of the substance. The thickness to which the film is reduced on this supposition is very approximately a ten-thousandth of a millimetre. The commonest observation on the soap-bubble (which in contractile force differs no doubt very little from pure water) shows that there is no sensible diminution of contractile force by reduction of the thickness to the ten-thousandth of a millimetre; inasmuch as the thickness which gives the first maximum brightness round the black spot seen where the bubble is thinnest, is only about an eight-thousandth of a millimetre.

The very moderate amount of work shown in the preceding estimates is quite consistent with this deduction. But suppose now the film to be further stretched, until its thickness is reduced to a twenty-millionth of a millimetre. The work spent in doing this is two thousand times more than that which we have just calculated. The heat equivalent is 1,130 times the quantity required to raise the temperature of the liquid by one degree centigrade. This is far more than we can admit as a possible amount of work done in the extension of a liquid film, A smaller amount of work spent on the liquid would convert it into vapour at ordinary atmospheric pressure. The conclusion is unavoidable, that a water-film falls off greatly in its contractile force before it is reduced to a thickness of a twenty-millionth of a millimetre. It is scarcely possible, upon any conceivable molecular theory, that there can be any considerable falling off in the contractile force as long as there are several molecules in the thickness. It is therefore probable that there are not several molecules in a thickness of a twenty-millionth of a millimetre of water.

The kinetic theory of gases suggested a hundred years ago by Daniel Bernouilli has, during the last quarter of a century, been worked out by Herapath, Joule, Clausius, and Maxwell, to so great perfection that we now find in it satisfactory explanations of all non-chemical properties of gases. However difficult it may be even to imagine what kind of thing the molecule is, we may regard it as an established truth of science that a gas consists of moving molecules disturbed from rectilineal paths and constant velocities by collisions or mutual influences, so rare that the mean length of proximately rectilineal portions of the path of each molecule is many times greater than the average distance from the centre of each molecule to the centre of the molecule nearest it at any time. If, for a moment, we suppose the molecules to be hard elastic globes all of one size, influencing one another only through actual contact, we have for each molecule simply a zigzag path composed of rectilineal portions, with abrupt changes of direction. On this supposition Clausius proves, by a simple application of the calculus of probabilities, that the average length of the free path of a particle from collision to collision bears to the diameter of each globe, the ratio of the whole space in which the globes move, to eight times the sum of the volumes of the globes. It follows that the number of the globes in unit volume is equal to the square of this ratio divided by the volume of a sphere whose radius is equal to that average length of free path. But we cannot believe that the individual molecules of gases in general, or even of any one gas, are hard elastic globes. Any two of the moving particles or molecules must act upon one another somehow, so that when they pass very near one another they shall produce considerable deflexion of the path and change in the velocity of each. This mutual action (called force) is different at different distances, and must vary, according to variations of the distance, so as to fulfil some definite law. If the particles were hard elastic globes acting upon one another only by contact, the law of force would be—zero force when the distance from centre to centre exceeds the sum of the radii, and infinite repulsion for any distance less than the sum of the radii. This hypothesis, with its "hard and fast" demarcation between no force and infinite force, seems to require mitigation. Without entering on the theory of vortex atoms at present, I may at least say that soft elastic solids, not necessarily globular, are more promising than infinitely hard elastic globes. And, happily, we are not left merely to our fancy as to what we are to accept for probable in respect to the law of force. If the particles were hard elastic globes, the average time from collision to collision would be inversely as the average velocity of the particles. But Maxwell's experiments on the variation of the viscosities of gases with change of temperature prove that the mean time from collision to collision is independent of the velocity, if we give the name collision to those mutual actions only which produce something more than a certain specified degree of deflection of the line of motion. This law could be fulfilled by soft elastic particles (globular or not globular); but, as we have seen, not by hard elastic globes. Such details, however, are beyond the scope of our present argument. What we want now is rough approximations to absolute values, whether of time or space or mass—not delicate differential results. By Joule, Maxwell, and Clausius we know that the average velocity of the molecules of oxygen or nitrogen or common air, at ordinary atmospheric temperature and pressure, is about 50,000 centimetres per second, and the average time from collision to collision a five-thousand-millionth of a second. Hence the average length of path of each molecule beween collisions is about $\frac{1}{100000}$ of a centimetre. Now, having left the idea of hard globes, according to which the dimensions of a molecule and the distinction between collision and no collision are perfectly sharp, something of apparent circumlocution must take the place of these simple terms.

First, it is to be remarked that two molecules in collision will exercise a mutual repulsion in virtue of which the distance between their centres, after being diminished to a minimum, will begin to increase as the molecules leave one another. This minimum distance would be equal to the sum of the radii, if the molecules were infinitely hard elastic spheres; but in reality we must suppose it to be very different in different collisions. Considering only the case of equal molecules, we might, then, define the radius of a molecule as half the average shortest distance reached in a vast number of collisions. The definition I adopt for the present is not precisely this, but is chosen so as to make as simple as possible the statement I have to make of a combination of the results of Clausius and Maxwell. Having defined the radius of a gaseous molecule, I call the double of the radius the diameter; and the volume of a globe of the same radius or diameter I call the volume of the molecule.

The experiments of Cagniard de la Tour, Faraday, Regnault, and Andrews, on the condensation of gases do not allow us to believe that any of the ordinary gases could be made forty thousand times denser than at ordinary atmospheric pressure and temperature, without reducing the whole volume to something less than the sum of the volume of the gaseous molecules, as now defined. Hence, according to the grand theorem of Clausius quoted above, the average length of path from collision to collision cannot be more than five thousand times the diameter of the gaseous molecule; and the number of molecules in unit of volume cannot exceed 25,000,000 divided by the volume of a globe whose radius is that average length of path. Taking now the preceding estimate, $\frac{1}{100000}$ of a centimetre, for the average length of path from collision to collision, we conclude that the diameter of the gaseous molecule cannot be less than $\frac{1}{500000000}$ of a centimetre; nor the number of molecules in a cubic centimetre of the gas (at ordinary density) greater than 6×10^{21} (or six thousand million million million).

The densities of known liquids and solids are from five hundred to sixteen thousand times that of atmospheric air at ordinary pressure and temperature; and, therefore, the number of molecules in a cubic centimetre may be from 3×10^{24} to 10^{26} (that is, from three million million million million to a hundred million million million million). From this (if we assume for a moment a cubic arrangement of molecules), the distance from centre to nearest centre in solids and liquids may be estimated at from $\frac{1}{140000000}$ to $\frac{1}{460000000}$ of a centimetre.

The four lines of argument which I have now indicated, lead all to substantially the same estimate of the dimensions of molecular structure. Jointly they establish with what we cannot but regard as a very high degree of probability the conclusion that, in any ordinary liquid, transparent solid, or seemingly opaque solid, the mean distance between the centres of contiguous molecules is less than the hundred-millionth, and greater than the two thousand-millionth of a centimetre.

To form some conception of the degree of coarse-grainedness indicated by this conclusion, imagine a rain drop, or a globe of glass as large as a pea, to be magnified up to the size of the earth, each constituent molecule being magnified in the same proportion. The magnified structure would be coarser grained than a heap of small shot, but probably less coarse grained than a heap of cricket-balls. W. T.

FRESENIUS'S ANALYSIS

Qualitative Chemical Analysis. By Dr. C. Remigius Fresenius. Seventh Edition. Edited by Arthur Vacher. 8vo., pp. viii. and 264. (London: Churchill, 1869.)

Quantitative Chemical Analysis. By Dr. C. Remigius Fresenius. Fifth edition. Edited by Arthur Vacher. 8vo., pp. viii. and 377. (London: Churchill, 1870.)

Anleitung zur qualitativen chemischen Analyse. By Dr. C. Remigius Fresenius. 8vo., pp. xii. and 240, with 43 woodcuts; price 4*s*. (Brunswick, 1869. London: Williams and Norgate.)

IN no branch of chemistry, perhaps, has more useful progress been made of late years than in analysis. The other departments of the science, technical and organic chemistry, for instance, have been cultivated with assiduity and even ostentation; while the study of analysis, invaluable and necessary as it is, has been comparatively neglected as humble and unadorned. Much of this apathy has no doubt arisen from the mechanical nature of the task of analytical discovery, which commonly requires a greater share of industry than intellectual effort. The gradual introduction of refined physical methods has, however, commenced, and will no doubt complete an entire change in the aspect of this subject.

Chemists will not need to be reminded of the obligations they owe to Fresenius, whose analytical manuals are deservedly known, and in common use in almost every laboratory. The enormous amount of special results they contain is hardly conceivable to an outsider, who will not readily appreciate the respect paid to them by grateful practitioners. The thirteenth edition (of which the first instalment has just reached us) has been retouched and improved, and is in every way worthy of the confidence of chemists. Its appearance has, however, suggested to us some reflections which might, not improbably, be carried out with advantage. Few readers will fail to observe that the dimensions of the book and the subject have both increased, and at a rate that will necessitate a remedy in the course of a few years. Possibly it may be agreed that, in addressing a single book to four kinds of students, the author has performed a somewhat superfluous task for three of them. Those who are engaged in pharmacy, the arts, manufactures, and agriculture, will all find here much more than they respectively require. The inconvenience obviously admits of easy removal; each class ought to have a handbook suited to its own peculiar demands, and to those alone. The mere economy of time thus effected would be an additional recommendation to such a step. Moreover, it would allow of altering, for the sake of the purely chemical student, the entire system of nomenclature and notation. These admittedly belong to a period that has passed away; and their presence in the book universally interferes much with its proper utility in the laboratory. The apology in the preface will hardly be accepted by teachers; neither can we suppose that the author, if writing specially, would say of chemistry that it is "the science which acquaints us with the substances of which our earth consists, their composition and decomposition, and mutual deportment generally." It is time that this barren and lifeless definition ceased to be adopted by every instructor. There is, indeed, a quaint mediæval tone about the whole of the book.

The historical reader will notice under the section devoted to "Operations," titles and processes and explanations that abound as we trace our steps backwards from Thénard. The practical investigator might regret the omission of Bunsen's method of filtration, of argentic sulphate as a common impurity in the nitrate, of the formation of Claudet's body as a test for cobalt. We see a condenser figured which could not easily be used with a continuous stream of water, and has been long abandoned in laboratories. Again, hydric nitrate is said to be purified by distilling at the temperature of ebullition; which does not, however, occur unless under that point. We may, nevertheless, assure the experimenter that he will not find in Dr. Fresenius's work more than a few errors of the kind which affect him. There is evidence throughout it of accumulated care and forethought, and the writer's clear exposition and systematic procedure are a proof both of unsparing labour and severe economy.

The author's two German treatises have hitherto been presented to the English student in the form of translations, which portrayed the characteristic features of the originals with satisfactory fidelity. But, for the reasons we have already intimated, there has been a general desire for such changes as would make each of these volumes a handy laboratory book. Mr. Vacher has boldly taken upon himself this task of dual reform, having "specially striven to meet the present wants of English students." He has no doubt succeeded in making two thoroughly English books, which will be most valuable to students; but they can no longer be legitimately termed editions of Fresenius, which they resemble only as a pen-and-ink sketch resembles a perfect picture. That the editor himself is to a certain extent conscious of this is tolerably apparent from the following passages, which are too important to be left unnoticed:—"The present edition has been entirely re-written and much condensed. . . . The metals have been grouped anew, and the old grouping of the acids has been abandoned. . . . The processes have been made as far as possible complete in themselves, so as to obviate constant reference to different pages of the book. Several new figures have been added, and the number of tables has been increased. I have endeavoured to render the arrangement as simple as possible" (preface to "Quantitative Analysis"). And again, "The language has been condensed, the notation and nomenclature have been modernised, the arrangement has been simplified. The consideration of rare inorganic bodies and of organic has been deferred to the latter part of the volume, where a section has been devoted to each. . . . The cause of analysis has been simplified in description, and the preliminary examination has been curtailed. . . . All the facts and, except in one or two trivial instances, all the processes given in this edition have the authority of Fresenius, but the principal changes in the arrangement have been made on my own responsibility" (preface to the "Qualitative Analysis"). Editions for which the editor is thus far responsible, while the reputed author is responsible for a part only of the *facts* (not the whole of them, as Mr. Vacher states), ought not to bear Fresenius's name in any other than a subordinate manner, all these works are, in reality, outlines of analytical chemistry on the basis of Fresenius.

Mr. Vacher has, on the whole, however, carried out successfully the various changes he had in view. The adoption of the prevailing notation is in itself an improvement, teachers having hitherto been compelled to use one interpretation for symbols in the lecture-room, and another in the laboratory. He has not, however, quite so well fulfilled his promise as to the nomenclature, which is still unsystematic, and therefore misleading. For example, at p. 3 ("Quantitative Analysis") we find *calcium chloride*, at p. 27 *carbonate of calcium*; at p. 40 *ferrous sulphide*, at p. 42 *sulphide of manganese*, at p. 40 *ferric oxide*, at p. 44 *alumina*. At p. 54 the word "acid" undergoes a very sudden transformation; "Ignited titanic *acid* does not dissolve in hydrochloric acid." These instances of haste, of which there are not a few, ought to be removed from the next edition.

It seems hardly probable that these large analytical treatises will be perfectly available for the use of students until they are divided into separate works. Subjects such as water analysis, manure analysis, volumetric analysis, assaying, &c., require, as we have said, a separate treatment. Mere condensation, however ably performed, will not accomplish a widely useful end. Mr. Vacher, nevertheless, deserves much credit for a hazardous experiment, which, though not altogether unimpeachable, is a real service to chemistry.

Our general impression of analysis is, that, both in point of scientific form and literary expression, it needs a strong stimulus from other quarters.

OUR BOOK SHELF

The Literature and Curiosities of Dreams. A commonplace Book of Speculations, concerning the mystery of Dreams and Visions, records of Curious and well-authenticated Dreams, and Notes on the various modes of Interpretation adopted in Ancient and Modern Times. By Frank Seafield, M.A. 2nd. Ed. Revised; pp. 518. (London: Lockwood and Co. 1869.)

IN this book the author has gathered together almost every kind of information on the subject of which it treats. The compilation of it has doubtless been a labour of love, and the author's great object has been to select, from all sources, whatever is most characteristic of his opinions which have been held on the subject of Dreams, and also all the best examples upon which these opinions have been founded. He tells us that no amount of research has been considered irksome or irrelevant, so that, in his opinion, "there is nothing extant in the way of dream-speculation or anecdote which is not fairly and impartially represented." The book is, in fact, a rich and methodically arranged storehouse of dreams and of opinions thereon, which will be valued by many who are merely curious, as well as by those who are more seriously interested about their causes and phenomena. It is likely to serve as a book of reference, or as one which may be had recourse to in spare half-hours, rather than as a work which will be taken up to be at once read and mastered.

Untersuchungen über Psychologie. Anmerkungen zu Robert Zimmermann's "Philosophische Propädeutik." Mit Rücksicht auf Herbart, J. H. v. Fichte, Ulrici, Fechner, Lindner, Drbal, Flüget, Nahlowsky, Lange, Darwin, C. Vogt, L. Büchner, Moleschott, Lotze, Hoppe, u.s.w. Von Dr. F. A. v. Hartsen. (Leipzig, 1869.)

Untersuchungen über Logik. Mit Rücksicht auf Apelt, Bolzaus, Drbal, Gratry, Kuno Fischer, Hegel, Herbart, Kant, Maudsley, J. Stuart Mill, Strümpell, W. Schuppe, Trendenburgh, Ueberweg, R. Zimmermann, u.s.w. Von Dr. F. A. v. Hartsen. (Leipzig, 1869.)

THESE publications by Dr. Hartsen are somewhat discursive criticisms of disputed matters in psychology and logic, and of the opinions of the different authorities whose names are mentioned on the title-pages. Neither of them lays claim to give a systematic account of the subject with which it deals, and both of them have the character of critical articles suited to a review, rather than of treatises. The "Psychological Inquiries" consist entirely of discussions upon Zimmermann's "Empirical Psychology," paragraph by paragraph, references being made to the numbered paragraphs in the original work. It will be obvious that this plan of procedure is rather trying to the reader who is obliged to guess from the critical observations at the nature of the opinions that are in question, and whose interest is not easily kept up in so desultory a disquisition. Nevertheless, if he is content to persevere, he will meet with much that is suggestive and instructive. The "Logical Inquiries," though not systematic and complete, will in like manner repay perusal; they are contributions to the foundation of a system of scientific logic.

Kurzes Lehrbuch der Physiologie des Menschen. Von Dr. E. Larisch. (Marburg: Oscar Ehrhardt. London: Williams and Norgate.)

THIS is very similar to Budge's little work, but smaller, and written in more of a narrative style. It therefore contains less matter, and this is especially the case in the part relating to the nervous system. Dr. Larisch has not the scientific eminence of Prof. Budge, and therefore speaks with less authority; on the other hand, he is free from the temptation of attaching too much importance to his own researches and views.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Formation of Ground Ice

I THINK the enclosed letter contains as good a description of the formation of ground ice as I have hitherto seen; I therefore send it to you, thinking it of sufficient interest to appear in NATURE. JOHN TYNDALL

Royal Institution, March 27

To PROFESSOR TYNDALL

I have been engaged since September last in making a survey for the Intercolonial railway, up the valley of the Matapediac, a stream about two hundred feet in width and four or five feet in depth, which discharges into the Restijinche river, about twenty miles above the head of the Baie des Chaleures.

The Matapediac, which is fed by large fresh water springs, runs over a rocky bottom covered with loose stones, ranging in size from coarse gravel to boulders as large as a hogshead, and the average current is about four miles an hour.

Early in November last the temperature went down in one night to 12°F., and on going out of camp the following morning I noticed large quantities of what appeared to be snow saturated with water floating down the stream, but not a particle of snow had fallen near us or for many miles round, as far as I could see by the mountain tops, nor had any ice formed on the surface of the river.

The water opposite where I stood was about six feet deep, and perfectly clear, so that I could see every stone on the bottom, and with the exception of the floating slush, the river was as it had been the previous day when the temperature was about 50° F.; I got into a canoe and paddled with the current for half a mile or so, and in shooting some small rapids, where the water in places was not more than two or three feet deep, I noticed on the bottom, masses of the slush clustered round and between the boulders, and a slight touch with the paddle was sufficient to free these clusters, when they rose to the surface, and were carried away by the current. I continued down the stream for three or four miles, and noticed the same thing in every rapid, where the water was shallow and *ruffled* by stones at the bottom.

The buoyancy of this slush was such that when detached from the bottom it rose so rapidly as to force itself well out of the water, and then floated off about half submerged.

I watched this forming of slush for many days, and in several cases found small stones imbedded in the floating slush, having been torn from the bottom when the buoyancy of the slush, aided by the running water, caused it to rise.

The temperature continued getting lower daily, and the slush in the rapids formed more rapidly than it was carried away, so much so that a bar or dam was formed across the river at each rapid, backing up the water in some cases five and six feet, when it generally found an outlet over the adjoining land, and into its natural bed again, or the head of water became sufficient to tear away the obstruction, which by this time had become a solid frozen mass.

All this time, no properly crystallised ice had formed on the surface of the river, the current being too rapid, but the slush or "anchor ice" as the trappers call it, was forming in deeper water than it had formed in before, indeed all over the river bottom, and was rising and floating away as I have already described. Eventually the temperature got down to two and three degrees below zero, when the river *surface* began to freeze in the eddies and along the edges, and the open water space became narrower every day, and was filled with floating "anchor ice" and detached masses of solid ice, which here and there became jammed and frozen together, so as to form ice-bridges on which we could cross.

These ice-bridges served as booms to stop much of the floating ice, which froze solid the moment it came to rest; and in this manner the river at last became completely frozen over for about forty miles of its length, but not until after we had experienced five weeks of steady cold, with the thermometer never above +12° F., and frequently down to −16° F.

It is just possible that what I have endeavoured to describe may suggest something to you, or it may be an old story; if so, please pardon the intrusion. W. G. THOMPSON

Dalhousie, N.B., February 18

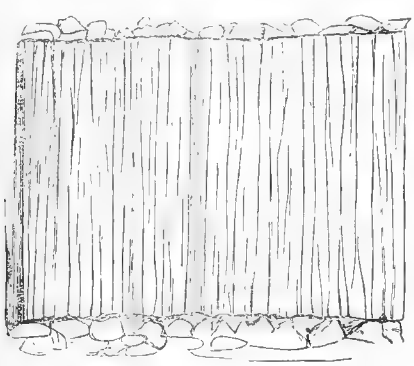
Prismatic Ice—Sandstone Boulder in Granite

WALKING over the Rough Tors of Dartmoor a few days since in company with a friend, Mr. Walter Morrison, M.P., we observed two phenomena which it appears to us should be recorded, since if they have been met with before, we believe that the occurrence of either is infrequent.

In a small roadside quarry, most probably excavated for the purpose of obtaining stones for metalling the road, we observed some granite undergoing the process of decomposition. The stratification of the superincumbent mass struck us as being peculiar, and we entered the quarry to examine it.

The near examination exhibited to us that the surface of the granite had been elevated to the extent of an inch and a half from the rock by means of ice. The whole of the ice, which formed a very extensive bed, was made up of a series of small needle-like prisms, which stood upon their end like minute basaltic columns. These prisms were all perpendicular to the surface of the rock on which they stood; that is, those that were situated on the side of the quarry projected horizontally, while those at our feet stood in a position vertical to the floor. These latter, instead of being on a rock, were upon the surface of granitic gravel, the débris of the surrounding rocks. And in the same manner as the ice mass had forced out the surface of rock at the sides of the quarry, it had raised up the entire surface of the gravel; and this so completely, that we only observed it in consequence of examining it for comparison, since the ice was strong enough to bear our weight when not increased by irregular motion.

It was to us new and interesting to find the ice assuming this basaltic form, and occupying the position in which we found it, in relation to the rock and gravel over which



a. Débris on the surface of the *b* Crystalline ice.
c. Surface of rock.

it lay. Water in freezing will put on almost any description of crystalline appearance; there is no reason then why upright needle-like prisms may not be as frequent as any other, but that it should put on this form in this position can only be explained when we know how the water that formed the ice got to that position. In trying to obtain this information, we observed that the lines of the stratification in the softer parts corresponded above and below the ice, and that those on the surface of the ice agreed with those at the base. This would demonstrate that the water did not arrive in that position as water flows over the surface of the rock. Had that been the case, the outer crust would, if it had not fallen off, have been moved a degree lower, which would have coincided with the spot at the base from which it was removed. The only way in which, therefore, the formation of the ice appears possible, consistently with existing facts, is by the water having percolated through the decomposing granite rock. There, oozing gradually, it only froze when it came to the surface, while the weight of water behind had power to lift off the external crust of rock. This again was forced outward by the water still pressing behind, the whole freezing only when it passed out through the rock. One and, I must admit, a strong objection to this idea lies in the circumstance that the gravel at the bottom of the quarry was elevated in the same manner; there cannot have been at the bottom of the quarry a weight of water from behind pressing the basaltic prisms outward. Whatever may be the cause of the phenomenon, there can be no doubt but that it must be an immensely powerful agent in the disintegration of rocks.*

The second feature that appears to be worthy of being recorded is that of a water-worn sandstone pebble imbedded in a mass of granite. On the summit of the hill near Warren Tor, we came upon the remains of a cairn, most of the stones of which had been carted away, apparently for the purpose of being built into a house that has recently been erected near it. The stones generally consisted, like those common to all the cairns of the moor, of angular pieces of granite of irregular shape and size, but mostly of such proportions as could be conveniently conveyed by hand. Lying near what appeared to have been the centre of the cairn were two other slabs of granite of much larger proportions. These were about four feet long by two and a half broad, and from eight to twelve inches thick, and appeared to us to have been the remains of the kistvaen, over which the stones were heaped. In one of these granite slabs my companion pointed out to me the presence of a large water-worn boulder pebble of sandstone. The pebble was about ten inches long by five wide at its longest and broadest diameters. It projected from the surface of the granite some two inches, or thereabout, but the form of the stone was suggestive of the larger part being still imbedded in the granite. The stone narrows somewhat towards one extremity, and at that extremity it is cracked across. The pebble is of blue sandstone, smooth but not polished on the surface, and at its contact with the granite exhibits no alteration of character.

The granite is of the grey colour that is so common on Dartmoor. It is of a coarse quality, containing numerous large crystals of felspar, locally known by the name of horses' teeth. The granite generally appears as if it had been deposited round the pebble, the crystalline character taking a bend somewhat conformable to the curves of the pebble.

The original rock from which the pebble was derived it is difficult to determine. In its general appearance the pebble bears a resemblance to those found on the pebble ridge of Northam Burrows, in North Devon. Unfortunately the granite slab itself is not in its natural bed. But since it forms part of an ancient monumental erection, and was placed in its present position long before the period when the transition of heavy weights could be easily accomplished, it is more than probable that the slab was procured from the neighbouring Tor.

The surface of the granite slab is very clean, being free from lichen and dendrital growths. But that it was weather-worn before it was placed in its present position, I think that there can be little doubt. Had it been artificially split, supposing that our ancient people had the knowledge and skill to have split the rock, they could not have done so without breaking the pebble as well.

Mr. Sorby demonstrated some five or six years since the presence of water in the hollows existing in crystals in granite, and thus came to the conclusion that granite must have been formed under a heat of less than 500 degrees. This heat is still, it appears to me, sufficient to convert all the water upon the surface of the earth into steam. But the rounded and smoothed character of the pebble of which we are speaking is evidence that water was present in its liquid state when it was rubbed into its present rounded form. It also demonstrates that the pebble was in existence as a hard rock before the granite was formed. Thus it would seem clear that when this granite was formed, the temperature of the earth must have cooled down to below the boiling point of water.

Plymouth, March. C. SPENCE BATE

* Since this was written I have seen Mr. Bonney's letter on Prismatic Ice. The wind during our walk was N.E. The quarry lay in a sheltered position. The temperature was probably as Mr. Bonney states.

Apparent Size of the Moon

THE public have what are called "views" on everything in the world and out of it. De Morgan well says that, on the question "whether there be volcanoes on the unseen side of the moon larger than those on our side," the odds are, that the first comer has a pretty stiff opinion in three seconds. Does anyone believe that the moon is made of green cheese? One woman hailing from this enlightened neighbourhood told my wife that she thought the moon was *made of blood!* She was not a Latter-day Saint, either.

If opinions differ as to the moon's constituents, they are not very divergent as to her apparent size. Mr. Thomas K. Abbott, of Trinity College, Dublin, in his singularly learned and able work called "Sight and Touch," 1864, p. 57, collates the opinions of Heraclitus, Aristotle, and Cicero, who all assign to the moon's apparent diameter the length of a foot. He quotes, too, from Arthur Collier's *Clavis Universalis* the expression, "the moon which I see is a little figure of light, no bigger than a trencher." The old-fashioned trencher was about a foot in diameter. The late Sir William Rowan Hamilton pointed out to me this passage in Descartes' "Dioptricæ," cap. VI. § xx.:—"Abque hoc patet ex eo quod Luna et Sol, qui sunt e numero corporum remotissimorum, quæ contueamur, ... *pedales ut plurimum, vel ad summum bipedales* nobis videantur," &c. Bishop Berkeley, as Philonous, asks Hylas, "Since, according to you, men judge of the reality of things by their senses, how can a man be mistaken in thinking the moon a plain, lucid surface, about a foot in diameter?" Many more such cases could be cited from ancients and moderns, all concurring in assigning a foot, or something between one foot and two feet, to the apparent diameter of the moon. Let me now cite two recent cases. A law-clerk, whose lay notions certainly owed very little to books, told me that the moon always appeared to him of the size of a door-handle. This would give, at most, a diameter of three inches. An eminent astronomer tried his daughter with the question. She replied that the moon looked to her about *half a degree*. He said, "Come, you learned that from astronomy; but answer as a girl of common sense." She now replied, "A small saucer." That would be some four or five inches in diameter.

I suppose I was too early spoiled by trigonometry to enter into the merits of this style of estimate. Look at the moon as I may, I cannot compare her to anything definite, as a door-handle, a saucer, or a trencher. Judging by the distance at which we ordinarily see such things in the use of them, they all seem to me to be enormously too large. Looking at the moon through my window, sitting three or four yards from it, I should guess that a wafer stuck on it would eclipse her. My own conviction is that in the ordinary estimate (or rather comparison), there is no reference, the most covert or subconscious, to any standard of distance. True, thirty-six or thirty-seven yards would be the distance at which Arthur Collier's trencher would subtend the same angle as the moon. But who thinks of this in connection with a trencher, which is usually under a man's nose or on the kitchen rack or shelf, at a distance not exceeding four or five yards? In another letter I will, if you will allow me, call attention to some of the *veræ causæ* which are probably concomitant in these popular estimates; and this I shall do in respect to the apparently augmented size of the moon's disc on the horizon. Meanwhile, let me ask as a preliminary to that inquiry, is it a matter of fact that *to the naked eye* the moon does subtend the same angle at the horizon as at positions near the zenith? I am unable to perform the measurement myself, not merely for want of a proper instrument, but by reason of the fact that I always see in the moon a multitude of discs partially overlapping each other, five of which I can distinctly count. It would be awkward to find that one was attempting to solve an imaginary problem, like the Royal Society over King Charles's fish.

Ilford, March 24 C. M. INGLEBY

THE "lurking idea" of Mr. G. C. Thompson, that the moon looks about the size of a fourpenny piece, seems to me to show that those views of it have made most impression on him which he has taken when standing a few feet from the window, when it would cover some such space: while others, with the one foot or two feet idea, have been more wrought upon by unconscious measurement of it against trees in the garden, or house chimneys along the street. I do not think we can get beyond this, in regard to a "personal equation." As to the apparent difference between the moon near the horizon and the moon in mid-sky, your correspondents have not yet referred to the theory that the felt degree of convergence of the eyes is one help toward measuring distance; which, however, soon ceases as the object is more remote, and the convergence insensible: and that, in looking at the moon along the earth's surface, we feel that she lies beyond this limit by comparison with the objects which intervene, while in looking up through free air there is no such gradation to guide us; that, therefore, we assign, unconsciously, a greater distance to her, *i.e.*, a greater "lurking idea" of estimated magnitude for the same apparent surface, in the former case than in the latter. I write from a dim recollection of one of Sir Sidney Smith's lectures on Moral Philosophy, but I suppose the notion is trite to experts. Is there anything in it? J. R.

Concomitant Sounds and Colours.

THE investigation of the points of resemblance between two sciences, has its value and assists the development of both. Music gains by being thus raised from a mere sentimental recreation to the dignity of a science, but the science of colours may perhaps gain even more than music by the comparison, and this because the ear, in most persons, can distinguish with more precision a discord in sound, than the eye can in colour.

In the most ancient times it was well known that concomitant sounds produce a resultant whose vibrations are generated by the interference of the sonorous waves of the primaries. This physical fact was not only known but employed in the construction of Gregorian *Cantilenas*, whose succession of intervals shows a deep penetration of this truth.

The law of combination of the vibrations of concomitant sounds may be stated thus:—The resultant of two sounds has, as its number of vibrations, the difference between those of its primaries. Also any number of sounds combined two and two together, the 1st with the 2nd, the 2nd with the 3rd and so on, will form a series of resultants, which similarly combined two and two together form a second series of resultants; so that (continuing this process) we finally arrive at a single resultant which is that of the original combination. This law has been tested experimentally by Hallström and Scheibler. I considered that it might be useful to express this law by a general formula, so I will give it in this place.

If we have n sounds whose vibrations are $x_1, x_2, x_3, \ldots x_n$, all in ascending order as to *pitch*, then the resultant will be

$$R = (x - 1)_{n-2} (x_2 - x),$$

where the suffixes must be treated as indices, and $(x - 1)_{n-2}$ expanded according to the binomial theorem.

R is not, however, a resultant in the strict sense requiring the vanishing of the primary sounds; it might, perhaps, be better called the *Residuant* of the combination. It is thus the measure of the imperfection of the combination which is, more or less, a discord according as R is less or more nearly related to the primaries.

If we apply this formula we shall easily see that the tonic and subdominant generate a note two octaves below the subdominant: for example, C and F generate $\frac{F}{4}$. Also CEG, CGC^2, and CDE and all similar combinations in which the vibrations stand in arithmetical progression generate no residuant, hence, combinations of this class are perfectly consonant and are called by Boethius *equisonal concords*. (The combination CDE is discordant enough on a modern instrument, but I mean CDE tuned perfectly without temperament.)

Supposing then that an impression is made upon the retina by two or more colours in juxtaposition, analogous to that produced on the auditory nerve by two or more simultaneous sounds. We shall perceive that two complementary colours placed side by side ought to increase in intensity that one whose vibrations are the most rapid. Red and green, for instance, should give intensity to the green, since D and G generate $\frac{G}{4}$. Moreover, the colours corresponding to the *equisonal concords* ought to give us the most harmonious combinations; these are they:—

Violet	placed	between two	yellows,
Red	,,	,,	greens,
Orange	,,	,,	blues,
Yellow	,,	,,	indigo-blues,
Green	,,	,,	violets,
Blue	,,	,,	reds.

Yellow and indigo-violet ought always to be discordant, as they correspond with the discord F B or *tritone*. Again—

Violet, orange, green
Yellow, blue, violet
Indigo-blue, red, yellow
Violet, red, orange
Yellow, green, blue
Indigo-blue, violet, red.

} All correspond to equisonal concords and should form perfectly harmonious combinations.

It will be noticed that these tints must be precisely of the same shade as those in Newton's image; the slightest variation would destroy the harmony of colour. I have no doubt if pigments were made of tints identical with the ring-colours, the beauty of these combinations would be appreciated by all who used them.

It will be noticed also that D, F, A generate $\frac{B\flat}{16}$, or red, yellow, blue generate indigo-blue. A, C, E generate $\frac{F}{16}$, or blue, violet, orange generate yellow. I need not increase the length of my paper by more examples, but leave the field open to all who choose to test the above formula as regards its application to combinations of colour.

In conclusion, I wish to make the following suggestion.

Should it be admitted that the musical scale, in its perfect division into intervals under the law of harmonical progression, finds its counterpart in Newton's rings rather than in the prismatic spectrum, would not a spectroscope, constructed so as to give the image of these rings, be a more perfect instrument for the comparison of colours than that in present use? We might also have a double spectroscope, capable of giving the images of the secondary rings produced by the refraction of homogeneous light, the cube roots of whose diameters give the series which corresponds to that of the musical scale.

We should in this way be able to know the melody which corresponds to the light of any particular star, provided that the light be strong enough to produce the images of the secondary rings.

W. S. OKELY

Rome, February 18

Analogy of Colour and Music

AT the close of my short article on the Analogy of Colour and Music, published in your journal of January 13, I ventured to ask for the opinion of physicists on the subject. Accordingly I, for one, am much indebted to the many able contributors who thereupon addressed you. The correspondence having apparently ceased, I will now ask your permission to say a few words.

Although I do not attach too much importance to the closely approximate ratios, given in my paper, between the wave-lengths of colour and the notes of the diatonic scale, yet I think nothing said by your correspondents seriously affects my main argument.

The most important objection is that urged by Mr. Monro (NATURE, No. 14), who regards the correspondence of the two ratios as a mere coincidence, depending on the mode by which Prof. Listing obtained his scale of wave-lengths of the colours. By an ingenious calculation, Mr. Monro shows that Listing most probably "divided his spectrum into seven equal parts upon some scale which varies inversely as the wave-lengths; . . . so that it nearly corresponds with the ratios of the musical scale because these approximately form a harmonic progression." When I wrote my article I had not read Listing's paper, but, as stated, quoted his numbers from a recent memoir by Thalen. The perusal of his original paper shows me that Listing obtained his numbers in the following manner, which I think Mr. Monro will see confirms his calculation, but overrides his criticism:—

Employing pure spectra, and using every precaution, Listing experimentally determines the transition places and the central region of each colour, Fraunhofer's lines being used as landmarks. The observations are repeated upon the normal spectrum obtained by diffraction, and are checked by the independent observations of others, and by repetitions at different times. In this way the remarkable fact is disclosed that the numbers of vibrations at the transition spots form an *arithmetical progression* throughout the entire series of colours. For reasons given he adopts the following scale of colours—brown, red, orange, yellow, green, cyanogen, indigo, and lavender, and states as a law that this series can be physically expressed by an arithmetical progression of eight numbers, in which the last is the double of the first. He then proceeds to discover the constant factor by which this series can be turned into absolute values. After considerable care, and upon grounds fully detailed, he selects $48\frac{1}{2}$ billions as the number of vibrations per second expressing the range of each colour. The possible error he shows to be $\pm$ 0·038—taking billions as unity—and this, though apparently a large error, is actually less than $\frac{1}{7}$th of the interval between the two D lines.

The number of vibrations corresponding to the extreme limit of colour at the red end, he fixes, upon Helmholtz's and Angstrom's authority, at 363·9 billions per second, or a wave-length of 819·8 millionths of a millimetre. By adding to the former number half the colour interval—namely, $24\frac{1}{4}$ billions—the normal centre of the first colour is obtained; $48\frac{1}{2}$ billions added to that gives the centre of the next colour, and so on. These, and also the limits of each colour, are tabulated along with the corresponding wave-lengths.

Listing closes his paper with the statement of a general law, that while the successive vibrations of the series of colours in the spectrum form an arithmetical progression, the same is also true of the logarithms of the vibrations corresponding to each musical note in the so-called chromatic scale. Hence he concludes that although physiologically and pyschologically there may be differences, yet there is an indisputable *physical* basis for the analogy between tones and colours. From this very imperfect outline it will be seen that the entire memoir is a remarkable one, and I am surprised no translation of it has appeared. It is certainly the most important contribution to the analogy that I have met with, and renders my little paper on the subject quite unnecessary.

Mr. Okely, writing to the next number of NATURE, gives some additional evidence in favour of the analogy, but thinks my process of taking the mean of the limiting wave-lengths of each colour, in order to obtain the average wave-length, is "very rough." Mr. Okely does not tell us what he would do in such a case, but turns aside to become the champion of the widths of Newton's rings, charging me with having treated too summarily this old and famous ally of the analogy. But to this, my next critic, Mr. Sedley Taylor, replies, although other considerations also influenced me in neglecting this analogy.

Mr. Taylor, however, believes that he has deprived my comparison of any serious importance, for the following reason:—In the musical scale, he observes, "a very slight departure from accurate pitch in any concord provokes a harsh dissonance;" but "any part of any one colour-division produces an equally harmonious effect on the eye," because "in the spectrum there is very little, if any, change of tint except close to the extremities of any one colour." Whilst it would be certainly unwise to push the analogy too far, I think Mr. Taylor is here mistaken. There *is* a very material difference of tint in different parts of any one colour in the spectrum. Regarded alone, any region of the spectrum, like any single musical note, is, of course, equally agreeable; but it is not the case that an equally harmonious effect on the eye is produced by the combination of *any* part of any one colour-division with some other colour.

Mr. Stuart, in an interesting letter, points out a close relationship, discovered by Prof. Mossotti, between the intensities of the light in different parts of a normal spectrum and the notes of the diatonic scale. Finally, Dr. Chaumont, in an early part of this discussion, showed, what indeed had been noticed elsewhere, that if the ratios I give be accepted, then the once-called primary colours, red, yellow, and blue, correspond to the notes of the common chord; whilst the modern triad, red, green, and blue, correspond to the tonic, sub-dominant and dominant, that is to say, to the three notes which in music constitute the fundamental base of the scale.

In addition to what has been brought forward in this correspondence, there are some valuable remarks on the analogy in one of Dr. Thomas Young's memoirs, "Philosophical Transactions, 1802"; in Chevreul's work on the "Principles of Harmony of Colour"; in a recent brochure by Dr. Macdonald on "Sound and Colour"; and, lastly and chiefly, in §19 of Helmholtz's "Physiological Optics." In this last a list is given of authorities who have written on the subject since the time of Newton.

Reviewing what has been done in this matter, there are therefore, I believe, many good grounds for asserting the existence of a physical basis for the analogy between colour and tone. Opposed, it is true, are many mental differences: such, for example, as that of the judgment, which is far more prompt and correct in determining a colour than a note; then also colour primarily involves only the conception of *space*, music the conception of *time*. Nevertheless against all this we may place the facts that the source of harmony in colour, as in music, is purely a question of *relative* impressions; and a painting and a melody evoke a succession of ideas that have a remarkable similarity.

Woodlands, Isleworth, March 13

W. F. BARRETT

THE METROPOLITAN MAIN DRAINAGE

THE magnitude of the underground works of London is scarcely understood by the public in general. They occasionally hear of this or that sewer or pumping station being completed, but as the greater portion of them is hidden beneath the surface of the ground, nothing but a personal inspection during the process of construction can give any adequate idea of the vastness and intricacy of our drainage system. The following facts, collected from the engineer's papers on the subject and reports to the Metropolitan Board of Works, may present to the mind some notion of these great works. There are about 1,400 miles of sewers in London, 82 miles of which are intercepting sewers of "The Main Drainage." The area drained by the intercepting sewers is about 100 square miles. The total amount of sewage and rainfall which they will carry off is 63 million cubic feet per day, or equal to a lake as large as Hyde Park four feet in depth. There have been consumed in their construction about 340 million bricks, and upwards of 900,000 cubic yards of concrete. The total engine-power employed is 2,380 nominal horse-power, but this will soon be increased by about 400 horse-power on the construction of the Pimlico pumping station. The cost of these works when completed will be a little over 4,000,000*l*.

The accompanying map shows the position of the main intercepting sewers, pumping stations, outfalls, &c., and it will be seen that they run east and west, the reason for this being that the main sewers in existence before the construction of the main drainage, emptied themselves into the Thames, running more or less at right angles to it, and consequently, by constructing the intercepting sewers parallel to it, they would cross all the main outlets and cut off their sewage. In carrying out this scheme the great object to be kept in view was to discharge as much sewage as possible by gravitation, in order to avoid the great expense of pumping. To this end three lines of sewers are constructed on each side of the Thames, called respectively the High, Middle, and Low Level sewers, together with their branches. On the north side the High and Middle Level discharge their sewage by gravitation; that of the Low Level, which joins them at Abbey Mills, being pumped up a height of 36 feet into the Upper Level, when all three flow through the Northern Outfall Sewer to the reservoirs at Barking, and discharge their contents into the river by gravitation. On the south side the Low Level sewer meets the High and Middle Level at Deptford, where its contents are pumped a height of 18 feet into the Outfall Sewer, which carries the three streams to Crossness, where they can discharge by gravitation; but as this can only be done at low water, they are generally pumped a height of 20 feet into the reservoirs. Such is the general outline of the Main Drainage scheme, as being carried out by Mr. Bazalgette, the able engineer of the Metropolitan Board of Works.

Before commencing these works a large number of experiments and observations had to be made in order to decide the numerous knotty points that suggested themselves: such as the determination of the position of the outfalls, the shape and inclination of the sewers, the amount of sewage and rainfall to be provided for, the amount to be pumped, &c., &c., each requiring a great amount of labour and study. The results arrived at, and which were acted upon, may be summed up as follows:—That it was necessary to take the sewage down the river as far as Barking Creek; that its lowest mean velocity should be 1½ miles per hour; the quantity of sewage to be intercepted was, in populous districts, 750,000 gallons per square mile per day; the amount of rainfall to be provided for was a quarter of an inch per day; the form of the sewers was to be circular, and the sewage was to be discharged at or about the time of high water. The above are a few of the principles upon which the Main Drainage of London is based.

THE WORKS.—The High Lever Sewer North commences near Hampstead Hill, where it intercepts the Fleet Sewer. It varies in size from 4ft. in diameter to 9ft. 6in. by 12ft., is about seven miles long, and drains an area of about ten square miles in its course from Hampstead to its junction with the Middle Level at Old Ford. It passes under three railways, the New River, and Sir George Duckett's Canal, in the last case the top of the sewer is within 2 ft. of the waters in the canal.

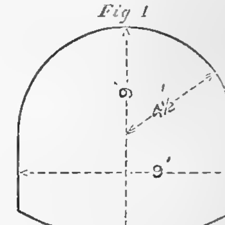
The Middle Level Sewer commences near Kensal Green and flows to its junction with the High Level at Old Ford. The total length of the main line, together with the Piccadilly branch, is about 11½ miles; the area drained is 17½ square miles; in form it varies from 4ft. 6in. by 3ft. to 9ft. 6in. by 12ft. Six miles of this sewer were constructed in tunnel. In its course it passes under two canals and one railway, and over the Metropolitan line, across which it was carried without interfering with the traffic, the bottom of the sewer being only a few inches above the chimneys of the engines.

At the junction of the High and Middle Level sewers there is a large "penstock" and "weir" chamber, for the purpose (should occasion demand) of letting storm waters or all the sewage flow into the River Lea. It is 150ft. in length, 40ft. wide, and 36ft. high, and fitted with five large penstocks or valves, which are raised or lowered by machinery.

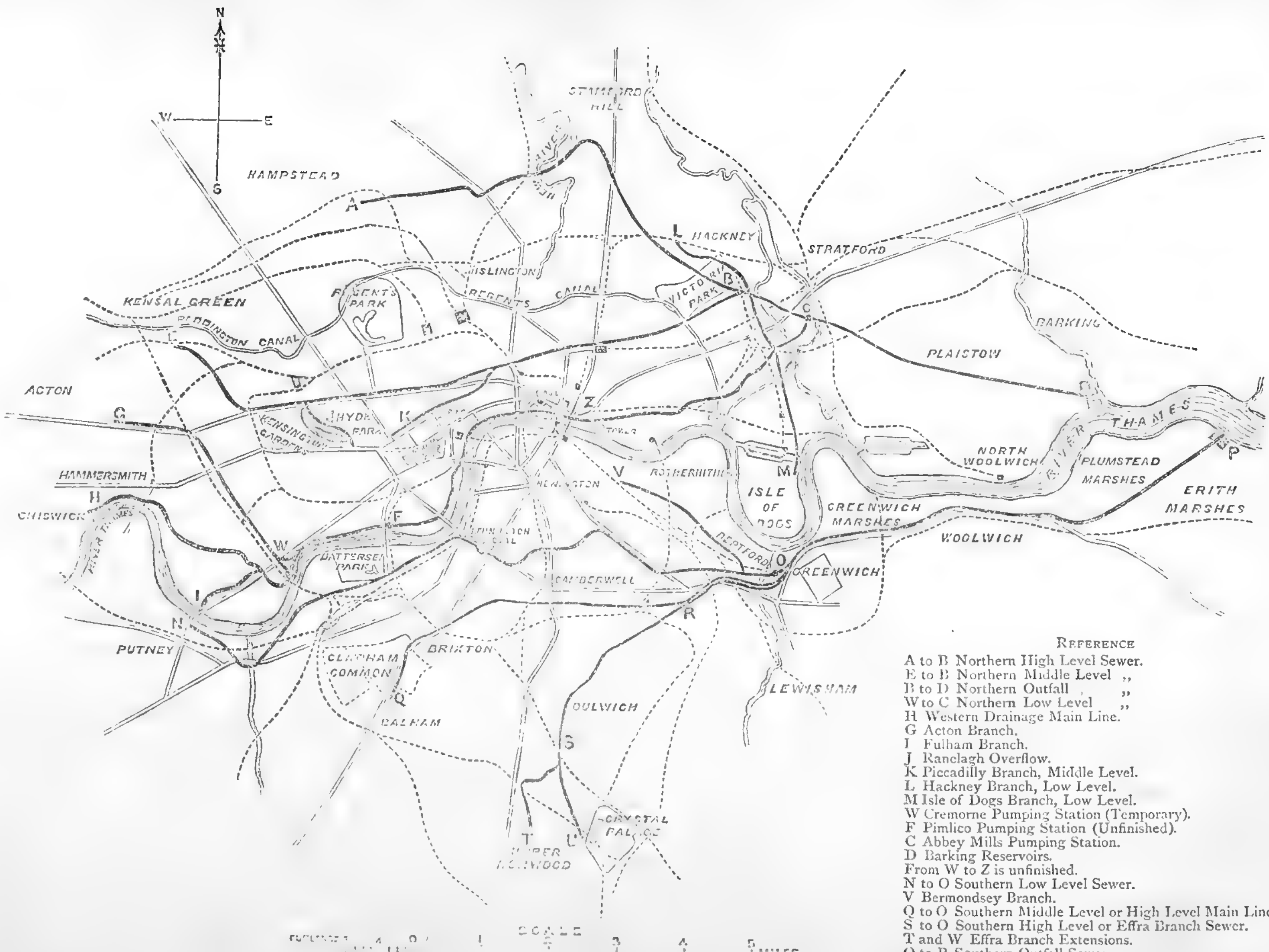
The Low Level North will commence by a junction with the Western Drainage near Cremorne, and flow along the intended Chelsea Embankment to Pimlico, where its contents will be pumped up a height of 17½ feet into the remaining length, which will flow *viâ* the Thames Embankment to Abbey Mills. Its length, including branches, is about 12¼ miles, and it varies in size from 6ft. 9in. to 10ft. 3in. diameter. The area drained by it, including the Western Drainage, the sewage of which it receives, is 24½ square miles. This sewer is by far the most interesting on the north side, in consequence of the large works in connection with it. In the first place, it receives the drainage of the Isle of Dogs, in consequence of which, what was formerly little better than a marsh is now perfectly habitable; in the second place, it will pass along the two new embankments, viz., Chelsea and the Northern Thames; and in the third, its contents will be twice lifted by steam power, the lift at Pimlico being over 17ft., and that at Abbey Mills 36ft. At Blackfriars Bridge, where it intercepts the Fleet, there will be a large penstock-chamber fitted with four penstocks and as many tide flaps, to prevent the return of the tide at high water. A large portion of this sewer, namely, that extending from Blackfriars to Abbey Mills, will be executed for the most part in tunnel.

The Northern Outfall Sewer, which receives the whole of the sewage on the north side of the Thames, is totally unlike any other portion of the Main Drainage system, being entirely above the ordinary level of the ground. The first length, from B to C (see plan), consists of a double line of sewers, each being 9ft. by 9ft. of the section shown in Fig. 1 running parallel to each other; at C it receives the contents of the Low Level, and from this point to the reservoirs at Barking it is of the section shown in Fig. 2, which is three parallel culverts 9ft. by 9ft. built upon a concrete foundation and covered by an earthen embankment, the top of which would serve as a road or railway. In its course to Barking it crosses the River Lea and six streams, four railways, and ten roads. Fig. 3 gives a general idea of the method adopted for carrying the sewers over the streams, railways, &c. It consists of three cast-iron culverts carried between four wrought-iron girders, the top being covered with cast-iron plates, which support the ballasting, roadway, &c.; the parapets are ornamented with cast-iron mouldings.

Fig 1



The contents of this sewer are received by the reservoirs at Barking. These are about 9½ acres in extent, and 16¾ft.



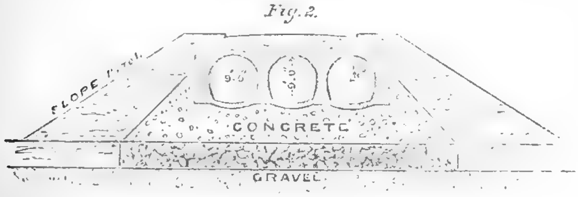
Reference

A to B Northern High Level Sewer.
E to B Northern Middle Level ,,
B to D Northern Outfall ,,
W to C Northern Low Level ,,
H Western Drainage Main Line.
G Acton Branch.
I Fulham Branch.
J Ranelagh Overflow.
K Piccadilly Branch, Middle Level.
L Hackney Branch, Low Level.
M Isle of Dogs Branch, Low Level.
W Cremorne Pumping Station (Temporary).
F Pimlico Pumping Station (Unfinished).
C Abbey Mills Pumping Station.
D Barking Reservoirs.
From W to Z is unfinished.
N to O Southern Low Level Sewer.
V Bermondsey Branch.
Q to O Southern Middle Level or High Level Main Line.
S to O Southern High Level or Effra Branch Sewer.
T and W Effra Branch Extensions.
O to P Southern Outfall Sewer.
O Deptford Pumping Station.
P Crossness Pumping Station and Reservoirs.

THE MAIN DRAINAGE OF LONDON

deep, covered in by brick arches, the floor being paved with stone. Attached to each is an outlet fitted with penstocks, &c. The Abbey Mills pumping station is a work of such magnitude and importance that but a scanty idea can be given of it here: suffice it to say, that there are eight engines employed, of a gross power of 1,140 horse-power, which work sixteen double-acting pumps of 3ft. 10½in. diameter and 4½ft. stroke. The engines are supplied by sixteen boilers, each being 8ft. diameter and 30ft. long. The engine and boilers, coal stores, &c., are enclosed in a fine block of buildings beautifully decorated.

Fig. 2.

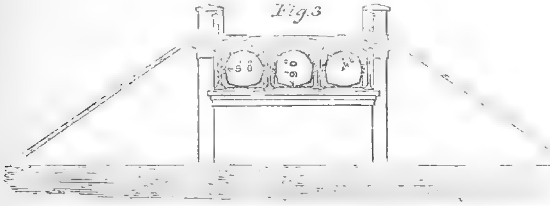


The Southern High Level, or Effra Branch Sewer, commences at Dulwich, and flows in a south-easterly direction to a junction with the Middle Level or High Level main line at New Cross. It is 4½ miles in length, ¼ mile of which is in tunnel. It varies in size from 7ft. diameter to a form similar to one of the culverts in Fig. 2, only the dimensions are 10ft. 6in. by 10ft. 6in.

The Southern Middle Level, or High Level main line, commences at Clapham, and flows under Deptford Creek to the Outfall Sewer. It, together with the High Level, drains an area of about 20 square miles. It is carried under Deptford Creek by four 3ft. 6in. diameter iron pipes. Overflows for storm waters are provided, which discharge into the Creek, if necessary.

The Low Level Sewer South commences at Putney, and flows to Deptford pumping station, where its contents are pumped up a height of 18 feet, by four engines 125 horse-power each, into the Outfall Sewer. Its length is about 10 miles, and it drains an area of about 20 square miles, the greater portion of which is considerably below high-water mark. It varies in size from one culvert 4 ft. in diameter, to two, each 7ft. by 7ft. The soil in which it was executed was exceedingly treacherous in places, being greatly charged with water: in one case sufficient engine-power had to be employed to pump ten million gallons per day, in order to keep the works clear of water. The Bermondsey branch of this sewer is two miles in length,

Fig. 3



and from 5ft. to 5ft. 6in. diameter. It joins the Low Level at High Street, Deptford.

The Southern Outfall Sewer, which receives the contents of the High, Middle, and Low Level sewers, flows from Deptford to the reservoirs at Crossness. Unlike the Northern Outfall, it is underground for its entire length. It is 11ft. 6in. diameter, and 7¾ miles in length. One mile of it was constructed in tunnel under the town of Woolwich. The outfall of this sewer is of such a level as to allow of the sewage being discharged at low water, but it will be pumped into the reservoirs, and there stored till high water.

The Crossness pumping station reservoirs are situated on the northern side of Erith Marshes at the point marked P on the map. They extend over 6½ acres. The reservoirs are similar to those at Barking. There are four beam engines employed of 125 horse-power each, which drive eight pumps, each pump having four compound plungers. The engines are supplied by twelve Cornish boilers 30ft. long and 8ft. diameter. The ordinary amount of sewage to be lifted is about 60,000 gallons per minute, the lift varying from 10ft. to 30ft., which necessitated a peculiar construction in the pumps. The sewage is delivered from the pumps into the reservoirs till high water, when it is discharged into the river. The foundations for the reservoirs, &c., had to be sunk 25ft. below the surface, as the ground consists of peat and sand. On the top of the reservoirs are built the manager's, schoolmaster's, and labourers' cottages, coal stores, school, and workshops, the centre space being laid out as ornamental gardens, the whole forming quite a village of some hundred inhabitants.

NOTES

THE last number of the Proceedings of the Royal Society contains the names of the 53 candidates, from among whom, 15 will be selected by the council for election into the society. The list is a varied one, and there is as usual a large number of medical candidates—21; Art and Literature being also represented. Here is the list:—William Baker, C.E., E. M. Barry, R.A., Rev. Francis Bashforth, B.D., B. E. Brodhurst, F.R.C.S., Samuel Brown, P.I.A., James Brunlees, C.E., F. T. Buckland, M.R.C.S., G.W. Callender, F.R.C.S., Commander W. Chimmo, R.N., F. Le G. Clark, F.R.C.S., Henry Dircks, Alex. Fleming, M.D., P. Le Neve Foster, Sir Charle Fox, C.E., William Froude, T. M. Goodeve, E. H. Greenhow, M.D., E. T. Higgins, M.R.C.S., Rev. Thomas Hincks, Charles Horne, Rev. A. Hume, LL.D., James Jago, M.D., W. S. Jevons, George Johnson, M.D., M. K. King, M.D., J. A. Langridge, C.E., N. S. Maskelyne, M. T. Masters, M.D., Major F. G. Montgomerie, R.E., Alfred Newton, Andrew Noble, Thomas Nunnely, F.R.C.S., E. L. Ormerod, M.D., Captain Sherard Osborn, R.N., Rev. Stephen Parkinson, B.D., Captain R. M. Parsons, R.E., W. O. Priestly, M.D., C.B. Radcliffe, M.D., W. H. Ransom, M.D., E. J. Reed, C.B., W. J. Russell, Ph.D., R. H. Scott, John Shortt, M.D., Edward Thomas, C. F. Varley, C.E., G. F. Verdon, C.B., Augustus Voelcker, Ph.D., Viscount Walden, P.Z.S., G. C. Wallich, M.D., A. T. H. Waters, M.D., Samuel Wilks, M.D., Captain C. W. Wilson, R.E., and John Wood, F.R.C.S.

THE *Pall Mall Gazette* has very properly called public attention to Lord Kinnaird's imputation of dishonesty brought against the late Master of the Mint, the lamented Graham. The good old rule, *de mortuis nil nisi bonum*, is one with which Lord Kinnaird does not seem to be acquainted; it is charitable, indeed, to suppose that he sinned in ignorance. He probably also does not know that Graham was a far greater man than he, and that Graham's name will live long after Lord Kinnaird's has been forgotten.

ON Saturday the members of Working Men's Clubs visited the British Museum, under the guidance of Professor Owen and Mr. Henry Woodward. Professor Owen explained the nature of the extinct animals. The next visit will be made to the National Gallery, under the guidance of Mr. Francis Turner Palgrave.

THE examinations for the gold and bronze medals offered as prizes for proficiency in Physical and Political Geography, by the Royal Geographical Society, were held on Monday last, 28th inst. Forty-one schools had been invited to compete, out of which number nineteen accepted, sending a total of fifty-nine candidates: thirty-four in Physical, and twenty-five in Political Geography. The names of the successful candidates will be announced at the ensuing anniversary meeting.

IN the introductory lecture to his course of Comparative Anatomy, delivered at the Royal College of Surgeons, Prof. Flower discusses the objection to the theory of the origin of species by the process of natural selection, founded on the existence of corresponding types of structure in the Monodelphous and Didelphous sections of mammalia. He considers the probabilities, instead of being against the independent origin of such similar structures, are exceedingly in their favour. The lecturer lays down as a valuable guiding principle in morphological studies, that when we wish to discover the distinguishing characters between different organisms, it is necessary to examine them in their most fully developed condition; if, on the other hand, our object is to trace their resemblance, their intimate relationships, we must study them in their early embryonic stages.

THE *Revue des Cours Scientifiques* reports that the Sars subscription now approaches 9,000 francs. Subscriptions have been received from Germany, Hungary, and America. In France nearly all the professors of higher instruction in science have subscribed to it.

WE have received from the Royal Society a report of Prof. Duncan's important paper on the Madrepores of the *Porcupine* Expedition. We shall return to this subject after completing Dr. Carpenter's report of the more general results of the expedition.

PROF. TYNDALL will have much to answer for in the results that may be expected from the spread of his "dust and disease" theory. It is stated by the *Athenæum* that a new idea has been broached in a recent lecture by Mr. Bloxam, the lecturer on chemistry to the department of artillery studies. He suggests that the committee on explosives, abandoning gun cotton, should collect the germs of small-pox and similar malignant diseases, in cotton or other dust-collecting substances, and load shells with them. We should then hear of an enemy dislodged from his position by a volley of typhus, or a few rounds of Asiatic cholera. We shall expect to receive the particulars of a new "Sale of Poisons" Act, imposing the strictest regulations on the sale by chemists of packets of "cholera germs" or "small-pox seed." Probably none will be allowed to be sold without bearing the stamp of the Royal Institution, certifying that they have been examined by the microscope and are warranted to be the genuine article.

WE have received from Professor H. A. Newton, of Yale College, a report on the meteor-display of November last, from which it appears that the cloudy weather prevented continuous observations in most parts of the United States. In the few stations, however, where the skies were clear, the observers furnish ample testimony to the appearance of unusual numbers of meteors on the morning of Nov. 14, the display continuing for several hours. The most successful observations were made at Pensacola, Florida, where they were observed in extraordinary numbers from 1·15 till dawn, most numerously between 3 and 4 a.m.; at Santa Barbara, California, where 556 meteors were observed between 1·18 and 3·43 a.m.; and at Fredericton, New Brunswick. Prof. Newton remarks that if the whole number coming during the twelve or more hours of the display had been condensed into an hour or two, as in 1866, we should have had a like though not equally brilliant shower.

THE Council of the University of Otago, New Zealand, announces that it is now prepared to consider applications from candidates for two of the professorial chairs to be instituted for classics, including Greek, Latin, the English language and literature; and for Mathematics and Natural Philosophy. The salary attached to each chair will be 600*l.* per annum, which will commence to run from the date of embarkation, besides the class fees, which have been fixed at 3*l.* 3*s.* for attendance on each professor, per term of six months, commencing in the beginning of May of each year. An adequate allowance will be made for passage money and outfit. All candidates must be graduates of some established and recognised university. No religious test will, however, be required from any person to entitle him to hold office in the university, or to graduate or to hold any advantage or privilege thereof. Applications from candidates must be addressed to John Auld, Esq., W.S., Edinburgh, agent of the Province of Otago in Britain, and must be accompanied with testimonials and certificates. They must be in his hands on or before the 1st day of April next. Further information relative to the university and the statistics of the province will be afforded on application to the agent.

BY the provisions of the late Dr. William J. Walker's foundation two prizes are annually offered by the Boston Society of Natural History for the best memoirs, written in the English language, on subjects proposed by a Committee appointed by the Council. For the best memoir presented, a prize of sixty dollars may be awarded; if, however, the memoir be one of marked merit, the amount may be increased, at the discretion of the Committee, to one hundred dollars. For the memoir next in value a sum not exceeding fifty dollars may be given; but neither of these prizes is to be awarded unless the papers under consideration are deemed of adequate merit. Memoirs offered in competition for these prizes must be forwarded on or before April 1st, of the years specified below, prepaid and addressed "Boston Society of Natural History, for the Committee on the Walker Prizes, Boston, Mass." Each memoir must be accompanied by a sealed envelope enclosing the author's name, and superscribed by a motto corresponding to one borne by the manuscript. Subject of the Annual Prize for 1870: "The reproduction and migration of *Trichina spiralis.*" Subject of the Annual Prize for 1871: "On the mode of the natural distribution of plants over the earth."

THE following are the Afternoon Scientific Lectures of the Royal Dublin Society, to be delivered during April and May, at four o'clock on Saturdays, in the Lecture Theatre. April 2nd, Dr. J. Emerson Reynolds, "On Ozone, Nature's bleaching agent and disinfectant." April 9th, Dr. H. Minchin, "On some interesting phenomena of sound. April 16th, Prof. E. Hull, "On the extension of the Coal-fields of England under the newer formations." April 30th, Prof. Wyville Thomson, "On the Cruise of the *Porcupine.*" May 7th, Mr. H. N. Draper, "On Colours from coal-tar." May 14th, Mr. C. R. C. Tichborne, "On Atmospheric Dust."

A COURSE of lectures for women on the science and practice of music, by Mr. Sullivan, will be delivered at South Kensington, under the patronage of the Science and Art Department, shortly after the close of Prof. Oliver's course on botany. It will include a class for part-singing.

WE have received a pamphlet entitled "Proposals for the Illumination of Beacons and Buoys," by Mr. Thomas Stevenson, F.R.S.E. The author discusses the different sources of illuminations for beacons and buoys, and the different applications of sound for warnings during fogs. The subject is a highly important one, and we purpose to return to it at an early period.

ACCORDING to the *British Medical Journal*, Sir W. Fergusson is about to resign the chair of systematic surgery at the Medical School of King's College, and Mr. Partridge his appointment as surgeon to the hospital. Sir William will, however, be appointed professor of clinical surgery, while Mr. Partridge still retains the chair of anatomy. Mr. Wood is expected to succeed Sir W. Fergusson as professor of systematic surgery;

he will also be appointed to the rank of full surgeon to the hospital. Two vacancies will therefore occur, that of assistant-surgeon to the hospital, and demonstrator of anatomy.

WE learn from *Van Nostrand's Eclectic Engineering Magazine* (New York) that the Darien Canal project is reviving. The United States steamer *Nipsic*, attached to the South Atlantic squadron, is under orders to proceed to the Isthmus of Darien to make surveys and explorations, with a view to determine the best location for an inter-oceanic canal. A similar survey on the Pacific shore of the Isthmus will be made at a future day.

M. FAVRE has recently detected evidences of the glacial period in the Caucasus, and M. Ed. Collomb finds traces, in the form of moraines and erratic blocks, of its having existed with great severity in the central plateau of France. This plateau forms an almost circular geological island 300 kilometres in diameter; its altitude increases progressively from north to south, and it is terminated on the south and west side by a barrier, the highest points of which, the Mézenc, the Plomb du Cantal, and the Mont d'Or rise to a height of from 1,750 to 1,900 metres (5,700 to 6,200 feet), above the level of the sea.

THE sense of taste has rarely been submitted to scientific examination, or at all events has attracted far less attention than its sister senses of sight and hearing, perhaps on account of the impossibility of treating it mathematically. That it differs to a remarkable extent in different individuals is, however, as every culinary artist would acknowledge, a matter of fact; and it is also well known that it is capable of extraordinary cultivation in some men, as shown by wine- and tea-tasters obtaining lucrative posts from the delicacy of their discrimination. Recently Dr. Keppler has published a paper in Pflüger's "Archives of Physiology," in which he gives the details of a number of experiments he performed with a view of determining the limits of gustatory discrimination for sapid substances in various degrees of concentration. In these experiments he first made a standard solution, and then successively employed weaker or stronger solutions, which were tasted with due precautions, sometimes before and sometimes after the standard solution, until no perception of flavour was distinguished. The substances he selected were common salt, quinine, phosphoric acid, and glycerine, all of them, be it observed, destitute of odour, which plays so important a part, often overlooked, in our ideas of the flavour of particular objects. In one series of experiments the solutions were taken freely into the mouth, rolled over all parts of the membrane lining it, and then discharged. In a second series the solutions, were more carefully applied to the surface of the tongue alone by means of a camel's hair brush. It was found in both cases that when a difference of 2·5 per cent. existed between the standard solution and the experimental one, the observers were able to form a correct judgment on the point that there *was* a difference in 53 per cent. of the trials, but when there was a difference between the two solutions amounting to 10 per cent., the answers were rightly given in 80 per cent. of all the trials. A more correct judgment was given when the standard solution was tasted before than after the experimental one with common salt and quinine, and the acuteness in the perception of a difference was greater when the trial solution was stronger than when weaker, but the opposite held good for the other substances.

WE learn from the *Gardener's Chronicle* that the Royal Horticultural Society has decided to retain a portion of the old Chiswick garden, comprising the ground occupied by the glass-houses, and extending sufficiently eastwards and southwards to include the large vinery and the fruit-room.

M. DUCLAUX has lately been experimenting on the effect of certain gases in retarding the incubation of silkworms' eggs. He has also been trying the effect of cold upon the same organisms, and finds that instead of retarding the period of incubation, it accelerated it: in fact, that eggs laid in autumn and left to themselves would only incubate in spring; but if subjected to the action of a freezing mixture for forty days, they would hatch into larvæ immediately afterwards, on being submitted to the action of a gentle heat. If these experiments are confirmed, M. Duclaux will have undoubtedly discovered an entirely new principle in physiology: that cold has a vivifying influence. Hitherto physiologists have always believed that its action was diametrically opposite.

THE journal of the Proceedings of the Asiatic Society of Bengal for January has an interesting article by Dr. F. Skoliczka on the Kjökenmöddings of the Andaman Islands.

THE *Journal of the Scottish Meteorological Society* has some interesting papers on the cold of last summer in Ireland, and upon the thunderstorms of Scotland. The part also contains a report on the Meteorology of Scotland and a minute of the meeting of the Council.

THE *American Gas Light Journal* reports that at a recent meeting of the Lyceum of Natural History of New York, Mr. Loew stated that ozone is produced copiously by blowing a strong current of air into the flame of a Bunsen's burner. He also communicated that he had observed the decomposition of sulphurous acid with production of sulphuric acid and deposition of sulphur, when an aqueous solution of the gas was exposed for two months to sunlight.

THE hardness of metals may now be ascertained by the aid of an instrument invented by a French engineer. It consists of a drill turned by a machine of a certain and uniform strength. The instrument indicates the number of revolutions made by the drill. From this, compared with the length of the bore-hole produced, the hardness of the metal is estimated. It is said that a great proportion of the rails now employed in France are tested by this instrument.

*ON THE TEMPERATURE AND ANIMAL LIFE OF THE DEEP SEA**

III.

AN enormous addition has been made to the list of British *Echinodermata* by the discovery in our own seas of a number of species which had been previously known only as Norwegian or Arctic; and these often occurred in extraordinary abundance. One of the most interesting of these was the large and beautiful feather-star, the *Antedon* (*Comatula*) *Eschrichtii*, hitherto known only as inhabiting the shores of Greenland and Iceland, but now found over all parts of our cold area. On the other hand, the influence of temperature was marked not only by the absence of many of the characteristically southern types of this group, but by the dwarfing of others to such an extent that the dwarfed specimens might be regarded as specifically distinct, if it were not for their precise conformity in structure to those of the ordinary type. Thus the *Solaster papposa* was reduced from a diameter of six inches to two, and had never more than ten rays, instead of from twelve to fifteen; and *Asterocanthion violaceus* and *Cribella oculata* were reduced in like proportion. But, in addition, several echinoderms have been obtained which are altogether new to science, most of them of very considerable interest. The discovery, at the depth of 2,435 fathoms, of a living crinoid of the Apiocrinite type, closely allied to the little rhizocrinus (the discovery of which by the Norwegian naturalists was the starting-point of our own deep-sea explorations), but generically differing from it, cannot but be accounted a phenomenon of the greatest interest alike to the zoologist and the palæontologist. Another remarkable representative of a type supposed to have become extinct, occurred at depths of 440 and 550 fathoms in the warm area; being a large *echinidan* of the *diadema* kind, the "test" of which is composed of plates separated from one another by membrane, instead of being connected by suture, so as to resemble an armour of flexible chain-mail, instead of the inflexible cuirass with which the

* A Lecture delivered at the Royal Institution (continued from p. 540).

ordinary echinida are invested. This type bears a strong resemblance to the very singular fossil from the white chalk, described by the late Dr. S. P. Woodward, under the name of *Echinothuria floris*. Specimens were also obtained, both in the first and third cruises, of a most interesting *clypeastroid*, which is closely allied to the *infulaster*—specially characteristic of the later chalk.* These constitute only a sample of the interesting novelties belonging to this group, which our explorations brought to light.

Besides further additions to the remarkable group of vitreous sponges, which were made in the area over which the Globigerina-mud extends, a peculiar and novel form of sponge was found to be one of the most generally diffused inhabitants of the cold area. This sponge is distinguished by the possession of a firm branching axis, of a pale sea-green colour, rising from a spreading root, and extending itself like a shrub or a large branching gorgonia. The axis is loaded with siliceous spicules; and spicules of the same form are contained in the soft flesh which clothes it.

The foraminifera collected in the *Porcupine* expedition present features of no less interest, though their scale is so much smaller. The enormous mass of Globigerina-mud (sometimes almost pure, sometimes mixed with sand) that everywhere covers the deep-sea bottom in the region explored, save where its temperature is reduced nearly to the freezing-point, may be judged of from the fact that in one instance the dredge brought up half-a-ton of it from a depth of 767 fathoms. The resemblance of this deposit to chalk is greatly strengthened by the recognition of several characteristically cretaceous types among the foraminifera scattered through the mass of *Globigerinæ* of which it is principally composed; as also of the *Xanthidia*, frequently preserved in flints. Not many absolute novelties presented themselves among the foraminifera that form true calcareous shells; the chief point of interest being the occurrence of certain types of high organisation at great depths, and their attainment of a size that is only paralleled in much warmer latitudes, or in the Tertiary or yet older formations. This is especially the case with the Cristellarian group, which has a long geological range; and also with the Milioline, of which specimens of unprecedented size presented themselves. The most interesting novelty was a beautiful Orbitolite, which, when complete, must have had the diameter of a sixpence, but which, from its extreme tenuity, always broke in the process of collection. Of Arenaceous Foraminifera, however, which construct tests by cementing together sand-grains, instead of producing shells, the number of new types is such as seriously to task our power of inventing appropriate generic names. Many of these types have a remarkable resemblance to forms previously known in the chalk, the nature of which had not been recognsied. Some of them throw an important light on the structure of two gigantic Arenaceous types from the upper greensand, recently described by the speaker and Mr. H. B. Brady, an account of which will appear in the forthcoming part of the "Philosophical Transactions;" and there is one which can be certainly identified with a form lately discovered by Mr. H. B. Brady in a clay-bed of the carboniferous limestone.

The question now arises, whether—as there must have been deep seas in all geological periods, and as the changes which modified the climate and depth of the sea-bottom were for the most part very gradual—we may not carry back the continuity of the accumulation of Globigerina-mud on some part or other of the ocean bed into geological epochs still more remote; and whether it has not had the same large share in the production of the earlier calcareous deposits, that it has undoubtedly had in that of the later. The foraminiferal origin of certain beds of the carboniferous limestone, for example, appears to be indicated by the presence of *Globigerinæ*, long since observed by Professor Phillips in sections of them, as well as by the fact just stated. The subcrystalline character of these rocks cannot be regarded as in any way antagonistic to such an idea of their origin, since it is perfectly well known that all traces of the organic origin of calcareous rocks may be completely removed by subsequent metamorphism, —as in the chalk of the Antrim coast.

What is the source of nutriment for the vast mass of animal life covering the abyssal sea-bed, is a question of the greatest biological interest. That animals have no power of themselves generating the organic compounds which serve as the materials of their bodies—and that the production of these materials from the carbonic acid, water, and ammonia of the inorganic world, under the influence of light, is the special attribute of vegetation —is a doctrine so generally accepted, that to call it in question would be esteemed a physiological heresy. There is no difficulty in accounting for the alimentation of the higher animal types, with such an unlimited supply of food as is afforded by the *Globigerinæ* and the sponges in the midst of which they live, and on which many of them are known to feed. Given the Protozoa, everything else is explicable. But the question returns,—on what do these Protozoa live?

The hypothesis has been advanced that the food of the abyssal Protozoa is derived from diatoms and other forms of minute plants, which, ordinarily living at or near the surface, may, by subsiding to the depths, carry down to the animals of the sea-bed the supplies they require. Our examination of the surface-waters, however, has afforded no evidence of the existence of such mycrophytic vegetation in quantity at all sufficient to supply the vast demand; and the most careful search in the Globigerina-mud has failed to bring to light more than a very small number of specimens of these siliceous envelopes of Diatoms, which would most assuredly have revealed themselves in abundance, had these Protophytes served as a principal component of the food of the Protozoa that have their dwelling-place on the sea-bed. Another hypothesis has been suggested, that these Protozoa which are so near the border of the vegetable kingdom, may be able, like plants, to generate organic compounds for themselves, manufacturing their own food, so to speak, from inorganic materials. But it is scarcely conceivable that they could do this without the agency of light; and as it is obviously the want of that agency which excludes the possibility of vegetation in the abysses of the ocean, the same deficiency would prevent animals from carrying on the like process.

A possible solution of this difficulty, offered by Professor Wyville Thomson in a lecture delivered last spring, has received so remarkable a confirmation from the researches made in the *Porcupine* expedition, that it may now be put forth with considerable confidence. It is, he remarked, the distinctive character of the Protozoa, that "they have no special organs of nutrition, but that they absorb water through the whole surface of their jelly-like bodies. Most of these animals secrete exquisitely-formed skeletons, sometimes of lime, sometimes of silica. There is no doubt that they extract both of these substances from the sea-water, although silica often exists there in quantity so small as to elude detection by chemical tests. All sea-water contains a certain amount of organic matter in solution. Its sources are obvious. All rivers contain a large quantity; every shore is surrounded by a fringe, which averages about a mile in width, of olive and red sea-weeds; in the middle of the Atlantic there is a marine meadow, the Sargosso Sea, extending over 3,000,000 of square miles; the sea is full of animals which are constantly dying and decaying; and the water of the Gulf Stream, especially, courses round coasts where the supply of organic matter is enormous. It is, therefore, quite intelligible that a world of animals should live in these dark abysses: but it is a necessary condition that they should chiefly belong to a class capable of being supported by absorption through the surface, of matter in solution; developing but little heat, and incurring a very small amount of waste by any manifestation of vital activity. According to this view, it seems highly probable that at all periods of the earth's history some form of the Protozoa—rhizopods, sponges, or both—predominated over all other forms of animal life in the depths of the sea; whether spreading, compact, and reef-like, as in the Laurentian and Palæozoic *Eozoon;* or in the form of myriads of separate organisms, as in the *Globigerinæ* and *Ventriculites* of the chalk."*

During each cruise of the *Porcupine*, samples of sea-water obtained from various depths, as well as from the surface, at stations far removed from land, were submitted to the Permanganate test, after the method of Prof. W. A. Miller, with an addition suggested by Dr. Angus Smith for the purpose of distinguishing the organic matter in a state of decomposition from that which is only decomposable; with the result of showing the uniform presence of an appreciable quantity of matter of the latter kind, which, not having passed into a state of decomposition, may be assimilable as food by animals, being, in fact, protoplasm in a state of extreme dilution. And the careful analyses of larger quantities collected during the third cruise, which have been since made by

* This was believed at the time to be an entirely new discovery; but since the return of the *Porcupine* we have learned that a type generically, if not specifically, the same, had been obtained by Count Pourtales during his most recent dredgings in the Gulf of Mexico, and had been described by Mr. Alex. Agassiz under the name *Pourtalesia miranda*.

* "The Depths of the Sea," a lecture delivered in the theatre of the Royal Dublin Society, April 10, 1869.

Dr. Frankland, have fully confirmed these results, by demonstrating the highly azotized character of this organic matter, which presents itself in samples of sea-water taken up at from 500 to 750 fathoms' depth, in such a proportion that its universal diffusion through the oceanic waters may be safely predicted.

Until, therefore, any other more probable hypothesis shall have been proposed, the sustenance of animal life on the ocean-bottom at any depth may be fairly accounted for on the supposition of Prof. Wyville Thomson, that the protozoic portion of that fauna is nourished by direct absorption from the dilute protoplasm diffused through the whole mass of oceanic waters, just as it draws from the same mass the mineral ingredients of the skeletons it forms. This diffused protoplasm, however, must be continually undergoing decomposition, and must be as continually renewed; and the source of that renewal must lie in the surface-life of plants and animals, by which (as pointed out by Prof. Wyville Thomson) fresh supplies of organic matter must be continually imparted to the oceanic waters, being carried down even to their greatest depths by that liquid diffusion which was so admirably investigated by the late Professor Graham.

Not only, however, has the nutrition of the abyssal fauna to be explained; its respiration also has to be accounted for; and on this process also the results of the analyses of the gases of the sea-water made during the *Porcupine* expedition throw very important light. Samples were collected not only at the surface, under a great variety of circumstances, but also from great depths; and the gases expelled by boiling were subjected to analysis according to the method of Prof. W. A. Miller—the adaptation of his apparatus to the exigencies of ship-board having been successfully accomplished during the first cruise by Mr. W. L. Carpenter. The general average of thirty analyses of surface-water gives the following as the percentage proportions:—25·1 oxygen, 54·2 nitrogen, 20·7 carbonic acid. This proportion, however, was subject to great variations, as will be presently shown. As a general rule, the proportion of oxygen was found to diminish, and that of carbonic acid to increase, with the depth; the results of analyses of intermediate waters giving a percentage of 20·0 oxygen, 52·8 nitrogen, and 26·2 carbonic acid; whilst the results of analyses of bottom-waters gave 19·5 oxygen, 52·6 nitrogen, and 27·9 carbonic acid. But bottom-water at a comparatively small depth often contained as much carbonic acid and as little oxygen as intermediate water at much greater depths; and the proportion of carbonic acid to oxygen in bottom-water was found to bear a much closer relation to the abundance of animal life (especially of the more elevated types), as shown by the dredge, than to its depth. This was very strikingly shown in an instance in which analyses were made of the gases contained in samples of water collected at every fifty fathoms, from 400 fathoms to the bottom at 862 fathoms, the percentage results being as follows:—

	750 fath.	800 fath.	Bottom 862 fath.
Oxygen	18·8	17·8	17·2
Nitrogen	49·3	48·5	34·5
Carbonic Acid	31·9	33·7	48·3

The extraordinarily augmented percentage of carbonic acid in the stratum of water here immediately overlying the sea-bed was accompanied by a great abundance of animal life. On the other hand, the lowest percentage of carbonic acid found in bottom-water, viz. 7·9, was accompanied by a "very bad haul." In several cases in which the depths were nearly the same, the analyst ventured a prediction as to the abundance, or otherwise, of animal life, from the proportion of carbonic acid in the bottom-water; and his prediction proved in every instance correct.

It would appear, therefore, that the increase in the proportion of carbonic acid and the diminution in that of the oxygen, in the abyssal waters of the ocean, is due to the respiratory process, which is no less a necessary condition of the existence of animal life on the sea-bed, than is the presence of food-material for its sustenance. And it is further obvious that the continued consumption of oxygen and liberation of carbonic acid would soon render the stratum of water immediately above the bottom completely irrespirable—in the absence of any antagonistic process of vegetation—were it not for the upward diffusion of the carbonic acid through the intermediate waters to the surface, and the downward diffusion of oxygen from the surface to the depths below. A continual interchange will take place at the surface between the gases of the sea-water and those of the atmosphere; and thus the respiration of the abyssal fauna is provided for by a process of diffusion, which may have to operate through three miles or more of intervening water.

The varying proportions of carbonic acid and oxygen in the surface-waters are doubtless to be accounted for in part by the differences in the amount and character of the animal life existing beneath; but a comparison of the results of the analyses made during the agitation of the surface by wind, with those made in calm weather, showed so decided a reduction in the proportion of carbonic acid, with an increase in that of oxygen, under the former condition, as almost unequivocally to indicate that superficial disturbance of the sea by atmospheric movement is absolutely necessary for its purification from the noxious effects of animal decomposition. Of this view a most unexpected and remarkable confirmation has been afforded by the following circumstance:—In one of the analyses of surface-water made during the second cruise, the percentage of carbonic acid fell as low as 3·3, while that of oxygen rose as high as 37·1; and in a like analysis made during the third cruise, the percentage of carbonic acid was 5·6, while that of oxygen was 45·3. As the results of every other analysis of surface-water were in marked contrast to these, it became a question whether they should not be thrown out as erroneous; until it was recollected that, whilst the samples of surface-water had been generally taken from the bow of the vessel, they had been drawn in these two instances from abaft the paddles, and had thus been subjected to such a violent agitation in contact with the atmosphere, as would pre-eminently favour their thorough aëration.

Hence, then, it may be affirmed that every disturbance of the ocean-surface by atmospheric movement, from the gentlest ripple to the most tremendous storm-wave, contributes, in proportion to its amount, to the maintenance of animal life in its abyssal depths —doing, in fact, for the aëration of the fluids of their inhabitants, just what is done by the heaving and falling of the walls of our own chest for the aëration of the blood which courses through our lungs. A perpetual calm would be as fatal to their continued existence as the forcible stoppage of all respiratory movement would be to our own. And thus universal stagnation would become universal death.

Thus it has been shown that the bed of the deep sea, even in the immediate neighbourhood of our own shores, is an area of which the conditions have until lately been as completely unknown as those of the ice-bound regions of the poles, or of the densest forests, the most arid deserts, the most inaccessible mountain-summits, that lie between the tropics; and further, that by the systematic employment of the sounding-apparatus, the thermometer, and the dredge, almost as complete a knowledge can be gained of those conditions, as if the explorer could himself visit the abyssal depths he desires to examine. Of the important discoveries in almost every department of science, but more particularly in what Mr. Kingsley has well termed Bio-Geology, which may be anticipated from the continuation and extension of an inquiry of which the mere commencement has yielded such an abundant harvest, the speaker felt it scarcely possible to form too high an expectation. And, in conclusion, he referred to the systematic and energetic prosecution of deep-sea explorations by the United States Coast Survey and by the Swedish Government —the results of which prove to be singularly accordant with those now briefly expounded—as showing that other maritime powers are strongly interested in the subject; and expressed the earnest hope that the liberal assistance of Her Majesty's Government, which has already enabled British naturalists to obtain the lead in this inquiry, would be so continued as to enable them to keep it in the future. In particular, he called attention to the suggestion lately thrown out by M. Alex. Agassiz, that an arrangement might be made by our own Admiralty with the naval authorities of the United States, by which a thorough survey, physical and biological, of the North Atlantic should be divided between the two countries; so that British and American explorers, prosecuting in a spirit of generous rivalry labours most important to the science of the future, might meet and shake hands on the Mid-Ocean.

W. B. CARPENTER

NOTE.—Tables I. and II. on the following page give the Temperature of the Sea at different Depths—(I.) in the Channel between the North of Scotland, the Shetland Isles, and the Faroe Islands (the Roman Numericals indicate the *Lightning* Temperature-Soundings, corrected for pressure); and (II.) near the Western margin of the North Atlantic Basin, as ascertained by *Serial* and by *Bottom* Soundings.

TABLE I.

Warm Area. Series 87. Depth.	Series 87. Temperature.	Station No.	Depth.	Surface Temperature.	Bottom Temperature.	Cold Area. Series 64. Depth.	Series 64. Temperature.	Ser. 52. Temperature.	Station No.	Depth.	Surface Temperature.	Bottom Temperature.
fths.	°		fths.	°	°	fths.	°	°		fths.	°	°
0	[illegible]					0	49·7	52·1				
50	[illegible]	73	84	52·7	48·8	50	45·5	48·5	70	66	53·4	45·2
		[illegible]	92	53·2	49·4				69	67	53·5	43·8
100	47·[illegible]					100	45·0	47·3	68	75	52·5	44·0
		71	[illegible]	53·0	48·6				61	114	50·4	45·0
		[illegible]	14[illegible]	53·3	49·1				62	125	49·6	44·6
150	47·0	[illegible]4	[illegible]	54·3	49·2	150	43·3	46·5	60	167	49·5	44·3
		[illegible]	[illegible]	53·9	48·7				IX.	170	52·0	41·0
200	46·[illegible]					200	39·6	45·6				
		74	[illegible]	52·5	47·7							
						250	34·3	38·4				
300	4[illegible]					300	32·4	30·8				
									63	317	49·0	30·3
									65	345	52·0	29·9
									76	344	50·3	29·7
		50	355	52·6	46·2	350	31·4	..	54	363	52·5	31·4
		46	374	53·9	46·0	384	..	30·6				
400	46·1					400	31·0	..	86	445	53·6	30·1
		89	445	53·1	45·6	450	30·6	..				
		90	458	53·1	45·2				56	480	52·6	30·7
		49	475	53·6	45·4				53	490	52·1	30·0
500	45·1					500	30·1	..	X.	500	51·0	30·8
		VI.	530	52·5	44·8				58	540	51·5	30·8
		47	542	54·0	43·8				VIII.	550	53·0	29·8
		XV.	570	52·0	43·5	550	30·1	..	77	560	50·9	29·8
									59	580	52·7	29·7
600	43·0					600	29·9	..				
		XVII	620	52·0	43·5				55	605	52·6	29·8
		XIV.	650	53·0	42·5				57	632	52·0	30·5
						640	29·6	..				
700												
		88	705	53·5	42·7							
767	41·4											

TABLE II.

Serial Soundings. Depth.	Temperature. Ser. [illegible]	Temperature. Ser. [illegible]	Temperature. Ser. 22.	Temperature Ser. 19.	Temperature. Ser. 20.	Temperature. Ser. 21.	Temperature. Ser. 38.	Bottom Soundings. Statn. No.	Depth.	Surface Temperature.	Bottom Temperature.
fths.	°	°	°	°	°	°	°		faths.	°	°
0	57·3	62·6	56·9	54·8	55·5	56·2	64·0				
50	..	53·2						27	54	55·6	48·3
								34	75	66·0	49·7
								6	90	54·0	50·0
								35	96	63·4	51·3
100	48·5	51·1						8	106	54·2	51·2
								24	109	57·7	46·5
150	..	50·9						7	159	53·2	50·4
								14	173	53·2	49·6
								18	183	53·2	49·4
200	48·0	50·5						13	208	53·6	49·6
250	..	50·2	48·5	48·0	48·5	48·3	50·5	4	251	53·5	49·5
300	47·8	49·6									
350	..	49·1						1	370	54·0	49·0
400	47·5	48·5									
450	..	47·6						15	422	52·2	47·0
								45	458	60·7	48·1
500	45·8	47·4	46·7	46·7	46·9	47·5	47·8				
								40	517	63·4	47·7
550	..	46·4									
600	44·5	45·5						41	584	63·4	46·5
630	43·4										
650	..	44·3									
700	..	43·6						12	670	52·2	42·6
								3	723	54·5	43·0
								36	725	63·9	43·9
750	..	42·5	42·0	41·2	41·6	42·4	41·3				
800	..	42·0									
								2	808	54·1	41·4
862	..	39·7						16	816	53·0	39·5
900								44	865	61·2	39·4
1000	..	..	38·8	38·5	38·8	38·5	38·3				
1200								43	1207	61·7	37·7
1263	..	..	37·3								
								28	1215	57·7	37·1
1[illegible]	..	..	..	..	37·7	37·9	37·7	17	1230	53·2	37·8
1[illegible]								29	1264	56·9	36·9
1[illegible]	..	..	..	37·4							
1[illegible]											
1443	..	..	..	..	37·0			32	1320	55·9	37·4
145[illegible]								30	1380	56·0	37·1
1476	..	..	..	..	..	36·9					
1500	..	..	..	..	..	..	37·2				
1750	..	..	..	..	..	..	36·7				
2090	..	..	..	..	..	..	36·3	37	2435	65·6	36·5

PHYSICS

Mechanical Theory of Heat

WE translate the following passages from a paper by Dr. Meyer, of Heilbronn:—

It has been inferred from the meteorite theory, which supposes the sun to derive its heat from the impact of planeto-kosmic masses, that the entire machine of creation must eventually come to a standstill. I gladly seize the opportunity which now offers itself, to state that I do not share this view. The doctrine of the development of heat by the collision of spatially separate masses, has but just arisen, has therefore advanced but little, and cannot yet serve as an appropriate foundation for so comprehensive a consequence. I will briefly state what may be said, from my own point of view, as to the stability of the universe. Its final cessation will occur, when all the ponderable matter it contains is combined in a single mass; whereupon, as we may readily perceive, the whole of its existing *vis viva* would be uniformly distributed in the form of heat throughout the mass, which would thus attain an eternal equilibrium.

But how could such a combination happen? Five years have passed since Brayley, of London (and Reuschle just recently in a number of the German quarterly journal), stated, that if masses of the magnitude of our sun, or only half as great, were to come into collision, so enormous would be the effect, that all cohesion would be at an end, and the molecules would fly off into infinite space. Now we have every reason to suppose that, in the ceaseless course of time, and in an unlimited expanse, this kind of destruction or partial ruin of worlds has taken place, and is actually in progress. We have a striking proof of it in the observation of meteorites with a hyperbolic path. On this point I would refer to the important memoir of Prof. Heis, of Münster. "The large fire-ball which was seen on the evening of March 4, 1863, in Holland, Germany, Belgium, and England (Halle, 1863)." The true heliocentric motion of this meteorite amounted to 9.145 geographical miles per second. A body lying between the earth's orbit and the sun, and owing its motion solely to the attraction of the latter, cannot have a greater rate than 5·8 geographical miles; so that the fire-ball above referred to must have entered the sphere of attraction of our sun with an initial velocity of 7 geographical miles per second. Now, whence could it have derived such a motion?

In order to throw light on this question, we might imagine a peculiar progressive movement of the whole solar system in space, or have recourse to a movement round a so-called central sun. But we cannot suppose any such accumulation exists sufficiently large to confer an appreciable velocity on our sun at the distance of the fixed stars. Moreover, if our earth possessed a distant motion towards space in addition to its centripetal motion towards the sun, the light which reaches it from the fixed stars would present phenomena of aberration different from those actually observed. Were this proved, meteors with a hyperbolic path would be so many fiery couriers, living witnesses of a conflict somewhere and sometime happening in strength sufficient to explode and scatter the molecules in every direction. If we also consider that the radiating power of the sun's body, as of all the fixed stars, is connected with the consumption of collided masses, yet that consumption has not therefore ceased, since throughout the disturbance, large masses of debris continually reach our world.

All the phenomena of terrestrial motion, except volcanic action and the ebb and flow of the tides, are eventually derived from the sun. One of these, which we are about to consider more particularly, is an electric current on the surface of the earth. That it actually exists is evident from the direction of the magnetic needle, as also from the immediate observations of Lamont. But as there can be no action without corresponding cause, it follows that this remarkable expenditure of electric effort must be attended with as large a compensation. We have, then, to consider our earth as being, in this respect, a huge and permanently efficient electric machine. I do not here refer to the local phenomenon of thunderstorms.

For a constant source of the constant disturbance of electrical equilibrium in the earth's body, we can only have recourse to the unceasing flow of air between the tropics, known under the name of the trade-winds. The lowest layer of the trade-wind assumes, by friction on the surface of the sea, an opposite electrical condition. This air, however, heated by the sun, and dislodged by the colder current setting beneath it, rises and directs its course to the poles, where its high electric tension originates the beautiful phenomenon of the aurora. It must now be observed that, on account of the physical condition of the earth's surface, the electromotor activity of the southern hemisphere must be throughout much stronger than in the northern; whence it happens, that not only on both hemispheres between pole and equator, but also between the north and south poles themselves, a continual disturbance of electric equilibrium occurs; and it is this by which the direction of the needle is determined. The narrow belt between the north and south-east trades—called by Dove the zone of calms—may be termed, for present purposes, the meteorological equator. This is known not to coincide with the geographical equator, but to oscillate slowly about a limit of 1 to $1\frac{1}{2}$ degrees north of it. The *experimentum crucis* for the theory—or, as we will only term it at present the hypothesis—here adduced of the trade-winds as the source of terrestrial magnetism, would consist in establishing that the known alterations which the magnetic pole, as well as declination, gradually undergo, are accompanied by parallel changes of our magnetic equator. But work of this description cannot be accomplished by a single private individual, and I must content myself with having brought the subject forward.

Amagat on the law of Mariotte

PROFESSOR E. H. AMAGAT has published the results of some experiments, still in progress, on the influence of temperature on departures from the law of Mariotte. The researches of Regnault have shown that this law is not rigorously obeyed by any gas excepting hydrogen; in all other cases compressibility increases with pressure, that is, when the gas approaches its temperature of ebullition. This phenomenon has received various explanations. It has been considered as resulting from reciprocal molecular attraction; it has also been elucidated by a theory which was first enunciated by Daniel Bernouilli, but has received successive additions at the hands of Joule, Krœnig, and Clausius. The theory in question takes into account not only the movements of translation of molecules, but their rotatory and internal movements, as well as the possible movements of imponderable fluids. If we admit the first explanation, then, as attraction only depends on the mean distance of the molecules, the departure from the law in any single case must be the same at any temperature, provided the initial and final volumes are the same. In other words, let V be a given volume of gas at the temperature t and pressure p. Reduce this volume to V' by a pressure p',' the temperature remaining unchanged. On heating the gas to t, it will expand; let P be the pressure necessary to restore the volume to V, and P' the corresponding pressure. If the departure be only a function of the volume, it is clear that we must have

$$\frac{pV}{p'V'} = \frac{PV}{P'V'}.$$

As $\frac{V}{V'}$ is common to both sides of this equation, it is only necessary to compare $\frac{p}{p'}$ with $\frac{P}{P'}$. The author has done this in the case of sulphur dioxide, ammonia, and carbon dioxide. In the instance of sulphur dioxide—

$$\left.\begin{array}{l}\text{at } 14^\circ,\ \frac{p}{p'} = 0\cdot50838 \\ \text{at } 98^\circ,\ \frac{P}{P'} = 0\cdot50277\end{array}\right\}\ \text{difference, } 0\cdot00561.$$

(This difference corresponds to an observed height of more than one centimetre of mercury.) For ammonia—

$$\left.\begin{array}{l}\text{at } 13^\circ,\ \frac{p}{p'} = 0\cdot50731 \\ \text{at } 97^\circ,\ \frac{P}{P'} = 0\cdot50402\end{array}\right\}\ \text{difference, } 0\cdot00329.$$

For carbonic dioxide—

$$\left.\begin{array}{l}\text{at } 13^\circ,\ \frac{p}{p'} = 0\cdot50981 \\ \text{at } 97^\circ,\ \frac{P}{P'} = 0\cdot50402^*\end{array}\right\}\ \text{difference, } 0\cdot00210.$$

It appears from the preceding numbers that the departure is not only a function of the volume, but also of the temperature at which the experiment is performed. This result agrees, however, with the second theory. In fact, the *vis viva* of the molecules being greater as the temperature rises, it may be readily conceived that the loss due to their collision is relatively smaller than the augmentation of pressure on the walls of the enclosing vessel, due to the augmentation of *vis viva*, this being true even when, as the rate is accelerated, the molecular collisions become more numerous.

* This number is obviously a misprint.

In a new series of experiments, M. Amagat kept the initial and final pressures as nearly as possible the same in each case, thus obtaining the influence of temperature alone. He then arrived at the following general results:—

1. That near 100°, sulphur dioxide and ammonia depart but little from Mariotte's law, yet more so than air at the ordinary temperature.
2. That near 100°, carbon dioxide is almost a perfect gas.
3. That near 100°, air exactly follows the law.

The author is convinced that the higher the temperature of liquefaction of a gas is found to be (under the same pressure), the less does it depart from the law of Mariotte at the same distance from its point of liquefaction.*—[Archives des Sciences physiques et naturelles, 139, p. 169.]

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, March 17.—Mr. Carruthers exhibited a section of a fossil *Osmunda* from the eocene beds of Herne Bay, in which not only the forms of the cells were preserved, but the contents of the cells, and even the starch-granules. Before its conservation it had been attacked by a parasitic fungus, the mycelium of which is preserved, in precisely the same condition as it would be in a recent specimen.—Dr. Hooker read a further communication from Sir Henry Barkly on the Flora and Fauna of Round Island. The highest point of the island is 1,049 feet above the level of the sea; the summit is smooth, with three large and remarkable blocks of granite. It is entirely composed of tufa, mixed with volcanic sand in perfectly preserved strata. The deeper ravines are crowded with lofty palms. Of the twenty-six flowering plants gathered, the greater number belong to the orders *Gramineæ*, *Pandanaceæ*, *Palmaceæ*, *Ebenaceæ*, *Cinchonaceæ*, *Compositæ*, and *Asclepiadeæ*. The proportion of Endogens to Exogens is very large, namely, twelve to fourteen; but this proportion by no means represents the enormous preponderance of the former in individuals, probably amounting to 99 per cent. Some of the Exogens are specifically identical with those of the Mauritius, but few of the Endogens; those of the former class which are common to the two islands have probably been introduced at some remote period. Of the three cryptogamic plants observed, one was a moss, probably a *Sphagnum*, one a *Selaginella*, certainly a new species, and one a widely-spread fern, *Adiantum caudatum*. Of the five grasses the most abundant is identical with the Indian Lemon-grass. The *Cyperaceæ* are represented by one species, *Scirpus maritimus*. The *Pandanaceæ* are very remarkable; *Pandanus utilis* occurs, but in one spot only, rare, and no doubt introduced, whilst the other, an allied species (*P. Vandermeerckii*, is quite peculiar to the islet). Of Palms there are no less than three species, probably all peculiar, the most remarkable being the bottle-stemmed species (a *Hyophorbe*) already described as peculiar to the island. The only other Endogen belongs to the order *Liliaceæ*, and is an aloe, growing on the summit, and probably a new species. Of *Ebenaceæ* there are three species, and two Asclepiads with trailing stems; one species of *Myrsineæ*, new; two *Compositæ*, one of them a *Sonchus*, both probably introduced; one species of *Combretaceæ* and one of *Myrtaceæ*; two *Cinchoneæ*, and a small tree about twelve feet high, resembling the *Blackwellia* of Mauritius. It will be seen that while the genera of the Round Island Flora are Mauritian, the species are mostly peculiar. It is probable that the whole group of islands—Mauritius, Bourbon, Round Island, Ile de Serpents, Rodriguez, with the smaller islets, and probably Madagascar—are fragments of a vast continent. As regards the Fauna, there are no indigenous mammalia, although goats and rabbits have been introduced and have multiplied exceedingly, and no land birds, not even the Mauritian pigeons. The island seems, on the other hand—perhaps from the absence of mammalia and birds—very favourable to reptile life. Of Chelonians, a female land-tortoise had previously been captured on the island. Four distinct Saurians were found, the largest exceeding a foot in length, a native of

* With the above results compare those obtained by Andrews (Proceedings of the Royal Society, xviii. 42).

Madagascar, but not of Mauritius or Bourbon; one species, at least, is altogether new. The four Ophidians are all undescribed, no authentic evidence being known of any such having at any time been indigenous to the Mauritius group. No Batrachians were discovered, and the time was too short to collect the Fish which abounded in the freshwater pools. Only one Gasteropod was collected, probably *Cyclostoma hemistoma*. Of Arachnida, the spiders are numerous and interesting, of four kinds, belonging to as many different families, two common to Mauritius and two not; also three scorpions, one measuring five inches, none of them Mauritian. Only one Myriapod was captured, a centipede six inches in length, belonging to India, but found also in Rodriguez. There were six Coleoptera, none of them Mauritian, though not very dissimilar. Of Orthoptera, one *Plasma*, peculiar to the island, and a grasshopper, also thought to be new. The Neuroptera included only one specimen of a dragon fly, and the Hymenoptera only a single bee. Generally speaking, the Fauna was of the type of the Malayan archipelago, with greater resemblance to that of Madagascar than of Mauritius or Bourbon. The reptiles have been sent to Mr. Gunther of the British Museum for examination and description, and specimens of the plants to the Kew Herbarium. Thus it will be seen that this little islet, not a mile in diameter, and only thirteen distant from the great island of Mauritius, is unique in respect of the peculiarity of both its animal and vegetable productions. In the matter of Ophidians it is especially so; the absence of them in other oceanic islets throughout the globe being one of the most remarkable features of their history.

Royal Geographical Society, March 14.—Sir R. I. Murchison, Bart., president, in the chair. The following new Fellows were elected:—Charles Ashton; William J. Anderson; Louis Alford; Charles Fairbridge; Charles W. Gray; Edward Gellatly; J. G. Gibson; T. D. Murray; Rev. W. R. Tilson Marsh, M.A.; M. the Chevalier de Overbeck; Robert T. Pigott; Albert Walker; Thomas Watson; Peter T. Wills. The President, Sir Roderick Murchison, read an official letter he had that day received from Lord Clarendon, stating that a severe outbreak of cholera had occurred in East Africa, at Zanzibar, and on the neighbouring mainland, which it was feared would delay the progress of Dr. Livingstone, inasmuch as the native carriers who were taking supplies to him had been attacked by the epidemic. Sir Roderick stated that there was little probability of the disease reaching the remote interior district where Livingstone remained waiting for the Zanzibar caravan. The following paper was read: "On Morrell's Antarctic Voyage, and on the advantages of steam navigation in future Antarctic Explorations," by Captain R. V. Hamilton, R.N. According to the author, a remarkable narrative of a voyage in high southern latitudes by Benjamin Morrell, in the *Wasp* sealing schooner, published at New York in 1832, had been hitherto overlooked by all concerned in Antarctic exploration. Even Morrell's celebrated countryman, Commodore Wilkes, seemed not to have been aware of this publication, which appeared before he sailed on his voyage of discovery. Captain Hamilton had laid down Morrell's route on a South Polar chart, and found that it intersected several times the land said afterwards to have been discovered by Wilkes. The portion of the Antarctic Ocean navigated was between 66° and 70° 14' lat., and between 105° E. long. and the meridian of Greenwich. South of 64° he found less ice, and in 69° 11' there was no field-ice visible. Captain Hamilton concluded that the Antarctic lands seen by Wilkes and others were mostly islands, and that one or other of them would offer a suitable site for the observation of the approaching Transit of Venus. The employment of steam-vessels, he contended, would add very greatly to the safety of the expedition as well as the facility of reaching the high southern latitudes. The great barrier of ice surrounding the South Polar lands, he believed, was not glacier ice, but an enormous floe. In the discussion which followed, Commander J. E. Davis (of Sir James Ross's Expedition) dissected many of Morrell's statements about well-known places in high southern latitudes, and showed that they were almost all pure fiction: he considered his work to be, therefore, of no authority, and denied that it had been overlooked; it had been examined by cartographers and writers, and set aside as unreliable. Mr. Enderby expressed similar opinions, from personal knowledge of Morrell, and Mr. F. Galton also exposed Morrell's inaccuracy with regard to the interior of South-west Africa. Captain Sherard Osborn differed in opinion from Captain Hamilton regarding the formation of the Antarctic icy barrier, and believed it to be the seaward edge of an enormous continental glacier. Admiral Ommaney also took part in the discussion. The meeting was then adjourned to March 28.

Anthropological Society, March 15.—Dr. Charnock, V.P. in the chair. Mr. William Stephens Haywood, Long Wittenham, near Abingdon, Berks; and Mr. P. Henderson, her Majesty's Vice-Consul at Benghazi, North Africa, and No. 1 Stafford Place, Buckingham Gate, were elected Fellows. Dr. Daniel Earl Burdett was elected a local secretary for Belleville, Ontario, Canada. The following paper, by Dr. Isidore Kopernicky and Dr. J. Barnard Davis, F.R.S., was read: "On the strange peculiarities observed by a religious sect of Moscovites, called Scoptsi." This curious Christian sect of a well-defined race was fully described in the paper by Dr. Barnard Davis from data supplied him by Dr. Kopernicky of Bucharest, and it was accompanied by an anatomical preparation which clearly demonstrated the character and amount of mutilation practised by the Scoptsi. That practice is based upon the twelfth verse of the nineteenth chapter of St. Matthew, and it has been carried out with such resolution and to so large an extent, that the Russian Government has been compelled to interfere and to punish with extreme severity all members proved to belong to that community. Hence, the Scoptsi are forced to conduct their worship and to carry out their peculiar rites in the most secret manner: nevertheless, they contrive to amass great wealth, and as a consequence they possess considerable influence in districts in which they reside. Accident alone brought under the notice of Dr. Kopernicky the case of the individual whose body furnished the preparation laid before the society. The paper, after entering at length into the modes of conducting the religious worship of the Scoptsi, their estimated numbers, their physical characteristics and other details, viewed the subject in its psychical aspect. Dr. Kopernicky was of opinion that this aberration in Christianity could not be explained otherwise than by the psychological peculiarity of the race of Moscovites in which it prevails. He endorsed the well-known views of the Rev. Dunbar Heath upon the difference which exists between the Semitic and "Aryan" races in their appreciation of the doctrines of Christianity, and held it to be an anthropological fact that the ideas and religious creeds, sound or absurd, moral or immoral, which are produced, or which develope themselves among a certain race, depend greatly upon the character of the psychological sentiments natural to that race. That was the reason why Christianity was so readily accepted, and has taken such root among the Aryan peoples, and why, on the contrary, the Koran has had most success and most persistence among the Semites. An animated discussion ensued, in which the Rev. Dunbar Heath, Mr. Moncure Conway, Mr. Ralston, Dr. Spencer Cobbold, and others, took part.

Institution of Civil Engineers, February 22.—The following papers were read:—"On the New Mhow-ke-Mullee Viaduct, Great Indian Peninsula Railway," by Mr. A. R. Terry; "On the Pennair Bridge, Madras Railway," by Mr. C. W. Stoney.

March 1.—"The Wolf-Rock Lighthouse." By James N. Douglass.

March 8.—"Description of the Line and Works of the San Paolo Railway in the Empire of Brazil." By D. M. Fox.

March 22.—"On the conditions and the limits which govern the proportions of Rotary Fans." By R. Briggs, of Philadelphia.

DUBLIN

Royal Irish Academy, March 16.—The Rev. John H. Jellett, M.A., was elected president, and the following gentlemen were elected council and officers for the current year:—Dr. W. K. Sullivan, Secretary of Academy; Dr. H. Hennessy, Dr. W. Stokes, Dr. A. Searle Hart, Dr. James Apjohn, Rev. Humphrey Lloyd, D.D., Rev. S. Haughton, M.D., Rev. J. A. Galbraith, Dr. MacDonnell, Dr. E. Perceval Wright, Mr. R. S. Ball; John T. Gilbert, Librarian; William H. Hardinge, Treasurer; Dr. John Kells Ingram, Secretary of Council; Sir W. R. Wilde, Secretary of Foreign Correspondence; Rev. George Longfield, D.D., Dr. Samuel Ferguson, Dr. W. J. O'Donnavan, Dr. Alexander G. Richey, Colonel Meadows Taylor, John R. Garstin. Heinrich Ewald, of Göttingen, was elected an honorary member in the department of Polite Literature. The following grants of money were voted:—20*l.* to Dr. John Barker, in aid of his experiments on "Microscopic Illumination." 15*l.* to Mr. E. Reynolds, to enable him to carry out his researches on the "Spectrum Analysis of Chlorine," &c. 15*l.* to Mr. N. Furlong, to enable him to carry out his experiments on the "Innervation of the Heart." Professor Hennessy read a note on "Two Streams flowing from the same source in opposite directions." The president nominated Henry Hennessy, F.R.S., William Stokes, M.D., Sir William R. Wilde, M.D., and Samuel Ferguson, LL.D., vice-presidents for the current year. The annual report was read and adopted, and then the Academy adjourned.

GLASGOW

Natural History Society, February 22.—Mr. David Robertson, F.G.S., vice-president, in the chair. Mr. Thomas Chapman exhibited specimens of *Venilia Macularia* which he had captured in June last in the Pass of Leny, Perthshire, and the Rev. James E. Somerville stated that he had taken the species in some numbers in Argyleshire, both at Loch Awe and Oban. The secretary exhibited a small collection of star-fishes, which had been forwarded from Girvan by Mr. Thomas Anderson, corresponding member.—Mr. Duncan McLellan exhibited monstrosities of the common ash and hawthorn from the Queen's Park; the former showing the twigs flattened like horns of a reindeer, the latter having its branches tortuous like a cork-screw. Both specimens presented a very unusual appearance.—Mr. Alexander Donaldson exhibited an example of malformation in the bill of a rook, regarding which Mr. Gray observed that it possessed additional interest from the fact of its showing only a partial abrasion at the base of the bill, and that it had been arrested probably in consequence of the malformation. Drawings of other malformations were exhibited by Mr. Gray. Mr. John Gilmour exhibited an unusually dark specimen of the hooded crow (*Corvus cornix*), which had the light space on the breast and shoulders very much clouded, giving the bird the appearance of a variety of the carrion crow (*Corvus corone*). Dr. Stirton exhibited specimens of *Adelanthus Carringtoni*—a Jungermannia new to science, which he had found on Ben Lawers, and other places. This moss had formerly been confounded with *Alicularia compressa*, from which, however, it differs not only in the colour and areolation of the leaves, but also in their mode of attachment to the stem. It approaches much more closely *Alicularia declusa* from Campbell's Island in the South Pacific; and as this last has been proved by Dr. Carrington to be an *Adelanthus*, it has been thought proper to refer this moss also to the same subgenus. The Rev. James E. Somerville than read a paper on *Danais chrysippus* and its food plant, *Asclepias gigantea*, with illustrative specimens from Upper Egypt. The author of this paper gave a very interesting account of this butterfly from personal observations made during a three months' residence in Egypt, and also of the plants on which it is known to feed. He likewise described the peculiar properties of the *Calotropis procera* or *Asclepias gigantea* of Linnæus—a plant better known as the apples of Sodom—a beautiful series of which, in its various stages of growth, was exhibited by Mr. Somerville in illustration of his remarks.

BOSTON

Boston Natural History Society, February 2.—Dr. B. Joy Jeffries states that, as at different times during the past three years he had had occasion to call the attention of the society to the physiology of accommodation in man and other animals, including birds, he would ask to be allowed to make a few remarks on a special part of the eye which is interested in, and may be employed in, accommodation. He illustrated his remarks by a series of pictures and diagrams representing sections of the human eye and a number of different animals, made through the ciliary muscle and the adjacent parts of the sclerotic, cornea and iris. From dissections made by many anatomists, and the special studies of several physiologists, it resulted that the space in the eye hitherto known as the canal of Fontana, who first described it in 1778, is now proved not to be a canal with walls, but rather a triangular space between the ciliary muscle, iris, and sclerotic or cornea, filled by a sort of mesh-work attaching the iris to the last-named membrane. This mesh-work is cut off from the aqueous humour. It constitutes the ligamentum pectinatum iridis, and is quite distinct from the circular venous sinus in the sclerotic just outside of it, which it has apparently sometimes been mistaken for it. Dr. Jeffries discussed the question as to whether it took part in the accommodation of the eye, if not in man where it seemingly could not, in the lower animals where its size increases with the decrease of the ciliary muscle. He remarked that our present knowledge of it is due to the recent researches of Drs. Iwanoff and Rollett.

Section of Microscopy, January 12.—Mr. Stodder referred to a communication of Mr. R. C. Greenleaf, on a specimen of *Aulacodiscus oreganus* Bail., prepared by Mr. Samuels, which in the process of mounting separated into two plates; one being the outer, and the other the inner plate of one valve. A few days since a similar thing happened to Mr. Samuels when mounting another specimen of the same species. The diatom separated into two pieces, the inner and outer plates of one valve as Mr. Samuels supposed. But a careful inspection of the specimen which was exhibited to the section, indicated an entirely different origin. One disc was a perfect *A. oreganus*, with all the characters of that species, having ten rays, and "feet." The other was more hyaline, the umbilicus less distinct, the granules and "feet" imperfectly developed, and having eleven rays and "feet." Mr. Stodder's explanation of the appearances—if Mr. Samuels was not mistaken as to the facts—is that the one disc is the parent, and the other a valve of a new frustule, which was forming in the process of self-division, the growth of which was stopped before it had come to maturity. Ehrenberg and some other naturalists have made the number of rays in such forms a specific character; Bailey and others have rejected this principle of classification, but here for the first time we have positive evidence that a form with eleven rays has been derived directly from one of ten rays. Such a change of characters in one order of plants being authentically established, it is a reasonable inference that all other orders may be liable to similar changes, and therefore great caution should be used in allowing specific value to unimportant characters.

January 26.—*Section of Entomology.*—Mr. E. Burgess in the chair. Twelve persons were present. Mr. F. G. Sanborn exhibited a drawing of the larva of *Callosamia promethea*, made by the late Mr. C. A. Shurteff, together with the specimen after it had spun its cocoon. Dr. H. Hagen read a criticism of the views of Dr. Packard concerning the *Neuroptera*, as given in his recently completed "Guide," and explained that in the manuscript of his own "Synopsis of North American Neuroptera" he had, in accordance with the views of the most prominent entomologists for twenty-eight years, distinctly separated the Pseudoneuroptera and Neuroptera as two different parts of the work. Dr. Hagen also remarked that Mr. Fritz Müller had sent to him some white ants from Itahahy, St. Catharina, Brazil, with the following remarks:—"These nests of white ants are more or less regular cylinders, one span high and two or three inches thick. By horizontal floors they are divided into twelve or fifteen compartments or chambers. The outer surface bulges out so that one can make out the number of chambers by the enlargements of the cylinder. A pillar goes through all the compartments; close to this, or in it, runs an oblique passage from each chamber to the next. Sometimes all these passages together form a somewhat regular winding stair through all the compartments. For the impregnated female these passages are too narrow, and she can therefore not leave her chamber. There are, both in the outer wall and in the horizontal divisions, passages too small to admit the passing of the winged ants; but neither in the outside wall nor in the chambers is there any opening to the outside in nests which have not been injured. In the outside wall the passages run from top to bottom. In the divisions, from circumference to centre without reaching this latter. In the flat compartments they are not to be detected from the outside; in the circumference they appear as flattened ridges. In drying, the outer side of the passages falls off, and then they are to be seen as deep hollows with inflated borders. In undisturbed nests the only entrance seems to be on the upper surface some inches under ground. The nest is not directly connected with the earth, but is surrounded by about a finger's breadth of free space. The nest can, therefore, as soon as the upper end is freed from earth, be easily taken out of the ground. I have never found in one of these nests more than one impregnated female. Besides the winged ants, the eggs, and the larvæ, there are found two kinds of labourers; of these, one kind is distinguished by a truncated nose. Not in the nest, but in the same piece of land, are found, in planting corn, single white ants with disproportionately large heads and long mandibles." The winged ants were stated by Dr. Hagen to belong to *Termes striatus*, or perhaps to *T. similis*; the imago is in too bad a condition for accurate determination. The soldier with truncated nose was figured by him as *T. similis*; the soldier with long mandibles as *T. cingulatus*. No description of white ants' nests like this has ever been given before.—Mr. S. H. Scudder remarked that in a recent examination of the external genital armature of our diurnal *Lepidoptera*, he had noticed the extraordinary fact that in the males of the North-American species of the genus *Nisoniades*, these organs were asymmetrical. The asymmetry is confined to the lower lateral plates, which are unusually developed in this genus, and shows itself in the diverse length of the lower process and in the size, and the entireness or the excision of the lateral flap. The only species in the genus, as generally accepted, which does not come under this rule, is *N. Catullus*, but the structural features of all the appendages of the body of this species show that it is wrongly placed in this relation. Mr. Scudder also stated that the butterfly described by Dr. Harris in his State Report as *Eudamus Bathyllus*,—a name invariably accepted by subsequent writers—was not the species originally described and figured by Abbot and Smith under the same specific name; he therefore proposed to call Harris's species *Eudamus Pylades*. Mr. Sprague referred to an instance related by a friend not versed in entomology, where "flies" were seen, through a hole in the ice in midwinter, to ascend in large numbers from the bottom of a stream to the surface and take flight. Mr. B. P. Mann stated that he had taken a specimen of *Carabus Chamissonis* Fisch., in Labrador. Mr. F. G. Samborn remarked that he had taken ten or twelve specimens of the same species in August, on the sides of Mount Washington, N.H., at a height of from four to five thousand feet above the sea. He also reported the capture in Andover, Mass., on Christmas Day, 1869, of *Capnia* and *Tæniopteryx*, moving actively upon the ice; of several *Staphylinidæ* of the genera *Lathobium*, *Stenus*, *Philonthus* and *Lithocharis*, together with *Photinus corruscus* and larvæ of *Telephorus*, and some undetermined Coleopterous and Geometrideous larvæ, also a species of *Salda* (Hemipterous), and of *Diptera*, *Hydrophorus pirata* Loew, and *Sepsis sp.*, which were struggling in water of about one-eighth inch in depth, covering the surface of the ice in meadows. A great number of *Arachnidæ*, mostly of small size, were noticed under the same circumstances, and appeared to represent many species. He was in pursuit of the aberrant forms, *Boreus* and *Chionea*, but several hours of careful search failed to reveal any specimens of either.

PARIS

Academy of Sciences, March 21.—The following papers relating to various departments of physics were read: A note on the variations of the calorific capacity of water towards the maximum of density, by M. Hirn; on the angle of adjustment of a liquid with a solid wall, by M. Moutier; a description of a vertical galvanometer with a balance, suitable for use before large audiences, by M. Bourbouze.—The chemical papers were rather numerous, and included a note on the analysis and uses of the rock known in the Ardennes under the name of *gaize*, or *pierre-morte*, by MM. H. Sainte-Claire Deville and J. Desnoyers, upon which M. Elie de Beaumont made some remarks.—A note by M. Descloiseaux upon some crystallised derivatives of the coal hydrocarbons; a memoir on the action of sulphuret of carbon and carburetted gases upon wood charcoal, by M. Sidot; a note on cobalt and manganese and their alloys with copper, by M. A. Valenciennes; a note on a new method of preparing hydrobromic acid, by MM. Champion and Pellet; a note on the properties of iodic acid, by M. A. Ditte; one on the hydrogenated derivatives of sulphuret of carbon, by M. A. Girard; a note on the vitality of beer-yeast, by M. Melsens; an important note by M. J. Raulin on the chemical conditions of the life of the lower organisms; a paper on tribromhydrin, by M. L. Henry; and a note on the isomeric xylenes and cumenes in the coal-oils, by M. Rommier.—M. Rosenstiehl also presented a paper on the nature of the motor force which produces the phenomena of endosmose; and M. E. Martin an electro-chemical investigation of ozone.—M. Blanqui forwarded a letter describing an instrument for solving spherical triangles without the aid of tables of logarithms; and M. Bowen a continuation of his communication relating to the distance of the sun, of which the titles only are given.—M. Chasles made known a theorem relating to the theory of surfaces which had been communicated to him by Mr. Spottiswoode.—M. Coumbary's notice of the fall of an aerolite in Barbary (given in our last number) was communicated by M. Le Verrier, who also presented some observations on storms in Norway during the year 1869, by M. Mohn of Christiania.—With the exception of a few medical miscellaneous notes, three botanical papers complete the list of communications at this meeting: these were the continuations of M. Trecul's and M. Chatin's valuable researches upon the tracheæ of ferns, and the causes of the dehiscence of anthers (the latter completed), and a notice of a remarkable case of subdivision of the top of a palm-tree, by M. Ramon de la Sagra.

DIARY

THURSDAY, MARCH 31.

ROYAL SOCIETY, at 8.30.—On the relation between the Sun's Altitude and the chemical intensity of total daylight in a cloudless sky: Prof. Roscoe and Dr. Thorpe.—On the acids contained in Crab-oil: Mr. W. J. Wonfor.

SOCIETY OF ANTIQUARIES, at 8.30.—On the Crypt of the Chapter-house at Westminster: H. Harrod, F.S.A.

ROYAL INSTITUTION, at 3.—Chemistry of Vegetable Products: Prof. Odling.

LONDON INSTITUTION, at 7.30.—Geology: Dr. Cobbold.

FRIDAY, APRIL 1.

ROYAL INSTITUTION, at 8.—Artificial Alizarine: Prof. Roscoe.

ARCHÆOLOGICAL INSTITUTION, at 4.

SATURDAY, APRIL 2.

ROYAL INSTITUTION, at 3.—The Sun: J. Norman Lockyer, F.R.S.

MONDAY, APRIL 4.

LONDON INSTITUTION, at 4.—Chemistry: Prof. Bloxam.

ROYAL INSTITUTION, at 2.—General Monthly Meeting.

ENTOMOLOGICAL SOCIETY, at 7.

MEDICAL SOCIETY, at 8.

ROYAL ASIATIC SOCIETY, at 4.

VICTORIA INSTITUTE, at 8.—On Comparative Psychology: E. J. Morshead.

TUESDAY, APRIL 5.

ANTHROPOLOGICAL SOCIETY, at 8.—Phallic Worship: H. M. Westropp:—The Influence of the Phallic Idea in the Religion of Antiquity: C. Staniland Wake.

ROYAL INSTITUTION, at 3.—Nervous System: Prof. Rolleston, M.D., F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Discussion on St. Pancras Station.—On the Dressing of Lead Ore: Thomas Sopwith, jun., Memb. Inst. C.E.

WEDNESDAY, APRIL 6.

SOCIETY OF ARTS, at 8.

THURSDAY, APRIL 7.

ROYAL INSTITUTION, at 3.—Chemistry: Prof. Odling.

CHEMICAL SOCIETY, at 8.—On the Analysis of Deep-sea Water: Dr. John Hunter.—On the refraction equivalents of the aromatic Hydrocarbons and their derivatives: Dr. J. H. Gladstone.—On an acid Feed-water from the Coal-fields of Shellarton, N.S., and the results of its use: Prof. How.

LINNEAN SOCIETY, at 8.—On new species of Annelids, &c.: Dr. Baird.—On Algæ from the North-Atlantic Ocean: Dr. Dickie.

BOOKS RECEIVED

ENGLISH.—A Poor Man's Photography at the Great Pyramid: Prof. Piazzi Smyth (H. Greenwood).—The Week of Creation: G. Warington (Macmillans).—The Philosophy of the Bath: D. Dunlop (Dublin, Moffat).—The Fuel of the Sun: W. Mattieu Williams (Simpkin, Marshall, and Co).

FOREIGN.—Grundzüge der Modernen Chemie: Dr. Eugen Zell, Organische Chemie (Berlin, Herschwald).—Grundriss der Physik und Meteorologie: Dr. J. Müller (Brunswick, Vieweg).—L'Année Géographique; révue annuelle: M. Vivien de Saint-Martin (Paris, Hachette).—Reden und Abhandlungen über Gegenstände der Himmelskunde: Dr. J. H. von Mädler (Berlin, Oppenheim).—Jahresbericht über die Fortschritte der Chemie: Adolph Strecker, für 1868, 1tes Heft (Giessen, Ricker).—Charles Darwin und Alfred Russel Wallace: Dr. A. B. Meyer (Erlangen, Befold).—Die Stellung des Menschen in der Natur; 2te Lieferung Wer sind wir: Dr. L. Büchner (Leipzig, Thomas).—Zeitschrift der Gesellschaft für Erdkunde zu Berlin, 4ter Band: Prof. W. Koner (Berlin, Reimer).—Studien über die Wanderblöcke und die Diluvialgebilde Russlands: C. von Helmersen, 10 Tafeln (St. Petersburgh, Eggers). Through Williams and Norgate.——Cryptogamie Illustrée, ou Histoire des Familles naturelles des Plantes Acotyledonées d'Europe: Casimir Bourneguère (Paris, Baillière).—Gedachtnissrede von Alexander von Humboldt: C. G. Ehrenberg (Berlin, Oppenheim).

CONTENTS

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

No. 23] THURSDAY, APRIL 7, 1870

Registered for Transmission Abroad]

THURSDAY, APRIL 7, 1870

THE SOCIETY OF ARTS CONFERENCE

THE Society of Arts is entitled to the thanks of the community for the service it performs in holding from time to time conferences for the discussion of public questions of immediate interest. Technical education, street tramways, the sewage question, and the Channel-spanning problem, have all been recently discussed in this way. Last Thursday another national movement, of greater importance than even any of those we have named, was brought under discussion at one of these useful gatherings, namely, the Relation of the State to Science,—a movement that could not have a more natural or more influential supporter than the Society whose special province it is to advance the practical application of science to the needs of our daily life.

The Conference was opened by a paper by Colonel Strange, "On the proposed inquiry, by a Royal Commission, into the Relation of the State to Science." The part which deals with the scope of the intended inquiry we reproduce in another column: we published some time ago a narrative of events.

It is easy to see that in the paper which formed the subject for debate, the writer aimed at giving to the discussion a practical direction, calculated to assist those interested, including the Government, in determining what objects should claim the attention of the Royal Commission which will probably soon be issued. The Conference, though not numerously attended, included many of our most eminent men of science, and the speakers were all of that class. Professor Williamson, of University College, and Dr. Miller, of King's College, addressed themselves chiefly to the educational side of the question, and insisted on the rights of independent teaching of which they are the recognised champions—rights which Colonel Strange in his paper mentions prominently as demanding examination. Professor Williamson forcibly deprecated any cut-and-dried scheme, thus endorsing Colonel Strange's recommendation that the fullest possible inquiry into all existing scientific agencies should be made first and foremost. Dr. Balfour Stewart suggested a very comprehensive classification of scientific work into Observational work, Experimental work not involving time as an essential element, and Experimental work involving time as an essential element. Of these, he stated that the first and last require the permanence and continuity of State institutions, and have been much neglected in England, while the second can to a great extent be achieved by individuals labouring independently. No doubt this classification will more or less form the basis of the scientific system of the future.

The Astronomer Royal, speaking with an evident sense of the weight that must attach to his opinions on such a subject, and in a tone that might almost be called official, announced his belief that much good would come of the proposed Royal Commission. He illustrated the confused state of our scientific officialism by a humorous description of the accounts of the Royal Observatory, of which three distinct sets were required, one for the Admiralty, another in a different form for the Treasury, and a third "to reconcile the other two." He considered that the present movement tended to the creation of a salaried Academy, to which he did not seem opposed, though he pointed out that there are some kinds of inquiry which such a body would never have initiated, as for instance the discovery of Neptune, and Mr. Lockyer's solar researches. Dr. Mann, Mr. De la Rue, and the Rev. Arthur Rigg warmly supported the recommendation that the inquiry should be full. Mr. Edwin Chadwick particularly dwelt on the advantage of official concentration in science, in a speech full of practical sagacity. The discussion was summed up most ably by the chairman, Lord Henry Lennox, President of the Society of Arts, who, in responding to a pointed appeal made to him by Mr. Chadwick, told the meeting how, on one occasion, desiring to ask in the House of Commons a question regarding some scientific matter, he found that it affected four different departments, and should therefore elicit a quadruple reply, the horrors of which he evaded by most informally putting the inquiry to the Premier himself. He did not add that his desire for information was gratified.

The proceedings of the Conference were brought to a practical issue by the following resolution :—" That this Conference desires emphatically to affirm the conclusion of the British Association for the Advancement of Science, that a Royal Commission to inquire into the relations of the State to Science is very desirable, and to recommend that the scope of the inquiry be made as wide as possible." This motion obviously conveyed the sense of the meeting with accuracy, and it was carried unanimously. The chairman announced that the resolution and a full report of the conference would be forwarded by the Council of the Society of Arts to the Government.

Armed with so competent and united an expression of opinion, following up that already given by the British Association, the Government will, no doubt, invest the Commission with very full powers. A little consideration, indeed, will show that the wider the scope given to the inquiry, the more easy will it be to conduct it. Nothing would be so difficult as to confine inquiry to selected portions of such a subject, all the parts of which are so intimately connected as to preclude the possibility of entering on one without trespassing on those which surround it. The whole field of science must be submitted to a comprehensive survey, before any project for its effectual cultivation can possibly be devised. The plain assertion made in Colonel Strange's paper, that at present we have not even the nucleus of a scientific system, received the tacit assent of the Conference, no speaker thinking it worth while to do more than incidentally illustrate its truth. Comprehensive confusion needing comprehensive remedies must first undergo comprehensive examination. We agree with those who think it will be difficult for the Commission to construct a new and complete system. A good and durable system must, as Dr. Mann expressed it, be built up by degrees—brick by brick, as it were. This work is administrative, not deliberative, and should therefore properly devolve on the Minister entrusted with the Department of Science. If, with the materials furnished by the Royal Commission to his hand, he cannot work them into shape, the course is simple—change him !

OUR NATIONAL DRINK

Strong Drink and Tobacco Smoke: the Structure, Growth, and Uses of Malt, Hops, Yeast, and Tobacco. With 167 original illustrations, drawn and engraved on steel by Henry P. Prescott, F.L.S. Pp. 71. (London: Macmillan and Co. 1869.)

Burton-on-Trent: its History, its Waters, and its Breweries. By William Molyneux, F.G.S. Pp. 264. (London: Trübner and Co. Burton-on-Trent: Whitechurch.)

WHEN Mr. Gladstone, some years ago, inaugurated a new era, and opened British ports to wine which could not be brought here previously on account of its value being actually less than the duty it was subject to equally with wine of the most costly sort, it was believed by many that a serious blow had been dealt against a branch of home industry—the production of malt liquor—which is probably more peculiar to this country than any other.

The fact that there has always been a host of poetic and jubilant notions associated with the name of wine, as well as the enhanced estimation of a thing not easily obtainable, may have seemed good reasons for anticipating a very general desertion of beer in favour of cheap wine; but when the inaccessibility which lent enchantment to the name of wine was replaced by the sour reality of shilling hock or claret, the halo of imaginative recommendation was soon dispelled; consequently, these beverages have been very generally classed among things to be avoided, and even "Gladstone" sherry is regarded with profound suspicion. Meanwhile, our national drink has maintained its supremacy, and though its prospects were for a time clouded by the advent of cheap wine, it may safely be said that while the beer-drinking class in this country is quite as large as ever, the amount of malt liquor consumed has scarcely been affected by the introduction of cheap wine.

One of the works referred to at the head of this article gives some account of the materials used in the production of beer, and of the operations they are submitted to; the other contains a history of a town which is now famous as one of the chief seats of the brewing trade, together with an account of the topography and geological features of the neighbourhood. There is also a good description of the breweries, and of the enormous extent to which the industry has grown, with much interesting information as to its origin and development.

The beer-consuming propensity of the Briton is not a characteristic exclusively his own. The Germans, Russians, and Belgians, have long been famous for their cerevisial devotion, and even the Frenchman is rapidly acquiring a taste for beer which demands satisfaction in spite of national tradition and fiscal regulations. At the same time, though the general excellence of British beer has so long been notorious throughout Europe, and the later fame of bitter beer has now become familiar in all parts of the world, it is not without a rival in the beer of Bavaria and Austria; and, while the stupendous proportions of British breweries as well as our vast trade in beer may have hitherto justified the belief that this country was without a competitor in the art of brewing, the rapid development of this branch of industry in Germany and Austria within the last few years is well calculated to suggest the question whether we may not before long find that in this art, as in most others, we no longer occupy a position of secure pre-eminence, but have to contend with other nations for a place in the markets of the world, if not in that of our own country.

The beer of Austria is already imported here and sold in London. It is largely consumed in Paris, where it excited quite a *furore* during the Exhibition of 1865. Moreover, the Austrian breweries, though of comparatively recent origin, are on a scale approaching that of our own great beer-producing establishments. Down the whole length of the Lower Danube, beer-brewing has become a settled and lucrative business. On the shores of the Black Sea and even in Constantinople this is also the case. Almost every town of any importance has its brewery, or several of them, where excellent beer is made. The proximity of these countries to grain-producing districts, as well as the extension of agriculture in the plains of Hungary and elsewhere, are all circumstances in favour of the development of this industry, and the opening of a means of transport to India and China by the Suez Canal may well afford an opportunity for future competition with this country in the supply of beer to those large markets which it has hitherto been our exclusive privilege to provide with beer.

Here, then, is a possibility of British beer finding a rival much more formidable than cheap wine is at home, and in this view of the subject it may be interesting to the readers of NATURE to know something more of the peculiarities of German beer. With the exception of Belgium, where inferior kinds of beer have long been made, the chief seat of beer production, until within the last few years, was Bavaria, and the beer made there was celebrated throughout the Continent. This beer is made by a method different from that practised in this country, and the difference consists chiefly in conducting the fermentation at a very low temperature. Under this condition the yeast that is produced does not collect as a scum at the surface of the fermenting wort, as is the case in our system of brewing; but it separates as small clots or flocculi, which fall to the bottom of the liquor, leaving the surface freely exposed to the atmosphere. The beer brewed in this way is less liable to become sour when kept than beer brewed by the method of frothing fermentation, and this is one of the special characteristics of Bavarian beer. Liebig, who has devoted much attention to the subject, explains this difference as resulting from the facility afforded by sedimentary fermentation for atmospheric oxidation of the soluble gluten, or that constituent of beer wort from which yeast is produced by oxidation. In frothing fermentation this action of the atmosphere is prevented by the layer of yeast collecting at the surface of the liquor. The formation of yeast then takes place by abstraction of oxygen from sugar, and consequently, since beer wort contains more soluble gluten than is requisite for converting the sugar into alcohol, the proportion of sugar to gluten is still further reduced in that way; so that after fermentation has ceased, some of the gluten still remains unaltered in the beer, and, by a subsequent slow fermentation, is capable of determining the conversion of alcohol into acetic acid. In sedimentary fermentation, on the contrary, the unimpeded action of atmospheric air has the effect of separating the whole of the gluten from the wort by converting it into yeast without any decomposition of sugar, otherwise than into alcohol and carbonic acid.

The brewing of beer on this system has latterly extended beyond Bavaria, and it is now extensively practised in Austria and the Rhine district, where the frequent occurrence of basalt and other porous volcanic rocks presents great facilities for making brewing vaults and çellars, in which a low temperature can be maintained. The various details of the art of brewing have also been carefully studied by chemists with Government support, and the rapid progress of this industry in Germany serves well to illustrate the great advantages resulting from the application of scientific skill to practical subjects. There are not a few of our own industrial arts that would be, in like manner, benefited by a better appreciation of the aid which science is capable of rendering them; not a few that are sorely in need of this aid to enable them to keep abreast of the progress made in other countries.

BENJAMIN H. PAUL

OUR BOOK SHELF

Handbuch der Allgemeinen Himmelsbeschreibung. Von Hermann J. Klein. Das Sonnensystem. (Braunschweig, 1869.)

THIS work professes to combine a full account of the most recent physical discoveries in astronomy, with an exact statement of all those points which are commonly met with in handbooks of the science. The present volume, as will be gathered from the title, deals only with the solar system. Certainly it cannot be said to bear out in full the promise of the author. We are particularly struck by the almost entire absence of reference to the labours of English spectroscopists within the bounds of the solar system. Mr. Huggins's researches on cometic spectra are briefly referred to; but his observations on the spectra of the planets are passed over in silence, while place is given to the comparatively less valuable researches of the Padre Secchi on the same subject. We should be far from desiring to undervalue the researches of the eminent Italian astronomer; but no one who is acquainted with the circumstances under which Mr. Huggins and Father Secchi have respectively observed the planetary spectra, could think (we imagine) of comparing the Italian with the English series of observations. A similar remark applies to the solar researches of Father Secchi, which have not been made with sufficient dispersive power to be fairly comparable with the researches of Mr. Lockyer. Yet the labours of the last-named observer are passed over unnoticed, not only in the body of the work, but in an appendix, wherein the author treats specially of recent solar observations. In a note, a brief and inexact account is given of Mr. Lockyer's discovery that the bright lines of the prominence spectra can be seen when the sun is not eclipsed. After this, it is surprising to find that a full account is given of Professor Tyndall's ingenious theory of comets.

The treatise is one, however, we can on the whole recommend. The arrangement of the chapters on the planets is particularly clear and satisfactory. It is noteworthy that the author, with praiseworthy exactness, gives the secular variations of the planetary elements to the term involving the square of the time.

We were inclined to take exception at the manner in which Professor Adams's labours on the planet Neptune are left to the very end of the chapter on the planet; and we still think that their proper place would have been immediately after the account of Galle's detection of Neptune. This, however, is perhaps a small matter; and the statement of the relative claims of Adams and Leverrier is in pleasing contrast with the unjust account which some continental astronomers have not scrupled to give of the matter. Not only does Herr Klein recognise the claims of Adams, but he assigns the just and sufficient reason for putting the two astronomers on the same level, that "Leverrier can no more deserve credit because Neptune was actually discovered before the end of September 1846, than Adams can deserve blame because Challis, up to that very time, though he had indeed found Neptune, had not yet recognised the planet."

R. A. PROCTOR

St. Pierre's Dictionary of Botany.—*Nouveau Dictionnaire de Botanique.* Par E. Germain de Saint Pierre, avec 1,640 figures. Pp. 1,388. (Paris: J. B. Baillière et fils, 1870. London: Williams and Norgate.)

WHEN it is recollected that this bulky volume is the product of a single mind, the industry, no less than the encyclopædic knowledge of its author, strikes the reader with astonishment. Whether it is desirable in the interests of science that a publication of this kind should be the work of one man is another question. The system pursued in the compilation of cyclopædias, of relegating each separate article of importance to the man who has paid special attention to that particular subject, has its advantages, and what is lost in unity is gained in exactness and thoroughness. In these days of subdivision of scientific labour, even a man of M. Germain de St. Pierre's vast erudition cannot be the highest authority in every branch of his science, and accordingly we find the articles of very unequal interest and value. Thus, under the head "Herborisation" occurs a list of plants gathered in the environs of Paris by Cornuti, in 1635, valuable, no doubt, in its way, but altogether out of place in a botanical dictionary. On the other hand, so many interesting observations have lately been made on the physiology of climbing plants by Mr. Darwin and others, that we turned with interest to this volume to acquaint ourselves with the newest researches on the subject. The heading "Liane" does not appear at all, while under "Grimpant" there are just a dozen lines, and no reference to any other article. Dissertations on the relative advantages of living in Paris and in the country like that under "Laboratoire du Botanique" might have been altogether spared. Other objections might readily be made to the plan of the work. A short description of the leading characters of each natural order is useful, but the utility would have been increased by inserting the Latin names of the orders, with a reference from them to the French names, as from *Ranunculaceæ* to "*Renonculacées*," or from *Umbelliferæ* to "*Ombellifères*." The selection of a few genera and even species for description does not commend itself in the same manner, and the selection must necessarily be arbitrary and partial. Nevertheless, with these defects, we have in the work before us a most useful and valuable cyclopædia, containing an immense mass of information on every branch of botany, which cannot fail to be almost a necessary book of reference alike to the man of science and the student. On those subjects in particular in which M. St. Pierre is an acknowledged authority second to none, the work is especially valuable. The illustrations are copious and admirable.

A. W. B.

THE second fasciculus of the twelfth volume of the *Atti della Societa Italiana delle Scienze Naturali*, which has lately reached us, contains only two zoological papers. The most important of these is a systematic catalogue of the testaceous mollusca of the neighbourhood of Spezia and of its gulf, by Dr. C. T. Canefri, which will be of value to the student of geographical distribution. The other includes the first century of South American Coleoptera, by Prof. P. Strobel, with descriptions of numerous new species by Dr. E. Steinheil.

THE ABUSE OF WATER

THOSE who have travelled in remote districts, even at home, cannot fail to have experienced at some time or other a keen sense of the fact that water is one of the most peremptory necessities of life, one which Nature generally supplies so freely and bountifully that habitual familiarity with the gift sometimes tends to lessen its appreciation. Moreover, the utility of water in various ways as a source of power, a means of communication, or a material of manufacturing industry, has led to its application for a multitude of purposes besides the daily wants of life, and in many cases, unfortunately, this has been done in a way that has been attended with very serious consequences as regards the condition of natural sources of water supply.

To take, for instance, the case of our largest river whence the inhabitants of London chiefly derive their supply of water. It became apparent some 20 years ago that the condition of the water, resulting from a variety of polluting influences, was so bad, that the river within the boundary of the metropolis was no longer a fit source of water-supply for domestic use. The commissioners appointed at that time to inquire into and report on the subject, stated as the result of their inquiry that they doubted whether the existence of organic contamination from town drainage was then perceptible in the water of the Thames above the reach of the tidal flow, or that it amounted to a sensible evil, although, as the main drain of a large and populous district, the Thames was at all seasons polluted by surface drainage, and by the sewage of several considerable towns, there being then a population of more than three-quarters of a million on the banks of the river above Kingston. They supported this conclusion by referring to the probability that the large dilution of the sewage with the well-aërated water of the river was attended with such an effect as to cause the disappearance of impurities and their conversion into harmless products of decomposition. But, at the same time, they added that, since the contamination of the water by sewage could not fail to become considerable and offensive with the increase of population and the more thorough and general drainage of towns, it appeared to them only a question of time when the sense of this violation of the purity of the river should decide the public mind to the entire abandonment of the Thames as a source of water supply, unless, indeed, artificial means of purification should, in the meantime, be devised and applied.

Since the date of this report the application of the system of water-carriage removal of excrementitious material from dwellings has been extended in the towns situated in the upper valley of the Thames, and consequently the discharge of such contaminating material into the river, as sewage, has become more direct and more abundant. Hence we find that on several subsequent occasions the foregoing view of this subject has been strongly urged by other authorities, with the addition of warnings that the evil, merely apprehended before, had actually come into existence. Thus in 1858 the first report of the Royal Commissioners on the sewage of towns represented the increased pollution of rivers as an evil of national importance urgently demanding remedial measures, notwithstanding the natural agencies at work to effect the purification of flowing water. Moreover, the influence of water, thus polluted, as a source of disease, was earnestly dwelt upon. Their second report, in 1861, stated that the still increasing pollution of rivers had become so great and general that, besides being in some instances a nuisance and rendering the water utterly unfit for drinking, it was a general source of serious danger of infection for persons consuming even water that presented no appreciable sign of such pollution. Again, in 1866 and 1867 the reports of the Rivers Commission, dealing chiefly with the Thames basin above Hampton and that of the Lea, illustrated very forcibly the abominable effects of the discharge of sewage into these rivers, which are the chief source of metropolitan water supply. Referring to the spontaneous purification of flowing water by atmospheric oxidation—alleged by some to be adequate to render polluted water free from any objectionable character—these reports state that, though the process tends to purification, it is no sufficient guarantee for the water being purged of injurious sewage taint;—that, though the water supplied to London usually contains but a very limited amount of organic impurity, even that fact is, under existing circumstances, no satisfactory ground of assurance that the metropolitan supply of water is wholesome, or that the London drinker of water may not be drinking with it some remnant of the filth of other towns.

The report just issued by the Rivers Pollution Commission reveals the existence of a still more frightful state of rivers in the manufacturing district of Lancashire, where the pollution of the water has reached such an extent that, as compared with the Thames at London Bridge, the rivers are in several instances mere open sewers. That such should be the case is not indeed surprising, when it is considered that in this locality there is an enormous demand for water for all kinds of industrial purposes; that the water generally becomes fouled by such use, and, moreover, that the population has, in some parts, increased fourfold during the last seventy years. This latter circumstance has a much greater influence as a cause of pollution than has been supposed; but the effect of the use of water for manufacturing purposes alone has been, in the words of the Commissioners' Report, "to absorb the whole of the stream, which is the outlet of the drainage of the country, and to apply it to manufacturing purposes solely, so as to throw out of sight altogether the right of the dweller on the bank of a stream to the use of the water of that stream, and, gradually, to assume that the extent of the evil, or the magnitude of the profits which arise from the *abuse* of water in various processes of manufacture, is sufficient justification of the course followed up to the present time."

The Lancashire rivers present a peculiar form of pollution, resulting from the discharge of manufacturing refuse into them. Among the materials thus introduced into river water is arsenic, which is largely used in the calico-printing works. The foul water running from one company's works was found to contain as much as ·042 lb. of arsenous acid in 100,000 lb. Several of the rivers in the Mersey and Ribble basins are thus becoming contaminated with arsenic; and though it appears that the arsenic is, in some respects, gradually got rid of and deposited in the mud, this probably is not always the case. Arsenic is also contributed by aniline colour works and woollen manufactories. In the latter case, its source is ultimately the iron pyrites now so largely used for making sulphuric acid. Taking the quantity of pyrites imported for this purpose to be 400,000 tons a year, and the amount of arsenic it contains at a moderate average, we thus import 1,600 tons of arsenic, of which, there is reason to believe, a large proportion ultimately finds its way into our rivers and streams. In its course there it is sometimes met with in soap, as well as washing soda, and in the soda-ash used for making them. In this way it is met with in London sewage at Barking to the extent of ·004 parts in 100,000.

The Commissioners do not take an alarmist view of this wide distribution of arsenic, for since they find it in appreciable quantity in the rain falling in London, they consider it would also be met with in the case of most large towns as derived from coal smoke; but they suggest that care should be exercised in alkali works to prevent its unnecessary introduction into manufactured products, and they consider that might be easily done.

As regards that pollution of rivers which is due to admixture of human excretal refuse with their water, it has long been maintained by the local authorities of many parts of Lancashire that the evil was less in that district than elsewhere, in consequence of the system adopted there for dealing with such refuse not affording such facility for its discharge into rivers as the water carriage system. On this ground the introduction of the water system of sewerage has been strenuously opposed. The report of the Commission, however, dispels this illusion by evidence which is conclusive in proving that the use of the old form of closets with ash pits, earth closets, &c., affords no protection to rivers. From a long series of analyses of sewage from towns where such closets and middens are used, it appears that, as compared with the sewage from towns where water-closets are used, the composition of both are remarkably similar. Besides the nuisance and other inconveniences of the dry closet system, it appears that the pollution of rivers is but very slightly prevented by it. On the other hand, while the advantage gained by that system consists merely in the retention of a small proportion of the excreta in a state to be available for agriculture, the treatment to which that portion is subjected renders its value as manure very small. Moreover, this is usually effected only at the expense of great risk to public health, and at a cost which is on the average double the money return obtained. The Commissioners, therefore, come to the conclusion that the retention of solid excreta in middens is not attended with any considerable diminution in the strength of the sewage, though the volume is somewhat reduced. On that ground they consider it hopeless to anticipate any substantial reduction of sewage pollution of rivers by dealing only with the solid residue of excreta. At the same time they point out the fact that the discharge of excretal refuse into rivers is not a necessary part of the water-closet system.

As to the influence of the dry closet system on health, the Commissioners refer to the returns of the Registrar-General, and to other evidence, as showing that typhoid fever, scarlatina, diarrhœa, and other epidemic diseases, commit fearful ravages amongst the populations exposed to the pestiferous influences it exercises, and they express the opinion that to it may be attributed much of the responsibility for the high death-rate of South Lancashire towns. They have, however, been unable to obtain conclusive evidence of this owing to the incompleteness of the health statistics. They express astonishment at the frequent inability of Health Boards to inform them of the death-rate in their districts, still less to give information as to particular parts of them.

It is a very general opinion of medical men that the presence of an extremely minute amount of organic impurity may, under certain obscure conditions, render water unwholesome, and capable of causing or propagating disease, especially if that impurity be of animal origin. Sewage is the source from which such impurity is most likely to originate in a specially dangerous form, and it appears the amount capable of causing injury may be so small as to have no influence on the outward appearance of the water. To the smell, sight, and taste all may seem innocuous, and yet there may be present an infinitesimal portion of substance rivalling in potency the most virulent poison.

That water subject to such contamination is thereby rendered unfit for human use, and repugnant to every sense of decency, can, it is believed, require no arguments to be admitted. That the use of such water is, moreover, dangerous and unwholesome, would seem to be suggested by a knowledge of the changes which excretal refuse naturally undergoes, and of the circumstances attending those changes. The medical officers of Her Majesty's Privy Council, after specially studying numerous instances of the outbreak of typhoid fever and cholera, have almost invariably found that the prevalence of these and other epidemic diseases was accompanied by the use of water that had been polluted with drainage from cesspools or sewers. But at the same time it has been impossible to detect or demonstrate, by chemical analysis, the presence in the water of anything to which a fatal influence or the production of disease can be ascribed. This fact, however, does not in any degree, afford a ground for regarding the water as free from suspicion. Such reasoning would apply with equal force to sewage itself, for chemical analysis does not indicate the presence in it of anything specially noxious.

It has indeed often been alleged that if sewage be mixed with twenty times its volume of river water, the organic matter which it contains will be oxidised completely while the river is flowing a dozen miles or so. Considering the importance of the subject, it is surprising that this assertion, though confidently made in many instances, should hitherto have rested upon no more solid foundation than mere opinion. But at last the test of positive inquiry has been applied by the Rivers Pollution Commissioners. The composition of the water of the Irwell, the Mersey, and the Darwen at various points in the course of these rivers has been ascertained with due regard to complications introduced by the influx of unpolluted affluents. The results have shown that when the temperature is not above 64° F., a flow of from 11 to 13 miles produces but little effect upon the organic material dissolved in the water. Examination of the gases dissolved in water containing an admixture of sewage led to the same result. Lastly, experiments devised to augment the effect of atmospheric oxidation on such water, so as to represent a flow of from 96 to 192 miles in a river at the rate of 1 mile an hour, showed that the reduction of organic carbon in the water amounted to only 6·4 and 25· per cent., that of organic nitrogen to 28·4 and 33·3 per cent., though the temperature was 68° F. Thus whether we examine the organic pollution of water at different points of a river, or the rate of disappearance of the organic material of sewage mixed with water and agitated in contact with air, or the rate at which dissolved oxygen disappears in water polluted with 5 per cent. of sewage, we are in each case led to the inevitable conclusion that the oxidation is very slow—so slow in fact that it is safe to infer there is no river in the United Kingdom long enough to effect the complete transformation of sewage in that way.

These results are further confirmed by evidence as to the state of the rivers in the Mersey and Ribble basins; they are consistent with the opinions of chemists, and they are opposed only by dogmatic assertions destitute of proof.

To illustrate the extent to which the polluted state of Lancashire rivers is a disadvantage to manufacturers, the Commissioners state that thirty-nine of the firms who are carrying on different branches of trade in the basins of the Mersey and Ribble, estimate the benefit they would derive if the river water were fit for their use at no less than 10,157*l.* a year, while one calico-printing firm estimates the gain to them at 3,000*l.* a year. The number of manufacturers who have given these estimates form only a small fraction of the total number in the district.

MAGNETIC AND SUN SPOT PHENOMENA FOR FEBRUARY, 1870.

(*As recorded at the Kew Observatory.*)

ON February 1st about 5 p.m. there occurred a very considerable disturbance of the three magnetic elements, which lasted until about 2 o'clock in the early morning of the next day. The tendency of this disturbance was to diminish the declination and the horizontal force, while on the other hand the vertical force was increased during the first half of the disturbance and diminished during the second. The oscillations of the declination were very large. The disturbance was accompanied with an aurora, which was widely observed, and also with earth currents affecting the telegraphic wires. From the appearance of the traces one is inclined to associate the aurora and earth currents with the oscillations of declination rather than with those of the other elements.

On February 11, a little after 6 p.m., another disturbance took place, which continued more or less for thirty hours. As in the previous case the oscillations of the declination were most marked, but these were not so excessive as for the previous disturbance. An aurora was visible at 8 50 p.m. of February 11, and one was said also to have been observed on February 12.

The following is the record of sun-spots derived from the pictures taken :—

February 5	... 4	small groups	2 large ones
,, 6	... 5	,,	1 rather large, 1 very large
,, 8	... 5	,,	2 large, 1 very large
,, 10	... 3	,,	4 large, 1 very large
,, 11	... 4	,,	2 very large
,, 15	... 5	,,	1 large, 2 very large
,, 20	... 7	,,	1 large
,, 21	... 5	,,	1 large
,, 22	... 5	,,	
,, 24	... 4	,,	
,, 25	... 3	,,	
,, 26	... 4	,,	

THE EXISTENCE OF MAN IN THE TERTIARY EPOCH

IN the *Bibliothèque Universelle et Revue Suisse* for the 15th February, M. Favre, in an article on the above subject, remarks that for some years the discovery of traces left by man of the pre-historic age on the earth have multiplied with a rapidity only explicable on the supposition that the population inhabiting a certain region of the globe was formerly abundant, and that numerous observers have recently applied themselves to the subject with extraordinary energy and zeal. He takes up the question whether the age of stone does or does not extend back to the tertiary period, and he thinks it will prove interesting to give a *résumé* of the various observations tending to show that man inhabited the earth at an epoch anterior to the great extension of the glaciers southwards, and during the tertiary epoch. On *à priori* grounds no substantial reasons can be advanced against the existence of man at the latter period. The temperate zone was then somewhat warmer than at present, and the temperature of Greeenland and Spitzbergen sufficiently agreeable to be adapted to the development of terrestrial mammals. But it is difficult to represent the duration of the period that elapsed between the end of the tertiary deposits and the termination of the glacial epoch. The portion of the quaternary period characterised by the enormous extension of the glaciers was very protracted, and many ages must have elapsed before the glaciers of the Alps were so large as to be able to transport erratic boulders to the height of 1352 metres on the Jura (near Soleure), and the glacier of the Rhone approximated the Rhine, or perhaps even reached it by passing across the cantons of Valais, of Vaud, of Freibourg, of Berne, of Soleure, and of Aargau. The form of the earth's surface must have presented to the eye of such old world inhabitants a very different aspect from that exhibited at present, and if they already existed in the middle tertiary period, they would have been contemporary with the upheaval of the Alps, and with an almost entirely distinct flora and fauna. Under these circumstances man would have to be included amongst the creatures who have survived two geological periods. M. Favre then proceeds to review the evidence that has at present been collected, embracing the following points :—First, the observations of M. Desnoyers in 1863 made at Saint-Prest near Chartres, but previously (1848) known to M. Boisvillette, and (1860) to MM. Langel and Lartel. Here, in a pliocene formation, were found the bones of the *Elephas meridionalis*, *Hippopotamus major*, *Equus arnensis*, *Cervus carnulorum*, and two other species of *Cervus*, *Bos*, *Trojonotherium Cuvieri* (a kind of large beaver), striated in such a manner as to convince M. Desnoyers that the markings were the effects of the handiwork of man. This conclusion has, however, been contested by Sir C. Lyell; but in 1867 arrow or lance-head flint instruments were found in this spot by M. l'Abbé Bourgeois, one of which appeared to have been subjected to the action of fire, though this might have resulted from exposure to forests burning by the action of lightning. Soon afterwards M. Delaunay discovered markings of an analogous nature to the former, on the bone of a Halitherium at Pouancé (Maine et Loire) in a miocene formation containing the bones of Dinotherium. About the same time M. Bourgeois found similar flints in a still older formation (the calcareous strata of Beauce) at Thênay, and at Billy near Selles-sur-Cher. Some differences of opinion exist as to whether these flints are really worked by the hand of man; but the majority of those who have seen them, and are competent to judge, is decidedly in favour of that view. Nevertheless, M. Fraas observes that he has himself seen a lamina of silex become detached from a mass by the action of the sun's rays alone in Egypt; Livingstone and Dr. Wetzstein seem to have observed similar phenomena; and a point that now demands intelligent observation is the greater or less similarity such fragments detached by natural causes bear to the flint instruments or the masses from which they have been detached. He refers also to two fragments of the jaw of a *Rhinoceros pleuroceros* found in the lacustrian chalk of Limaque, and which appear to have been grooved by man, which, however, he admits to be doubtful; and to the observations of Whitney in California, which tend to show the existence of man anterior to the glacial epoch and to the period of the mastodon and elephant, at an epoch since which vertical erosion of the surface has taken place to the extent of two or three thousand feet of hard and crystallisable rocks. Finally he refers to the observations of M. Issel in Piedmont.

MODIFICATIONS IN THE CONSTRUCTIONS OF THE NEST OF THE SWALLOW

IN the tenth number of the *Comptes Rendus* for the present year, is a paper by M. Pouchet, on the Modifications of the Nests constructed by the common Swallow, (*Hirundo urbica* Linnæus,) in which he remarks that it is evident the mode of life of certain animals, far from being persistent and invariable, undergoes modifications under different terrestrial conditions, and that, in many instances, their habits are different from what they were in former ages. Spallanzani indeed remarks in one of his remarkable memoirs on the swallows, that the shape and structure of the nests of birds are interesting features in their history, and that each species constructs its habitation on a plan peculiar to itself, which never changes, and is continued from one generation to another. And this opinion is shared by many naturalists; observations, however, when sufficiently close and attentively made, show that it is erroneous. We do not indeed see any modifications of those of their habits which are associated with their biology, so that the arboreal species seek to form for themselves a subterranean nest, or rear their young ones in dwellings adherent to the coigns of our houses, but it nevertheless is ascertained that in a succession of years, each learns to improve the construction of his residence. Certain birds work up only the products of our own handiwork, and would necessarily employ natural substances if these were deficient. Thus, as may be seen in the museum of Rouen, the Loriot of Europe sometimes forms its nest with thread ends under the branches of trees, which cannot possibly be the natural method. For several centuries the common swallow has disported itself in our crowded cities, and with its friendly masonry attached itself to our houses. The chimney swallow, still more familiar and audacious, often builds in the smoky shafts of our domiciles, or even in the noisiest factories, undisturbed by the din or the fires or the movement around them. Such habits must form a strong contrast with those of their predecessors in times long gone by. When we ourselves wandered untutored savages in the prehistoric times, or when still later we constructed lacustrine towns, or megalithic monuments, the habits of the birds can scarcely have been identical with those of to-day, for such human edifices afforded little security or shade. They must then have built amongst rocks. Nearly the same remarks apply to the storks, which have not remained stationary, but have preferred to their less commodious dwellings those offered to them by man. These changes in the industry or the manners of birds are perhaps even more rapid than we might at first sight suppose; and M. Pouchet's observations have demonstrated to him that notable improvements have been adopted by swallows in their modification during the first half of the present century. Having directed a number to be collected for the purpose of having drawings made from them, M. Pouchet was astonished to find that they did not resemble those he had collected some forty years ago, and which were still preserved in the museum of Rouen. The present generation of swallows have notably improved on the architecture of their forefathers, amongst those still building in the arches and against the pillars of the churches. Some, however, still adhere to the old methods, or such nests may possibly have been old ones which have undergone reconstruction. In the streets, on the other hand, all the nests appeared to be constructed on the new method. And now for the differences observed. The old nests show, and all ancient writers as Vieillot, Montbrillard, Rennie, Deglaud, &c., describe the nest of the house-swallow as globular, or as forming a segment of a spheroid with a very small rounded opening, scarcely permitting the ingress and egress of the couple that inhabit it. The new nests, on the contrary, have the form of the quarter of a hollow semi-oval (le quart d'un demi-ovoide creux), with very elongated poles, and the three sectional surfaces of which adhere to the walls of edifices throughout their whole extent, with the exception of the upper one, where the orifice of the nest is situated; and this is no longer a round hole, but a very long transverse fissure formed below by an excavation of the border of the section, and above by the wall of the building to which the nest is attached. This opening has a length of nine or ten centimetres and a height of two centims. M. Pouchet considers this new form affords more room for the inmates and especially for the young which are not so crowded, whilst they can put out their heads for a mouthful of fresh air, and their presence does not interfere with the entrance and exit of the parents. Lastly, the new form protects the inhabitants of the nest better than the old one, from rain, cold, and foreign enemies.

THE ROTUNDITY OF THE EARTH

A RECENT number of the *Field* contains an account of a very amusing investigation which has been recently conducted on the Bedford Level to settle the question whether the earth is a globe or not! It appears that a Mr. Hampden threw out a challenge by which he offered to pay 500*l.* to anyone who would prove the rotundity, which challenge has been taken up by Mr. A. R. Wallace, who has lodged a similar sum with the Editor of the *Field*. To test this point, six miles of the Bedford Level were used, three signals, each 13 feet 4 inches above the water level, being put up three miles apart. Mr. Wallace asserted that if he were correct the central signal would appear elevated about 5 feet above the line joining the other two; Mr. Hampden holding, of course, that they would all be in the same straight line. It is needless to say what the result was, but we now come to a part of the story which is not so amusing, and here we quote from the *Field*:—

Both Mr. Hampden and Mr. Carpenter assented to the details of this experiment in our presence as conclusive, although we regret to say that Mr. Carpenter alleged his opinion was founded upon theory alone, and that it had never, as far as he knew, been tried. Now, the fact really is, that in a little treatise published by "Parallax," and which we have now in our possession, with Mr. Carpenter's name on the title-page, in his own handwriting, an experiment similar in its nature is described as having been made on the very same piece of water as that on which we were then occupied, with a result exactly the reverse of that which recently occurred. Mr. Carpenter was, in fact, engaged to decide a disputed question of which he and his principal professed to be practically ignorant, although it was in print on the authority of the head of their sect that it had already been tried in the same locality; *and this must have been then known to Mr. Carpenter, and has since been admitted by him in our presence.* The good faith and perfect fairness of Mr. Carpenter were not, therefore, quite of the nature we then believed them to be, and we have no hesitation in affirming that he was a most improper person to be selected to act as referee in such a matter. The deception was, to say the least of it, "unscientific;" yet Mr. Carpenter and his master, "Parallax," both profess to be ardent in the cause of science; and that it has recoiled upon their heads can cause no regret to anyone who values the truth.

Although the diagrams of what was seen by the telescopes used at both ends, and acknowledged to be correct by Mr. Carpenter and Mr. Hampden, show the central signal more than 5 feet above the line of the two extremes, these gentlemen coolly claim the victory, and threaten to bring an action against the Editor of the *Field* (who was appointed umpire by Mr. Hampden himself) for fraudulently deciding against them.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

On Prof. Tyndall's Exposition of Helmholtz's Theory of Musical Consonance

IN NATURE for March 3 you published a letter of mine, in which I stated that the exposition of Helmholtz's theory of musical consonance given in Prof. Tyndall's lectures on Sound was both "radically different from the original, and erroneous." I supported my assertion by a series of arguments which, both to myself and to other competently informed persons, appeared conclusive.

Prof. Tyndall has taken no notice, public or private, of my letter, although he has since its publication written in your columns on another subject.

Your readers, as well as myself, are surely justified in calling on Prof. Tyndall either to rebut my argument or admit my conclusion.

Trinity College, Cambridge, March 29 SEDLEY TAYLOR

[Prof. Tyndall's Lectures on Sound have been translated into German, and the following is a verbatim copy of the "Vorwort des Herausgeber":—

"Die Vorlesungen welche Herr Tyndall als Nachfolger der grossen Naturforscher Davy und Faraday in dem Wintermonaten vor den gebildesten Kreisen Londons in der Royal Institution über die verschiedenen Theile der Physik zuhalten pflegt, haben in England allzeitige Anerkennung gefunden. Herr Tyndall besitzt in ungewöhnlichem Grade die Gabe, durch die glückliche Vereinigung einer eben so klaren wie eleganten Darstellung, mit vortrefflich ersonnenen und schlagenden Versuchen selbst die schwierigeren Lehren der Physik dem gebildeten Publikum zugänglich zu machen. Eine Herausgabe seiner Vorlesungen in deutscher Bearbeitung dürfte desshalb auch bei uns nicht wenig zur Verbreitung physikalischer Kenntnisse in weiteren Kreisen beitragen. Die Unterzeichneten haben daher, wie schon früher die Vorlesungen über die Wärme, so auch jetzt die vorliegenden Vorträge über den Schall unter ihrer besonderen Aufsicht übersetzen lassen, und die Druckbogen einer genauen Durchsicht unterzogen, damit auch die deutsche Bearbeitung den englischen Werken ihres Freundes Tyndall nach Form und Inhalt möglichst entspräche.—H. HELMHOLTZ, G. WIEDEMANN."

Prof. Tyndall's work, his account of Helmholtz's Theory of Dissonance included, having passed through the hands of Helmholtz himself, not only without protest or correction, but with the foregoing expression of opinion, it does not seem likely that any serious damage has been done.]

Apparent Size of Celestial Objects

ABOUT fifteen years ago I was looking at Venus through a 40-inch telescope, Venus then being very near the Moon and of a crescent form, the line across the middle or widest part of the crescent being about one-tenth of the planet's diameter. It occurred to me to be a good opportunity to examine how far there was any reality in the estimate we form of the apparent size of celestial objects. Venus through the telescope, with a magnifying power (speaking from memory) of 135, looked about the size of an old guinea, *i.e.*, of a crescent cut off from that coin. The Moon, to my naked eye, appeared the size of a dessert plate. Having fixed their apparent dimensions in my mind, I adjusted the telescope so that with one eye I could see Venus through the telescope, and with the other the Moon without the telescope, and cause the images to overlap. I was greatly surprised to find that Venus instead of being about one-sixth of the diameter of the Moon was rather more than double its diameter, so that when the adjustment was made to bring the upper edge of the Moon coincident with the upper point of the crescent of Venus, the opposite edge of the Moon fell short of the middle of the crescent, a very palpable demonstration of the fallacy of guesses at size, when there are no means of comparison.

On another occasion a lady was looking at Jupiter through my telescope, and having first put on a power of 60 I changed it for one of 140. To my question, what difference she observed in the size of the planet, she answered, I see no difference in size, but a good deal in brightness. Here the area of the one image was more than five times that of the other.

The fallacy of guesses at size without objects of comparison is most strikingly shown in the ordinary expression of an ignorant observer looking at objects by day through a spy-glass. If you ask, as I have often done, a person unacquainted with optics whether he recognises any difference in size between an object, say a horse or a cow, seen with or without a telescope, he will always answer No, but it (the telescope) brings it much nearer. This, of course, is really an admission of increased magnitude, but the observer is unconscious of it; a horse to him is as big as a horse, no larger or smaller, whatever be the distance.

The assistance which may be derived from the degree of convergence of the optic axes alluded to by your correspondent "T. R." may be something when we know what the object is, or when it is moved to and fro, but if the object be unfamiliar, and there be no standard of comparison, I doubt whether any fair guess could be made.

Suppose all objects had never been seen but at one and the same distance, then an observer looking at a given object without any external standard of comparison, would probably make a fair guess at its size, for the picture on his retina would have a definite size, and his mind would estimate it by relation to other pictures of known objects which he had seen at other times; but as we see all the objects with which we are familiar at all degrees of distance, we have no standard of comparison for an image on the retina.

The common phantasmagoria effect where a figure appears to advance or recede from us though it really does not change its position, but its size is one of the many illusions produced by representing things as they are seen under certain circumstances which have become habitual, and habit interprets the vision. So if one lie on his back in a field, and throwing the head back, look at distant trees or houses, they will appear to be in the zenith, because when we ordinarily look at the zenith the head is thrown back.

Is the apparent size of the Sun or Moon, as expressed in common parlance, anything more than a reference to some standard which we have early adopted, and which, not having any means of rectifying, we assume. To me the Moon at an altitude of 45° is about 6 inches in diameter; when near the horizon, she is about a foot. If I look through a telescope of small magnifying power (say 10 or 12 diameters), so as to leave a fair margin in the field, the Moon is still 6 inches in diameter, though her visible area has really increased a hundred-fold.

Can we go further than to say, as has often been said, that all magnitude is relative, and that nothing is great or small except by comparison? W. R. GROVE.

115, Harley Street, April 4

An After Dinner Experiment

SUPPOSE in the experiment of an ellipsoid or spheroid, referred to in my last letter, rolling between two parallel horizontal planes, we were to scratch on the rolling body the two equal similar and opposite closed curves (the *polhods* so-called), traced upon it by the successive axes of instantaneous solution; and suppose, further, that we were to cut away the two extreme segments marked off by those tracings, retaining only the barrel or middle portion, and were then to make this barrel roll under the action of friction upon its bounding curved edges between the two fixed planes as before, or, more generally, imagine a body of any form whatever bounded by and rolling under the action of friction upon these two edges between two parallel fixed planes; it is easy to see that, provided the centre of gravity and direction of the principal axes be not displaced, the law of the motion will depend only on the relative values of the principal moments of inertia of the body so rolling, in comparison with the relative values of the axes of the ellipsoid or spheroid to which the *polhods* or rolling edges appertain; and consequently, that, when a certain condition is satisfied between these two sets of ratios, the motion will be similar in all respects to that of a free body about its centre of gravity.

That condition (as shown in my memoir in the Philosophical Transactions) is, that the nine-membered determinant formed by the principal moments of inertia of the rolling body, the inverse squares and the inverse fourth powers of the axes of the ellipsoid or spheroid shall be equal to zero—a condition manifestly satisfied in the case of the spheroid, provided that two out of the three principal moments of inertia of the rolling solid are equal to one another.

My friend Mr. Froude, the well-known hydraulic engineer, with his wonted sagacity, lately drew my attention to the familiar experiment of making a wine-glass spin round and round on a table or table-cloth upon its base in a circle without slipping, believing that this phenomenon must have some connection with the motion referred to in my preceding letter to NATURE: an intuitive anticipation perfectly well founded on fact; for we need only to prevent the initial tendency of the centre of gravity to rise by pressing with a second fixed plane (say a rough plate or book-cover) on the top of the wine-glass, and we shall have an excellent representation of the free motion about their centre of gravity of that class of solids which have, so to say, a natural momental axis, *i.e.* (in the language of the schools) two of their principal moments of inertia equal. For greater brevity let me call solids of this class uniaxal solids. I suppose that the centre of gravity of the glass is midway between the top and bottom, and that the periphery of the base and of the rims are circles of equal radius. These circles will then correspond to *polhods* of a spheroid, conditioned by the angular magnitude and dip of the spinning glass; to determine from which two elements the ratio of the axes of the originally supposed but now superseded representative spheroid is a simple problem in conic sections; this being ascertained, the proportional values of the moments of inertia of the represented solid may be immediately inferred. The wine-glass itself belonging to the class of uniaxal bodies, the condition that ought to connect its moments of inertia with the axis of the representative spheroid (in order that the motion may proceed *pari passu* with that of a free body) is necessarily satisfied.

The conclusion which I draw from what precedes is briefly this—that a wine-glass equally wide at top and bottom, and with its centre of gravity midway down, spinning round upon its base and rim in an inclined position between two rough but level fixed horizontal surfaces, yields, so long as its *vis-viva* remains sensibly unaffected by disturbing causes, a perfect representation, both in space and time, of the motion of a free uniaxal solid, as *e.g.* a probate or oblate spheroid, or a square or equilateral prism or pyramid about its centre of gravity, and conversely that every possible free motion about its centre of gravity of every such solid admits of being so represented.

To revert for an instant to the general question of the represensentative rolling ellipsoid, I think it must be admitted that the addition of the time element to the theory and the substitution of a second fixed plane in lieu of a fixed centre, considerably enhance the value and give an unexpected roundness and completeness to Poinsot's image of the free motion of rotation of a rigid body, of which so much and not altogether undeservedly has been made. From an idea or shadow Poinsot's representation has now become a corporeal fact and reality, as if, so to say, Ixion's cloud, in the moment of fruition, had substantified into a living Juno. I heard the late Professor Donkin, of revered and ever-to-be-cherished memory, state that when as a referee of the Royal Society he first took in hand my paper on rotation, he did so with a conviction that all had already been said that could be said on the subject, and that it was a closed question; but that when he laid down the memoir he saw reason to change his opinion. I owe my thanks to M. Radau and the editors of the Annals of the Ecole Normale Supérieure for having been at the pains to disentomb the little-known conclusions therein contained from their honourable place of sepulture in the Philosophical Transactions. J. J. SYLVESTER

K House, Woolwich Common, April 2

The Principle of the Conservation of Force and Mr. Mill's System of Logic

WILL you permit me briefly to point out, what has not, as far as I am aware, been yet noticed—the very important modifications of the logical theory of induction resulting from the consideration in reference thereto of the physical theory of the correlation of forces?

As I believe the subject is now more ripe for discussion than it was when, some dozen years ago, I first began to work out the bearings of the higher results of physical research on the general theory of causation, logical, and metaphysical; the following questions which, in the course of a correspondence on this subject, I submitted to Mr. Mill so long ago as 1863, may, perhaps, contain suggestions of thought not unwelcome to some students of NATURE.

"How then," I wrote, "do our new views of force affect the established theory of causation? Now I would rather, if you will allow me, submit the whole subject interrogatively to you, than give dogmatically my own thoughts. And, more particularly, allow me to submit to you these two questions—1st, Whether the physical theory of transformation (and identity) does not necessitate all such logical changes of expression, at least, as may be implied in the abolition of the conceptions of "permanent causes," and of "kinds," as real and absolute existences? And, 2ndly, whether—"if, as I have endeavoured to show, the inductive facts on which are based the principles of conservation and correlation lead to such a more general principle as may be thus expressed, *every existence has a determined and determining co-existence*,—whether, I say, "we are not justified in enunciating such a principle as the complement of that fundamental axiom of our present logic, 'every effect has a cause'?"

I believe I am at liberty to say that, though affirmative answers to these questions would necessitate very important changes in the "system of logic, inductive and ratiocinative," Mr. Mill, as to the first, admitted the necessity of certain changes of expression, at least, and generously encouraged me in the prosecution of the researches indicated by the second question.

Of the results of these researches I shall here only say that, as the axiom, "every effect has a cause," is the foundation of a logic which must be distinguished as a *logic of sequence*, the new axiom above stated may be shown to be the basis of a *logic of co-existence*, of which *Geometry* appears as an example. But as to this, as to the conception of force implied in this idea of co-existence, and as to the bearing of this new conception of force on the speculations with regard to space of a fourth dimension, perhaps I may have another opportunity of addressing you.

J. S. STUART GLENNIE

Athenæum Club, March 30

Dust and Germs of Life

PROF. TYNDALL'S exceedingly interesting article in No. 20 of NATURE seems to me to leave unexplained a fact very familiar to naturalists. It is well known that collections of natural history, say a Herbarium or an Entomological cabinet, will, if left undisturbed for a number of years, and unpoisoned, become infested with animal life, chiefly Acari and larvæ of Coleoptera; and that the surest way of preventing such attacks is thorough ventilation. Now if the floating matter in the air settles so readily after only a few days' stillness, as Prof. Tyndall's experiments seem to indicate, and does not even enter into an uncorked flask, it is out of the question that it can penetrate through the keyholes or chinks of our cabinets. Setting aside the theory of spontaneous generation, we are then forced to the conclusion that this life must arise from germs already existing in the specimens when they are preserved, or in the very limited amount of atmosphere originally confined in the cabinet. Is either of these explanations tenable? A strong argument against the former alternative seems presented by the fact that, as far as I am aware, the same species of Acarus infests plants in a Herbarium brought from the most widely diverse localities, an inland meadow or the seashore, the plains of England or the Alps of Switzerland. Can any of your physiological readers throw light on this subject? F. L. S.

Catkins of the Hazel

WHILE looking at some hazel bushes to-day, I noticed that where the red tuft of stigmas was protruded, the male catkins adjacent on the same twig were immature; while, on the other hand the stigmas had fallen, and the fruit was already swelling, where the scales of the male flowers were open to show the stamens.

A week or two back (in another locality) I could not find a single female catkin which had not lost its stigmas; while nearly all the male catkins had opened, and many had shed their pollen.

Is this always the case with the hazel? If so, it would be a striking illustration of Darwin's aphorism, "Nature abhors perpetual self-fertilisation."

I ought to add, that my observations are not confirmed by the illustrations in the books to which I have access, namely, Balfour's "Class Book," Lindley's "School Botany," and Lemaout and Decaisnes' "Traité de Botanique." In all these, a female catkin with its tuft of stigmas is represented on the same twig as a bunch of fully developed male catkins.

Will some one of greater experience inform me if I am in error as to the above facts? MARCUS M. HARTOG

University College, London, March 24

ANCIENT BRITISH LONG BARROWS

II.

THE chambered long barrows of North Wilts, Somerset, and Gloucestershire differ, as a rule, but slightly in external form from the simple or unchambered long barrows of South Wilts and Dorset. They are, however, generally of somewhat smaller dimensions, being from about 120 to 200 feet in length and from 30 to 60 feet in breadth. The side ditches characteristic of the unchambered barrows are seldom to be met with, but the margin of the grave-mound is, or rather was, usually defined by a low wall, built of loose tile-shaped fragments of oolitic stone. In some cases, as at West Kennet (see fig. 1), there is good evidence that the mound was originally surrounded by a series of obelisks of sarsen stone, the intervals being filled up with the usual dry walling just described. Sometimes, too, large monoliths or triliths are found at the broad end of the tumulus. As regards orientation, or position in reference to the points of the compass, the direction of east and west commonly observed in the simple barrows prevails in four out of five cases with the chambered barrows; and as in the former class of monument the interments were at the eastern end, which is also the higher and broader, so likewise do we find that the stone chambers or cists occupy the same position in the chambered barrows.

In internal structure the chambered barrows exhibit many varieties, but three principal types are recognised by Dr. Thurnam, viz.—(1) those in which the chamber opens into a central passage or covered way; (2) those with chambers opening externally; (3) those containing cists instead of chambers. The essential distinction between a chamber and a cist is, that the former is entered by a lateral aperture, whilst a cist can only be opened by removing the covering stone from above. The views and plan in figs. 4 and 5 of the chamber and gallery of the great tumulus at West Kennet already alluded to will show the reader at a glance the nature of the simpler specimens of the first and most characteristic type of structure. It is only necessary to add that the West Kennet chamber was covered by three very large blocks of sarsen stone, and that its dimensions were as follows: length 8 feet, breadth 9 feet, height 8 feet. Some of the barrows of the first type—as, for example, those of Stoney Littleton and Uley—are of much more complicated internal structure than that of West Kennet; but they all possess in some form or other the central gallery or avenue, ingeniously supposed by Nilsson to be the homologue of the passages to the caverns which probably served as the first dwelling-places of man.

It must not be supposed that chambered barrows are confined to North Wilts, Somerset, and Gloucestershire; but those in distant counties appear to differ from those of the districts above referred to in certain respects, and especially in being usually circular in form. The sepulchral stone chamber, universally known under the name of "Wayland's Smithy," though situated in Berkshire, is close to the confines of North Wilts, and was originally covered by a true long barrow. Dr. Thurnam surmises that the barrow was removed, or at least the chamber disclosed, at an early date, as he finds that the name "Welandes Smiththan" was applied to it so long ago as the middle of the tenth century, a name very unlikely to have been used so long as the barrow was intact.

It might seem at first sight that the presence of megalithic chambers in the tumuli of North Wilts, Somerset, and Gloucestershire is a characteristic which entirely differentiates them from the simple earth mounds of South Wilts, and that we should be warranted in assigning the two classes of monuments to different peoples, or at all events to different stages in the history of the same people. Every one familiar with the surface geology of the two districts will, however, at once admit the validity of Sir Richard Hoare's statement, that the absence of the stone structures in the South Wiltshire long barrows is simply due to the want of the necessary material. Referring in connection with this subject to the South Wiltshire Downs, Dr. Thurnam writes:—"Scattered blocks of silicious grit or sarsen stone are indeed found here and there on the surface, but they are neither numerous nor large enough for this purpose. In North Wiltshire and the adjacent part of Berkshire the case is different, and sarsen stones of large dimensions and in great numbers are found in the hollows of the higher chalk downs. From these were derived the immense stones of the circles and avenues of Avebury; and as most geologists and antiquaries believe, those out of which the great trilithons, and mortised uprights and imposts of Stonehenge itself, in South Wilts, were formed."

FIG. 1.—LONG BARROW AT WEST KENNET (PERISTALITHS AND WALLING RESTORED)

The implements and pottery of the chambered barrows agree very closely with the specimens derived from the simple earthen tumuli. The infrequency and rude character of these objects, especially when compared with the comparatively abundant and highly-finished weapons and tools yielded by the chambered tumuli of Scandinavia and Brittany, are sufficiently remarkable. Perhaps the fact that our chambered barrows have been so generally searched by treasure-hunters in various ages may serve to some extent to explain the almost entire absence of polished stone implements. Such objects would probably have attracted the attention of persons of that class; the ruder objects, having no value in their eyes, would be left in the tombs. The delicate leaf-shaped arrowheads alluded to in our former article as found in unchambered tumuli also occur, though rarely, in the chambered barrows. Fig. 3 will show that the manufacturers (whoever they may have been) of these weapons were possessed of no mean skill in the fashioning of flint; and it may perhaps be allowable to infer from the rarity and perfection of these objects, as contrasted with others obtained from long barrows, that they were obtained from tribes in a somewhat more advanced stage of civilisation. It is a singular circumstance that all the leaf-shaped arrowheads have

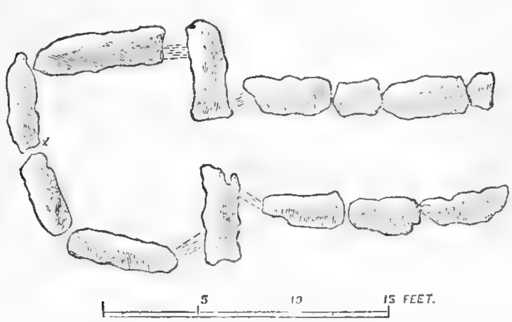

FIG. 2.—PLAN OF CHAMBER AND GALLERY

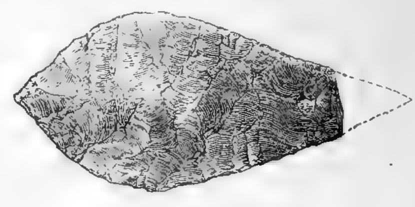

FIG. 3.—FROM FYFIELD LONG BARROW

one or both ends broken off. The breaking of the point of the dead warrior's spear was probably a solemn ceremony, and contrasts agreeably with repulsive funereal practices to which we shall presently refer.

The bones and teeth of animals apparently used for food, are found in considerable numbers. The remains of *Bos longifrons* and *Cervus elaphus* are, however, less frequent than in the unchambered barrows, whilst those of the wild boar are much more abundant.

We have already in our first article alluded to the important evidence which the critical study of the human remains from the long barrows is calculated to afford us, but in our remarks thus far we have purposely refrained from entering into the details of this subject. Although certain of the chambered barrows have afforded numerous skeletons, these monuments have been so frequently disturbed by treasure-seekers in bygone times, that our information as to the mode of interment is not so satisfactory as could be wished. There seems, however, to be little doubt that the bodies were placed round the walls of the chambers in a crouching or squatting posture, a favourite attitude for the dead both among early races and existing savages. The primary interments in the simple unchambered barrows consist either of a single or two separate skeletons, or of a number of bones promiscuously interred. In the latter case the bones are frequently found huddled together in so narrow a compass as to preclude the idea of the corpses having been buried entire. This is most reasonably accounted for by the practice known to prevail among savage races of burying the dead in or near their huts, and subsequently disinterring the bones for the purpose of burying them in the cemetery of the tribe. Canon Greenwell, so well known for his explorations in the Wolds of Yorkshire, thinks that some of the bones from long barrows examined by him indicate the horrible practice of cannibalism. Dr. Thurnam endorses Mr. Greenwell's opinion on this point in the following words: "Altogether I see no difficulty in acceding to the conclusion of Mr. Greenwell, that in the disjointed, cleft, and broken condition of the human bones in many of the long barrows, and especially in those examined by him at Scamridge, near Ebberstone, and near Rudstone, Yorkshire, we have indications of funeral feasts, where slaves, captives, and others were slain and eaten."

In a large proportion of the long barrows of the South-West of England, many of the skulls have been found to be split open apparently by some such weapon as a stone axe. The sharpness of the fracture seems to leave no doubt that the injuries were inflicted during life, or at all events before burial. It is inferred from the frequency of these cleft skulls, and the direction in which they are split, that they are those of victims immolated at the burial of a chief. Sometimes one skull is found uninjured while all the others are injured. In the light of what has come down to us from classical writers of the customs of Western Europeans at the beginning of our era, we see no reason to doubt Dr. Thurnam's conclusions on this point, although we should have liked to have more precise information of the relative number of cleft and uninjured skulls in particular barrows.

The question how far the human remains, more especially the skulls, enable us to determine the race characters of the people or peoples who lie buried in the tumuli of Britain, has been discussed with great care and at considerable length in two papers by Dr. Thurnam, published in the Memoirs of the Anthropological Society for the years 1864 and 1870. In the first of these papers the conclusions, based on the examination of a very considerable number of skulls and limb bones, were maintained that the people whose remains are found in the long barrows were a short, long-

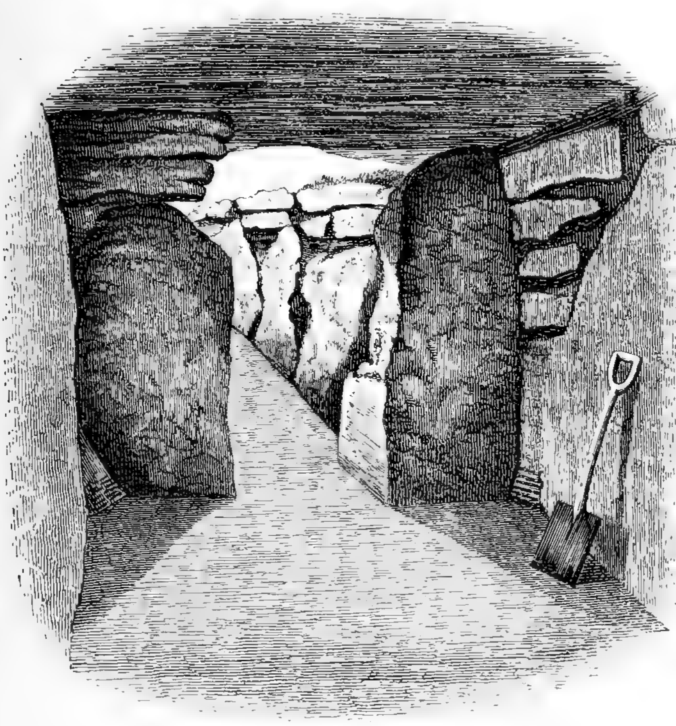

FIG. 4.—VIEW IN THE CHAMBER, LOOKING THROUGH THE ENTRANCE

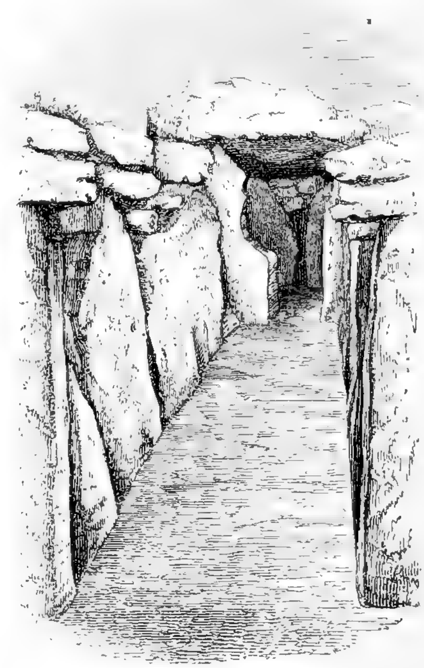

FIG. 5.—GALLERY LOOKING TOWARDS THE CHAMBER

headed race, with small features, whilst those from the round barrow were a tall, short- or round-headed race, with larger and more prominent faces. There was nothing new in this statement that the skulls of the ancient Britons of the later or Bronze age were usually of rounded form ; the chief novelty was the fact deduced by Dr. Thurnam from his explorations in the primeval long barrows, that the skulls from that form of tumulus are of extreme length, such as now prevails only in far distant lands, as for example in India, Africa, and Australia.

Dr. Thurnam's general conclusions as to the skull-forms from the barrows, were concisely expressed by him in the formula—"long barrows, long skulls: round barrows, round skulls." This coincidence between the form of the barrow and the shape of the skulls which it contained, appeared to be so strange to some minds that they hesitated to give full weight to the statistics brought forward in support of it. The unfavourable reception which Dr. Thurnam's conclusions met with in certain quarters, however disagreeable to him at the time, can now only be a subject of congratulation, as it no doubt served as a spur to further investigation, the results of which are most conclusive. In the paper published in the Anthropological Memoirs of 1870, Dr. Thurnam was enabled to discuss the character of as many as sixty-seven skulls from the two classes of long barrows, no fewer than twenty-seven of them being from simple barrows, although the first described skull from that class of tumulus was obtained so recently as 1863. The results of the measurements of these sixty-seven skulls, as contrasted with those derived from seventy skulls from the round barrows, may readily be made evident to those of our readers who are least acquainted with the technicalities of craniology. Skulls are now usually classed according to the form of the brain case, as "long," "short," and "intermediate," the limits of each class being accurately defined. Of these sixty-seven skulls from long barrows, then, it is found that eighty-two per cent. are technically long, and eighteen per cent. intermediate; not one technically short or round. On the other hand, of the seventy round barrow skulls, eighty-three per cent. are short, and seventeen per cent. intermediate ; not one long. Bearing in mind that the archæological evidence has satisfactorily established the superior antiquity of the long as compared with the round barrows, the conclusions here arrived at, based as they are upon a wide induction of instances derived from one district and one class of monuments, are a clear gain to science, and are not for one moment to be compared with such hypotheses as that of a primitive short-headed population, founded by Retzius upon the examination of isolated crania from various parts of Europe.

The question of the relation of the men of the long barrows to the existing people is one of great difficulty. It might seem natural to infer that the skulls recognised by some excellent observers, such as Dr. Beddoe, as Keltic skulls, are the modern representatives of the ancient long heads. They seem to us, however, to differ in many essential particulars, especially in the important element of height. Dr. Thurnam appears to have been impressed with certain historical evidence favourable to the notion of the Iberian origin of the long barrow people, and he has accordingly carefully studied the large series of Basque skulls in the museum of the Anthropological Society of Paris. The results of the comparison between the two classes of skulls do not, however, seem to go far towards supporting the Iberian theory. We are inclined to think that Dr. Thurnam should have turned to the north rather than to the south of Europe for the representatives of the primitive long-headed population of Britain. He readily allows that certain skulls obtained from ancient cemeteries (grave-rows) in northern Germany closely resemble those of the long barrow folk, but he seems to have been deterred from following up the clue by the fact that these grave-row skulls are of the iron period, and probably of post-Roman date. Since the date of Dr. Thurnam's paper, however, skulls of the same long and high form have been found in Rheinhessen, in graves assigned by the eminent archæologist Lindenschmidt to a date 500 years before Christ. Similar skulls have also been discovered in Bohemia with weapons of stone and bronze.

We have devoted so much space to the archæological and craniological portion of Dr. Thurnam's paper, that we are unable to notice in detail the admirable way in which the physical facts observed are reviewed in the light of historical evidence. It must suffice to say that the men of the long barrows are identified with those "described by Cæsar under the name of *Interiores Britanni*, as forming the aboriginal population," whilst those of the round barrows are inferred to be the Belgæ, who, according to Cæsar's account, passed over to Britain from the Continent, in immediately pre-Roman times, for the purpose of plunder and making war.

NOTES

We are glad to be able to state that energetic steps are now being taken in the matter of the Expedition to view the approaching Eclipse of the Sun. We believe that Mr. Lassell, the President of the Royal Astronomical Society, will call attention to the subject at the meeting of the society to-morrow evening.

Mr. Lockyer, in his third lecture on the Sun, delivered at the Royal Institution on Saturday last, showed an interesting experiment with a candle, which gives a good general idea of the solar phenomena as observed by his new method. As round the sun Mr. Lockyer can spectroscopically detect an ordinarily invisible hydrogen envelope which is rendered evident by bright lines only as contrasted with the nearly continuous spectrum given by the white light of the surface of the sun, so also there is an ordinarily unnoticed envelope (of sodium vapour) round a common candle flame which gives a bright line spectrum as contrasted with the continuous spectrum of the flame itself. Mr. Lockyer also showed that some of the phenomena he has seen when watching a solar storm may be reproduced by disturbing a candle flame.

We have heard so much recently of the long-delayed determination of Cambridge University to apply itself in earnest to the cultivation of Natural Science, that the information contained in the following paragraph must be a blow to those of its friends who hoped to see that it was entering on a new course :—"The Syndicate appointed to consider the means of raising the necessary funds for establishing a Professor and Demonstrator of Experimental Physics, and for providing buildings and apparatus required for that department of science, and other wants of the University, have made a report to the Senate, in which they state that they have addressed a communication to the several colleges of the University, to inquire whether they would be willing, under proper safeguards for the due appropriation of any moneys which might be entrusted to the University, to make contributions from their corporate funds for the above-mentioned objects. The answers of the several colleges, except that of King's, which has not yet been received, have been fully considered by the Syndicate. They indicated such a want of concurrence in any proposal to raise contributions from the corporate funds of colleges, by any kind of direct taxation, that the Syndicate felt obliged to abandon the notion of obtaining the necessary funds from this source, and accordingly to limit the number of objects which they should recommend the Senate to accomplish. They confined their attention, therefore, to the means of raising sufficient funds only for carrying out the recommendations of the Physical Science Syndicate in their report dated Feb. 27, 1869. These were to provide the stipends of a Professor of Experimental Physics, of a Demonstrator and an attendant, requiring altogether a sum of 660*l.* per annum; also to provide a capital sum of 5,000*l.* for a new building, and 1,300*l.* for apparatus. The Syndicate are of opinion that these sums may be raised from the ordinary sources of revenue of the University, and that a small addition (viz., 2*s.* a head) to the amount of the annual capitation tax will suffice for the purpose. They think, also, that there are circumstances connected with the fixing the amount of the capitation tax by the Grace of May 31, 1866, which in themselves justify some increase, and they mention the increased payments of late required for the town improvements. They think that the buildings may be erected from the existing building funds, and apparatus purchased by money belonging to the chest, and now invested." Was ever a more lame and impotent conclusion? It makes us seriously think whether the time has not come when the State should exercise more control over the enormous revenues of these old colleges, which seem determined to go on in the old track.

AN important zoological discovery has just been made in Australia. Mr. Gerard Krefft, the energetic curator and secretary of the Australian Museum, Sydney, has sent to the Zoological Society of London an account of a new and very singular freshwater fish recently discovered in Queensland, which united the external form of *Lepidosiren* with other characters belonging to the extinct Ganoid fishes of the genus *Dipterus* and its allies, and seems to form a connecting link between the *Dipnoi* and the *Ganoidei*. Mr. Krefft proposes to call this fish *Ceratodus forsteri*, after Mr. William Forster its discoverer. His paper on this subject will be read at the next scientific meeting of the Zoological Society on the 28th inst.

IN calling attention to a paper read before the Society of Arts on Thursday last, an abstract of which will be found in another column, we cannot avoid contrasting with the fact that our Legislature is now for the first time directing its attention to the question whether the State ought to recognise Science, the support which the French Government is at the present moment actually giving to scientific researches of the highest importance. In the Budget for 1870 there is a grant of 60,000 fr. for the meteorological observatory at Montsouris; one of 12,000 fr. for the publication of Delaunay's Lunar Tables (to be the first of five similar annual grants); one of 100,000 fr. (to be followed by one of 300,000 fr. in 1871), for the Ecole pratique des hautes études; one of 500,000 fr. for technical instruction; and one of 60,000 fr. for the observatory at Marseilles; while primary instruction finds its true level in a supplementary grant of 1,112,000 fr. for the necessary expenses during 1869 and 1870. In contrast with this, it is doubtful whether the grant of 4,000*l.* voted by Parliament some years ago for a botanical museum at the Glasnevin Gardens, Dublin, may not actually be withdrawn.

WE hear from Edinburgh that there is much excitement amongst the supporters of the Lady Medical Students, on account of the Professor of Chemistry refusing to accord one of the Hope Scholarships to Miss Edith Pechey, who is studying medicine at the university in that town, and who, by the number of marks gained, is entitled to a junior scholarship. The case is stated thus. Many years ago a Dr. Hope, amidst great opposition, opened a chemistry class for ladies. The movement was then so unpopular that he admitted these students through a window, as they were not allowed to pass through the gateway of the college. At his death all the fees he had obtained from this class, amounting to about 1,000*l.*, he left to found the Hope Scholarships. These scholarships consist of four, two senior and two junior. The rule is as follows:—"The class honours are determined by means of written examinations held during the session. The four students who have received the highest marks are entitled to have the Hope Scholarships to the laboratory of the University." This passage from the university calendar certainly gives us the idea that *any* student who has passed the written examinations is entitled, if a sufficient number of marks be obtained, to the benefit of it. Dr. Crum-Brown proposes to give Miss Pechey one of the bronze medals, but declines to give her the junior Hope Scholarship she has obtained, and which entitles her to six months' free admittance to the laboratory. Out of 234 men and six women, Miss Pechey comes third: the two men above her were last year's students, so that of this year's students Miss Pechey stands pre-eminently first. As she is a matriculated, registered, medical student, her supporters contend that she can legally claim the honours due to her. We believe, however, that the matter is to be put before counsel, so that a legal opinion may be obtained on the subject. We are informed, also, that Miss Sophia Jex-Blake's name has come out in the first-class honours list in chemistry; so the lady doctors may fairly be congratulated on the results of their first session in Edinburgh.

THE Senate of the University of London has appointed to the new office of Assistant-Registrar Professor T. A. Hirst, Ph.D., F.R.S., Professor of Mathematics in University College, London, and one of the permanent secretaries to the British Association.

THE new building of the University of London, in Burlington Gardens, will be opened by the Queen in person on Wednesday, May 11. Her Majesty, accompanied by the Prince and Princess of Wales and the Princess Louise, will be received at the entrance of the building by the Chancellor (Lord Granville), the Vice-Chancellor (Mr. Grote), the member for the university (the Chancellor of the Exchequer), and the Chairman of Convocation (Dr. Storrar), and be conducted to the Senate Room, from whence Her Majesty will pass to the larger rooms in the building, and finally to the large theatre, where an address will be presented. The Queen will then declare the building opened, and leave by the principal entrance. As many visitors as can conveniently be accommodated in different portions of the building will be invited, including the Premier, some of the Secretaries of State, the Lord President of the Council, representatives from the sister universities, the learned bodies and affiliated colleges, with the examining staff of the university.

THE chair of Natural History in the Royal Agricultural College, Cirencester, lately vacant by Prof. Thistleton-Dyer's removal to Dublin, has been filled by the appointment of Dr. W. R. M'Nab, of Edinburgh.

THE University of St. Andrews has conferred the honorary degree of LL.D. on Mr. J. T. Boswell-Syme, well known as the editor of the last edition of "Sowerby's English Botany," and the author of many valuable contributions to botanical science.

THE origin of the minute discs termed red blood-corpuscles, which float in our circulating fluid in such countless millions, communicating to it its rich opaque hue, is still a matter of question amongst physiologists, though most are inclined to believe that they proceed from the nuclei of the white corpuscles. But even supposing this to be the case, the question immediately arises, whence come the white corpuscles? and the reply is, from the lymphatic glands, and those large organs which for want of a better term are called ductless glands, of which the spleen, the thymus, and thyroid glands are examples; this reply being grounded on the fact that large numbers of white corpuscles are found distributed in the interior of the glands, whilst the blood returning from them contains more such corpuscles than the blood running towards them. Still the mode of origin of the white corpuscles in these glands and elsewhere is unknown. A recent investigation by Dr. Klein, of Vienna, appears to furnish some clue to the discovery of this point, for he has demonstrated that a process of division of white corpuscles may, under favourable conditions, be observed to occur, a statement which, if corroborated by further researches, will prove of much importance both in physiology and pathology. In the blood of the water-newt, he remarks, three kinds of colourless cells may be distinguished, though their differences are not very strongly marked. In one of these forms the clump of protoplasm, of which the corpuscle is formed, assumes an hour-glass form, and with the performance of the liveliest movements in each half, ultimately divides into two, in each of which a nuclear structure is visible. In a second kind the protoplasm forms a flat transparent disc, from the border of which a projection containing a distinct nucleus forms and gradually becomes detached. In a third form a kind of pinching off occurs of a minute portion from the general mass. The primary corpuscles may divide twice or thrice.

Les Mondes for March 31st contains a translation of Prof. Tyndall's article in NATURE for the 17th of the same month, on Floating Matters and Beams of Light.

MESSRS. W. & A. K. JOHNSTON are preparing a series of Botanical Diagrams for Schools and Colleges, uniform with their "Illustrations of Natural Philosophy," 50 in. by 42 in. A good series of diagrams is very much wanted by botanical lecturers; the parts should be on a larger scale than in the late Prof. Henslow's diagrams published under the authority of the Government School of Science and Art, and the series more complete than that issued by the Christian Knowledge Society, which is very good as far as it goes, and remarkably cheap.

THE Marlborough College Natural History Society has published its report for the half-year ending Christmas 1869, from which we gather, that beyond all question a real taste for science is taking firm root at Marlborough, though here and there, in the various papers, we get all too glowing descriptions, instead of the sober evidence of the keen eye of the observer. Here, for instance, is a description of the cuttle fish:—"And while I enumerate the greatest oddities to be seen in the 'motley crew' of fishes, shall I forget thee, O cuttle, that lookest so innocent and harmless, till some white-waistcoated visitor takes thee up condescendingly, when with one mighty effort thou contractest thy muscles, and in an instant sendest a mighty stream of thy own peculiar ink over that erst virgin waistcoat? Oh, the inimitable look of pity and contempt then depicted on the faces of the natives! If by thy squirts and fliks, O cuttle, thou hast made an enemy, thou hast made one that will never molest thy inky tribe again. It is interesting to know that these murky creatures are provided with backbones which have the peculiar quality of ink-erasing."

THERE is in the West Riding a Geological and Polytechnic Society, which publishes an annual report of proceedings. In that for 1869 an account is given of the meeting held at Wakefield, together with a number of papers on the history, antiquities, and mineral products of the county. The author of "On the Rocks of the neighbourhood of Pontefract," shows that there is coal enough along the line of the Lancashire and Yorkshire Railway, to yield nearly ten million tons a year for 489 years: and that the prospect of getting further supplies below the Magnesian Limestone and the New Red Sandstone is very promising. The Rev. Scott F. Surtees contributes an argumentative paper to prove that the memorable battle between Harold of England and Harold of Norway was fought, not at Stamford Brig, but at Pontefract, and that the memory thereof is preserved by the name Ponte-fract—broken bridge. Other papers contain notices of the extinct fauna of Yorkshire, of flint implements, and of certain singular ancient pits in the neighbourhood of Ripon.

A PARAGRAPH appears in a recent number of the San Francisco *Bulletin*, stating that deer, antelope, bear, and elk constitute the large game of California. Deer are found in great abundance, and many hundreds are killed yearly on Tamalipas. The deep gulches, woods, and covers of Marin County afford excellent sport to the deer hunter. Elk do not range nearer than the Oregon line, but a few are still met with on the banks of the Sacramento and San Joaquin rivers, where in former years they were so abundant. The brown and black bear are also hunted in Marin County, and along various parts of the coast range. White and grey geese are found in all the bay counties, on the lakes, and up the rivers in abundance. Duck are shot in the same localities, of which the most valued is the mallard, which remains and breeds in the country. Then come the redhead, springtail pigeon, wood duck, blue and green winged teal, broadbill, spoonbill, sawbill, whistler, butterball, fantail, or Dutchman, and Cadwell's. Quail abound in the surrounding counties. In the immediate neighbourhood of the city quail are scarce, being trapped and slaughtered for the markets so earnestly, that here they are now almost exterminated. Rabbits are also found in the quail grounds. The English or jack snipe are shot in the freshwater marshes on the San Joaquin and Sacramento rivers, in the Amador, Gilroy, and Santa Clara valleys. Of the bay snipe there is an abundant variety, such as curlew, willet, whitewings, plover, yellowlegs, robin, doewitch, ringneck, and sandpiper. The grouse, one of the finest game birds, frequents Mendocino and the upper counties of the State; several attempts have been made to stock the lower counties with these birds, but with little success. Trout abound in all the rivers running into the bay, and are taken with both bait and fly, but principally the former.

REMARKABLE SPECTRA OF COMPOUNDS OF ZIRCONIA AND URANIUM

THOUGH the spectra of different salts of bases which show well-marked absorption bands often differ in detail, yet they generally resemble one another so much that there is no difficulty in recognising each element. Judging from facts hitherto known, it was more probable that spectra of the new type described in my former paper* were due to a new element than that they were merely due to a combination of zirconium with uranium, and that there seemed to be no reason for suspecting a few special compounds of uranium would give spectra with bands unlike all others. Uranic salts, when in a state of moderately fine powder, give a spectrum not only showing absorption-bands, but also those which depend on fluorescence, and are characteristic of light reflected from the powder.† These two kinds of bands can be easily distinguished by means of a plate of deep blue cobalt glass, which proves that the abnormal bands seen in the spectra of the compounds of zirconia with the oxides of uranium are due to genuine absorption and not to fluorescence.

In studying the spectra of crystalline blow-pipe beads, it seemed desirable to examine those made with carbonate of soda, with or without a little borax. Though beads of carbonate of soda crystallise on cooling, so as to be only partially translucent, yet with strong direct sunlight well-marked spectra may be seen. For example, in the oxidising flame uranic oxide is easily dissolved by carbonate of soda alone, and when quickly cooled an orange-coloured bead is obtained, probably containing uranate of soda in a vitreous condition. It gives a single well-marked absorption-band in the green, with so small a quantity of the oxide, that in a bead $\frac{1}{8}$ inch in diameter $\frac{1}{2000}$ grain shows the spectrum to the best advantage, and even $\frac{1}{10000}$ grain can be easily detected. In examining the various products from jargons in order to study the supposed new earth in a state of purity, a small quantity of a dark-coloured substance was obtained, apparently zirconia, containing some oxide which communicated a green tint to a glassy, borax blowpipe-bead, but yet not sufficiently

* Proceedings of R. S. vol. xvii. p. 511.
† See Stokes's paper, Phil. Trans. 1852, p. 463 and 1853, p. 392.

distinct to show that it was due to uranous oxide. Though the presence of zirconia prevented solution by pure carbonate of soda, the addition of a little borax enabled me to prove that uranic oxide is really present in some jargons. Such then being the case, it seemed desirable to ascertain whether the oxides of uranium would give rise to any special spectra when present along with zirconia in crystalline blowpipe-beads. To my astonishment I found that the spectra were precisely the same as those obtained in the case of what I had thought to be an approximately pure new earth.* Hence the very abnormal spectra, which seemed sufficient to establish the existence of a new earth, are really due to compounds of zirconia with the oxides of uranium, which have such a powerful action on light, that an almost inappreciable amount is sufficient to produce the spectra to great perfection—in fact so small an amount, that the total quantity which misled me was only a few thousandths of a grain; and its presence might easily have remained unsuspected, if I had not discovered the carbonate of soda test just named. In the case of transparent blowpipe-beads of borax with microcosmic salt, it is requisite to have as much as about $\frac{1}{50}$ grain of uranous oxide to show faintly the characteristic absorption-bands, whereas, when present along with zirconia in the crystalline beads, $\frac{1}{30000}$ grain gives an equally well-marked spectrum; and $\frac{1}{2000}$ grain shows it far better than a larger quantity, which makes the beads too opaque. These very minute quantities were obtained by the repeated division of a small known weight, either before or after fusion with borax. This spectrum also differs very considerably from the spectra of the usual salts or blowpipe-beads of uranous oxide. On comparing them side by side, the only common peculiarity is the fact of there being numerous absorption-bands distributed over a large part of the spectrum; but they do not correspond in either number or position. On the contrary, they differ almost as much as possible; and the darker bands in the spectrum of this zirconia compound occur where the transmitted light is the brightest in other cases. One of the most striking peculiarities of the spectrum of some jargons is, that when light passes in a direction perpendicular to the principal axis of the crystal, and the spectrum is divided by means of a double-image prism into two spectra, having the light polarised in opposite planes, though some of the absorption-bands are of equal intensity in both images, yet others are comparatively absent, some in one and some in the other; whereas, in the case of other dichroic crystals, all the absorption-bands are usually more distinct in one image, and fainter, or even comparatively absent, in the other. The general character of the spectrum was entirely unlike that of all the known compounds of uranic oxide. Instead of the moderately broad absorption-bands in the blue end, ignited jargons give a most unusually large number of narrow black lines, extending from the red end, so that nearly all occur in that part of the spectrum which is entirely free from bands in all previously known compounds of uranic oxide. Besides uranium, and several of the more common earths and oxides, I have detected in some zircons erbium, didymium, yttria, and another substance which exists in such small quantity that I have not yet been able to ascertain whether or no it is the suspected new earth. These accidental constituents do not indeed occur in sufficient quantity to be of importance, except as modifying the physical and optical properties, the didymium giving the usual characteristic absorption-bands (zircons from Sveneroe, Norway), and the manganese, the same spectrum as that of garnets (zircons from an unknown locality in Siberia†). The oxide of uranium is so easily reduced at a high temperature to the state of protoxide in a borax-bead, with excess of boric acid, and is so readily peroxidised at a dull-red heat, when crystallised along with borate of zirconia, that there seemed good reason to refer the change in the spectra to temperature rather than to the state of oxidisation, until after it was found that they were due to uranium. By gently flaming the crystalline bead, the spectrum is entirely altered, and presents five well-marked absorption-bands, all of which occur at the red end, where no trace of bands exists in the case of ordinary uranic salts. I have not found any other element besides zirconia which causes uranium to give similar abnormal spectra, at all events in similar conditions. A few have special characters, but the majority exert little or no influence. Even when the blowpipe-beads are crystalline, they show only the usual spectra of the oxides of uranium. Moreover no such great change in the character of the spectra of other elements which give absorption-bands is to be seen when they are combined with zirconia. So far as my present experience goes, it seems as if such very abnormal spectra were met with only in the case of these remarkable compounds of zirconia with the oxides of uranium. These facts now put us in a position to explain why certain zircons give three different spectra. Some jargons (usually those of a green tint) contain a little uranium so combined that the characteristic spectrum is only faintly visible, whereas, after ignition, the intensity of the absorption bands is permanently increased often to a very great extent, and this more powerful action on light is accompanied by an increase in hardness and in specific gravity, sometimes as much as from 4·20 to 4·60. These changes are approximately proportional to the amount of uranic oxide in the various specimens, as shown by comparing the spectra of the blowpipe-beads. On the whole, since this abnormal type of spectrum is so characteristic of combination with zirconia, it appears probable that the effect of a high temperature is to cause the uranic oxide to combine more specially with the zirconia, as though the greater part existed naturally as a silicate, but after ignition as a zirconiate. We may also apply the same explanation in the case of zircons, more or less strongly coloured by other oxides, which become almost colourless when heated; and this unexplained peculiarity of zircons may depend on the fact of zirconia being able to play the part of both a base and an acid, which as compared with silica has an affinity for bases varying according to the temperature. The brown-red zircon from Ceylon, named at page 514 of my former paper, gives a spectrum precisely like that of the borax blowpipe-beads crystallised after treatment in the deoxidising flame. No doubt it contains uranous oxide. These facts thus clearly show that the various spectra which seemed to indicate the presence of a new element existing in three different physical conditions, are in reality only characteristic of the two oxides of uranium combined with zirconia, or not in combination. Perhaps some may think that my having been thus led astray shows that little or no reliance can be placed on the method of investigation employed, but I contend that the mistake was due to its being such an unexpectedly delicate test for uranium; moreover, the error was ultimately corrected by a further development of the same method. As far as the interests of science are concerned, there is no need to regret the general result. We have lost what appeared to be good evidence of a new earth, but have gained an almost entirely new system of blowpipe testing, which enables us to detect such a minute quantity of some substances as could not be recognised by the ordinary means.

H. C. SORBY

* Figs. 1 and 2 of my former paper.
† For both of these I am indebted to my kind friend Mr. David Forbes.

THE RELATION OF THE STATE TO SCIENCE

WE have referred in another column to Lieut.-Colonel Strange's valuable paper, read before the Society of Arts. The following is a report of the more important part of it. After giving a sketch of the history of the movement in favour of a recognition by the Government, of the necessity of defining the relations which should subsist between the State and scientific education throughout the country, commencing with the meeting of the British Association at Norwich in 1868, Colonel Strange proceeds to state the points which he thinks should be especially kept in view in the proposed inquiry. These are:—

1. The scope which the inquiry should include.
2. Some of the probable results of the inquiry.
3. The constitution of the Commission itself.

1. *The Scope of the Inquiry.*—The first thing to do will certainly be to take stock of what is now done by the State for advancing science. A reference to the parliamentary votes shows a considerable expenditure on science, in some form or other. The British Museum receives upwards of 100,000*l.* a year, the South Kensington Museum 92,000*l.*, and the Science and Art Schools 74,000*l.*, but in these cases a large proportion goes to art, not wholly to science.* The Royal Observatories of Greenwich, Edinburgh, and the Cape of Good Hope, the Royal School of Mines, the Ordnance Survey, the Hydrographic Department of the Admiralty, are all scientific branches of the admi-

* The total amount voted in the Estimates, for 1869-70, to maintain the "Science and Art Department of the United Kingdom" was 225,253*l.*

nistration, supported by the State at considerable cost. Enormous sums of money have been spent on special inquiries of a scientific character, such as those on armour-plate structures, ordnance, ammunition, small arms, explosive agents, and projectiles. The Parliamentary votes show also 10,000*l.* a year as given for meteorological observations. We also find a large number of small sums, forming, however, a considerable aggregate amount, given in aid of the funds of various colleges, universities, and museums; in some instances towards the salaries of specified professors, in others towards general purposes. The Royal Gardens of Kew receives 22,075*l.*; the Botanical Gardens of Dublin and Edinburgh receive respectively 1,931*l.* and 1,893*l.*; 20,900*l.* is spent on geological, and 92,790*l.* on the Hydrographic Department and naval surveys, besides very large sums on other miscellaneous objects.* Some of the institutions above named issue reports, from which the results of the expenditure on them may be inferred. In other cases this is not done. The wording of the votes seldom conveys any useful information on the subject whatever, and sometimes conveys incorrect information. The grant of 1,000*l.* a year distributed by the Royal Society is an example of such inaccuracy. This is said, in the words of the vote, to be given to the Royal Society "to enable the society to carry on certain experiments for public objects," whereas, instead of being given, as here stated, to the Royal Society, or for public objects, it is given to the community at large, and a committee of the Royal Society undertakes gratuitously the very laborious task—which does not even receive nominal acknowledgment—of distributing it with the strictest economy and impartiality, to such persons, whether belonging to the Royal Society or not, as may prove their ability to make good use of the aid they solicit in prosecuting scientific research.

Now, the results supposed to be obtained by the large expenditure recorded in the estimates may be thus enumerated:—(1). The maintenance of the efficiency of the public services in matters of a scientific nature. (2.) The teaching of science, directly, as by payment of professors, or indirectly, as by the maintenance of museums, botanical gardens, and the like. And (3), direct or indirect scientific progress, whether observational or experimental. What is wanted is, a clear statement of the degree in which these several results are attained in each particular case. With this information before us, we shall be in a position to arrive at trustworthy conclusions as to whether the money brings in each case an adequate return; whether the inadequacy of the return is due to defective organisation or to abuse; and whether, therefore, a more satisfactory result may not be obtainable in each case by a process of remodelling, without increased expenditure. We shall also ascertain, probably, that the whole expenditure in some particular case is needless, and is at present absolutely wasted. We shall learn, too, no doubt, that there is much divided, and probably much utterly undefined, responsibility in many of the cases in which large sums of public money are spent. Another fact, already patent, will be brought out prominently, namely, the entire absence of any pervading system by which the expenditure on scientific objects is regulated. Finally, it will clearly appear that the expenditure is very partially distributed, some branches of science receiving a very large amount of assistance from the public purse, whilst others, of equal importance to the community, receive none at all. This taking stock of our present scientific arrangements, it can hardly be doubted, is an absolute necessity to the success of the proposed inquiry.

Much of the information above adverted to will bear more or less on the question of "the higher scientific education." But in indicating the scope of the inquiry in this direction, it is very desirable that a clear conception should be formed of the meaning of this phrase. My own conception of it is this. Public opinion has decided that science should form part of the general education given at large and public schools, and at the universities. Such scientific education should comprise the elements of scientific knowledge, and the results of scientific labour, so far as these results are generally accepted as settled. Teaching of this kind forms, in my opinion, a portion of the great educational question which has been for some time occupying public attention, and which is now in a fair way of being put on a satisfactory footing. To impose on the Royal Commission the consideration of such teaching would be doing the same work twice over, and adding, therefore, unnecessarily to their already most laborious inquiry. But beyond the scientific teaching of schools and universities, there is much to be done in order to train advanced students to become investigators and observers, and this I conceive to be the object intended to be described by the phrase "higher scientific education."

It is maintained by very high authorities that it is beneficial intellectually to the investigator himself to have to teach, on account of the mental discipline and the habit of precise thought which it imposes on him. At present, unquestionably many of our best investigators are teachers also, and in all Continental scientific systems the two functions are combined. Two conditions seem important. First, that an investigator should not be required to impart the mere rudiments of scientific knowledge, but that his students should be far advanced before they come under his tuition; they should, in fact, be men who had already gained some distinction at the universities or elsewhere, and who had resolved on following science as a profession. The second condition is that the labour of teaching should engross only a moderate portion of the time of the investigator, leaving him ample leisure and spare energy for original research. At present, this latter condition is precisely reversed in the cases of most of our professors engaged in investigation, and we accordingly only reap the benefits of a mere residuum of their highest faculties.

Another matter connected with scientific teaching is considered by persons engaged in that important occupation to require attention, namely, the possible effect on independent educational institutions of rival State schools of science. The apprehended interference with such interests may perhaps be obviated by restricting State aid to the "higher" teaching which I have attempted to define, leaving the preparation of students for such higher teaching to the universities and other institutions of an independent character. But before any rules on this subject can be laid down, it is obviously necessary that the exact amount and kind of action now taken by the State in respect of teaching, and the effect of that teaching, both on scientific progress and on independent interests, should be ascertained with the utmost care.

It is also desirable that the Commission should collect the fullest possible information regarding all foreign scientific systems, down to the latest period. I by no means consider that any of these systems in particular is so perfect as to justify our creating a servile imitation of it. But it is only the part of wisdom, before organising our own scientific administration, to examine carefully the results attained abroad by nations whose experience in such matters is now very extensive. This examination will suggest many arrangements that we may safely adopt, and, no doubt, some that we should do well to reject. Not even the nucleus of a scientific system at present exists in England, and we are therefore the more free to shape, on the best available models, the organisation which a full inquiry will undoubtedly show to be necessary.

A great mass of facts connected with both scientific teaching and scientific investigations having been thus accumulated, the next step will be to digest and analyse them. The result of this most important process will be to show—first, what is redundant; secondly, what is imperfect; and thirdly, what is altogether wanting. It will indicate cases in which separation is desirable, as, for instance, cases where the concurrent cultivation of two or more branches of science, not naturally allied, tends to impede the growth of each. Cases will also occur in which combination would be beneficial. But one of the most important results of the analysis will be the bringing to light the scattered character of our scientific efforts; almost every department of the State having charge of some scientific institution—the Admiralty of one, the War Office of another, the Board of Trade of a third, and so on, a dispersion which is absolutely prohibitive of harmonious system, of progressive improvement, of efficient superintendence, of economy in expenditure, and of definite responsibility.

The final process will be to reduce to order the chaos of which I have merely attempted a broad indication. This will probably consist in a total re-arrangement of the internal organisation and the official distribution of our scientific institutions, with a view to concentrated superintendence and responsibility. It will also involve a revision of scientific staffs and salaries, with all the attendant questions of patronage, promotions, distinctions, privileges, and pensions.

2. *Some of the Probable Results of the Inquiry.*—The first of these will be the accumulation of a vast amount of facts and opinions, collected from every available source, and from the most competent authorities, regarding an extensive variety of

* The amounts above given are quoted from the Civil Service Estimates or 1869-70, those for the present year not having yet been published.

subjects of which we are at present in a state of comparative ignorance. If the inquiry produced no other immediate fruits than these, it would have performed a priceless service. Another result will be that we shall see for the first time what are the principles which should determine the action of the State for the advancement of science. At present there exists the most violent conflict of opinion on this subject, from those who hold that State intervention in science is unjustifiable and disadvantageous, to those who desire such intervention to be universal. Between these extremes there lies the middle and more reasonable section of thinkers, who recognise in the State simply a machinery for doing, on the part of the community, whatever is generally advantageous to the great mass of the people, but which transcends the power of individuals to perform. To discriminate fairly between the branches of scientific exertion which should devolve on the State and those which should be left to private energy, is one of the most valuable results that can be expected from the inquiry.

We may hope, as another most important result, that a central ministerial administration of scientific affairs will be shown to be necessary. In all other civilised countries a Minister of State is charged with this duty. It seems absolutely impossible to organise or maintain in an efficient state anything like a harmonious scientific system, without a dominant authority presiding over the whole. There are already indications of a coming Minister of Public Instruction, to administer the proposed national system of primary education; it can hardly be doubted that he should also have charge of whatever relates to State intervention in science.

The creation of such new scientific institutions as may be proved to be necessary, is another result that may be looked for. Though I have long been of opinion that the want exists, I do not think that the time has yet arrived to indicate how it should be supplied. The inquiry will develope clearer and more consistent estimates of the extent of the want, and of the best mode of meeting it, than, in the absence of full information regarding existing institutions, anyone can now hope to form. The cost of new scientific institutions alarms many persons who have only superficially examined such questions, but it will be probably found that increased expenditure in some directions may be met by retrenchment in others, and that no great change in the aggregate outlay on science will have to be made. On the other hand, we may feel sure that no outlay whatever will be recommended by a Royal Commission, unless it be incontrovertibly proved that such outlay will be beneficial to the nation.

Eventually, the responsibility of sanctioning increased expenditure for scientific purposes must rest with Parliament, by whom any proposals of that kind will be most scrupulously examined.

3. *The Constitution of the Commission.*—This is of vital importance. If its constitution be not such as to command, not only the confidence of the public generally, but also that of men of science, it cannot hope for success. The necessary elements in such a body seem to be administrative capacity, impartiality, and varied scientific knowledge. The first two elements will be secured by the nomination of persons versed in public affairs, and of high and independent station; the last by the due representation of the main branches of scientific activity. Probably four scientific members will suffice, to represent respectively, (1) Mathematics, including Astronomy; (2) Chemistry; (3) Physics; and (4) Natural History. To give a decided preponderance to either one of these great subdivisions will create strong and well-founded dissatisfaction. However lamentable the fact, it is certain that men engaged in one branch of science are very apt to underrate the importance of all others. The decision of a physiologist on an astronomical inquiry, or that of a mathematician on a matter connected with biology will be received with jealousy, a jealousy not by any means in most cases destitute of reasonable foundation. The subjects which will come before the Commission will be so difficult and so various, that four of the ablest men of science in their different departments will not be found more than will be necessary to give weight to the conclusions at which the Commission may arrive, and they should be men admittedly representative of their respective departments.

In the remarks which I have ventured to make, I have not dwelt on the importance to a civilised nation of progress in scientific knowledge. I have felt that I might safely take this for granted in addressing the Society of Arts, a society whose efforts have been during so long a period devoted to the promotion of such progress, and who do not require to be told that our commerce, our arts, our national supremacy on land and at sea, and our everyday conveniences are, more or less, dependent on our application of the laws of nature and the properties of matter. Whether or not an exhaustive inquiry into the state of science in England is imperatively needed, and what should be the scope of that inquiry, are the questions which, I believe, we have to-day met to discuss. It appears to me that the time for such an inquiry is opportune.

At no period of our history has there been so great a readiness to place administrative power in the hands of the Government. Public opinion acts now so energetically and effectually in the legislature, that the old jealousy of Government interference has been almost entirely dispelled. The tendency of the day is rather to impose fresh duties on the Government than to restrict its action. Men's minds, at the present time, view without apprehension, and examine with more impartiality and a higher discrimination than at any former period, proposals for radical changes. The nation has, moreover, been roused from the apathy with which it used to regard the ignorance of the masses, and is prepared for measures to redress the evil which, even ten years ago, would not have been listened to. It cannot be doubted that an equal readiness will be shown to examine with calmness and candour well-considered proposals to place on a proper footing a department of the State's duties which has never as yet undergone a strict and methodical examination. The nation requires primary education, and will enforce it upon those whom it is to benefit; it insists on the teaching of science in schools and universities; will it not approve of measures without which that teaching must be comparatively fruitless—measures calculated to attain the ends to which teaching is but a means—a more perfect knowledge of nature, and more absolute sway over her forces and her laws?

SCIENTIFIC SERIALS

THE *Student and Intellectual Observer*, New Series, No. 2, for April, contains an article entitled "Animals as Fellow-Boarders," being a translation of Von Beneden's valuable paper on *Commensalisme*, read before the Belgian Academy, describing the habits of creatures who may be said to board together, but whose association is distinct from that of victim and parasite. They are of two kinds, Free Fellow-Boarders, such as the tiny pea-crab, which lives in mussel-shells; and the Fixed Fellow-Boarders, like the barnacles which cover the skin of whales.

THE *Journal of Botany, British and Foreign*, New Series, No. 2 (double number for March and April) contains the following original articles: On two new British *Hepaticæ*, by Dr. Carrington; a fifth decade of new Chinese plants, by Dr. Hance; on *Rosa sepium*, by Mr. J. G. Baker; Addenda to the "Cybele Hibernica," by Mr. Ralph Tate; notes on Ray's "Hortus Siccus," by Dr. H. Trimen, with other shorter papers; also reports of recent additions to our moss and lichen flora, by Dr. Braithwaite and Rev. J. M. Crombie; a continuation of Mr. Baker's Review of the genus *Narcissus* from the *Gardener's Chronicle*, with other extracts and translations, reviews of new publications, proceedings of societies, &c., &c.

THE *Revue des Cours Scientifiques* for March 26 contains report of a Lecture by M. Paul Bert, on Sympathetic Nervous Actions, an article by Alph. Favre on the Existence of Man in the Tertiary Epoch, and a notice of Prof. Harkness's Spectroscopic Observations. The number for April 2nd is almost entirely filled by a translation of Prof. Tait's lecture before the University of Edinburgh, on the characters of a true science; and report of a lecture by M. Lorain at the Hospital Saint Antoine at Paris, on Scientific Medicine.

IN the *Deutsches Archiv für Klinisches Medicin* (xiii. and xvii. Heft. 1, received March 12), Liebermeister, of Basle, describes a very ingenious apparatus, constructed under his superintendence, for determining quantitative variations in the production of carbonic acid by man, and gives several examples of the results obtained. Amongst other conclusions he shows that the increase of carbonic acid in reading and singing is only to a small extent attributable to increased exertion consequent on fuller ventilation of the lungs, but is essentially due to the increased muscular energy exerted in the performance of those acts.

REICHERT and Dubois Reymond's *Archiv für Anatomie und Physiologie*, Heft. vi., 1869, is almost entirely occupied with a valuable contribution by Dr. Gustav Fritsch, assistant in the anatomical museum at Berlin, on the comparative anatomy of the hearts of amphibia, illustrated by four plates and many drawings.

THE *American Naturalist* for March contains several interesting articles. The longest is by Mr. E. G. Squier, "On the Primeval Monuments of Peru compared with those in other parts of the world." He describes a class of stone structures in Peru belonging to what is regarded as the earliest monumental period, coincident in style and character with the cromlechs, dolmens, and "sun" or "Druidical" circles of Scandinavia, the British Islands, France, and Northern and Central Asia. Considerable aboriginal Peruvian tribes once lived in houses built on piles, or on floats in the shallow waters of the Andean lake. The remnants of such a tribe still live in this manner, and bear the name of Antis; they spoke and still speak a language differing equally from the Aymara and Quichua, called Puquina. Early chroniclers speak of them as extremely savage, and calling themselves, not men, but *Uros*. Whole towns of them, it is said, lived on floats of *tortora* or reeds, which they moved from place to place according to their convenience or necessities.—Prof. Joseph Leidy contributes remarks on some curious sponges; and Mr. W. W. Bailey a sketch of the Truckee and Humboldt valleys between the Sierra Nevada and the Rocky Mountains.

Silliman and Dana's American Journal of Science and Art for March contains the following articles:—Photometric Experiments, Part I., by O. N. Rood. Contributions to the Chemistry of Copper, Part I., by T. Sterry Hunt. Notice of a recent Land-slide on Mount Passaconaway, by G. H. Perkins. On the Silver Mines of Santa Eulalia, Mexico, by J. M. Kimball. Machinery and Processes of the Industrial Arts, and Apparatus of the Exact Sciences by F. A. P. Barnard. On Norite or Labradorite Rock, by T. Sterry Hunt. On the Cause of the colour of the water of Lake Leman, by A. A. Hayes. On the Potassio-Cobaltic Nitrite known as Fischer's Salt, by S. P. Sadtler. Notice of some Fossil Birds from the Cretaceous and Tertiary formations of the United States, by O. C. Marsh. Descriptions of Shells, from the Gulf of California, by A. E. Verrill. Notice of Dr. Gould's Report on the Transatlantic Longitude. Meteors of November, 1869, by Prof. H. A. Newton.

SOCIETIES AND ACADEMIES

LONDON

Ethnological Society, March 22.—Prof. Huxley, F.R.S., president, in the chair. Mr. R. S. Newall was announced as a new member. — A paper was read on current British Mythology and Oral Tradition, by Mr. J. F. Campbell (of Islay). After explaining the sources whence his popular tales of the Western Highlands had been derived, he referred to the traditional character of myths, and expressed an opinion that many genuine British traditions orally preserved in Celtic may probably be old Aryan myths, mingled perhaps with pre-Aryan myths. Popular oral history must be founded on a real event, but minor details gradually drop out, while the most conspicuous incidents approach each other. The author showed how a legend sprouts from a fact which, being at first accurately told, passes into a tradition, while the dates and persons and localities become uncertain. Poetry is a good vehicle for preserving facts, and many current traditions carry with them a rhyme or a proverb to aid the memory. Hence, too, historic events are readily preserved in the ballad form. The president, Dr. Archibald Campbell, and Mr. Bouverie Pusey spoke upon this communication.—Dr. Campbell then read a note by the Rev. R. J. Mapleton on a Cist with Engraved Stones on the Poltallock Estate, Argyleshire.

Zoological Society, March 24.—Dr. E. Hamilton, V.P., in the chair. Mr. P. L. Sclater exhibited a coloured drawing received from Dr. Salvadori, of Turin, of a bird which Dr. Salvadori had proposed to describe as a new genus and species, but which was evidently referable to the singular pigeon recently named by Mr. Gould as *Otidiphaps nobilis*.—Mr. W. B. Tegetmeier exhibited and made remarks on a living specimen of an Axolotl (*Siredon pisciformis*) which had undergone the change into the Salamandroid form recently described by Professor Dumeril, of Paris.—A third letter was read from Mr. W. H. Hudson, containing remarks on the ornithology of the vicinity of Buenos Ayres.—Mr. Osbert Salvin read a paper on the birds of Veragua, based on large collections recently formed by Enrique Arce in that country, and in continuation of a former memoir on the same subject. The present communication contained an account of 214 species not given in the former list, and made altogether 434 species now known to occur in this limited district. Of these additional species several were stated to be new to science and of great interest.—Mr. P. L. Sclater read a notice of two rare species of pheasants from Upper Assam recently added to the society's living collection. These were a Monaul (*Lophophorus sclateri*) and a Tragopan (*Ceriornis blythii*), both lately described as new by Dr. Jerdon. For these specimens, both of which were in fine plumage and of very remarkable beauty, the society was indebted to the liberality of Major Montagu, of the Bengal Staff Corps.—Mr. P. L. Sclater read some further notes on the cuckoos of the genus *Coccyzus*, in continuation of a former paper on the same subject.—A communication was read from Professor J. V. Barboza du Bocage, containing a description of a new species of pelican from Angola, proposed to be called *P. sharpii*.—A communication was read from Dr. J. C. Cox, giving descriptions of eight new species of shells from Australia and the Solomon Islands.—A communication was read from Mr. Jonathan Couch, of Polperro, describing a new species of *Aplysia* or sea-hare, which had recently occurred on the coast of Cornwall, and which he proposed to call *A. melanopus*.

Chemical Society, March 17.—Prof. Williamson, F.R.S., president, in the chair. The following gentlemen were elected fellows: D. Brown, A. Muirhead, T. L. Patterson, D. Penny, S. T. Smith. The first paper read was on artificial alizarine, by W. H. Perkins, F.R.S. The lecturer commenced by sketching the history of the researches which had finally led to the artificial production of alizarine. This colouring matter was first obtained by Robiquet and Colin from madder root, and investigated by Schunk, who assigned to it the formula $C_{14} H_{10} O_4$; it will subsequently be seen how very near this formula comes to the truth. Strecker and other chemists had reasons to write $C_{10}H_6O_3$ as the composition of alizarine, relating it to the compound $C_{10}H_5Cl\,O_3$ which Laurent had produced from naphtaline, and which Strecker regarded as chloralizarine. A few years since Graebe, when investigating a hydrocarbon known as quinone, $C_6H_4O_2$, found it to be a benzol in which two atoms of hydrogen were replaced by the group $[O-O]''$. A derivative of this body, the chloranil, $C_6Cl_4\,[O_2]''$ yields hydric chloranilate on successive treatment with caustic potash and hydric chloride. This reaction induced Graebe to view the chloride of Laurent's chloroxynaphtalic acid as the dichlorinated quinone of naphtaline,—

$C_{10}H_8$	$C_{10}H_4Cl_2\,[O_2]''$
Naphtaline.	Chloride of chloroxynaphtalic acid or Dichlornaphtoquinone.

and indeed when this naphtaline derivative is acted upon successively by potash and hydric chloride, it furnishes chloroxynaphtalic acid. After it had thus been shown that chloroxynaphtalic acid, Strecker's chloralizarine, was a quinone acid, Graebe and Liebermann thought it probable that alizarine might also be the quinone acid of some hydrocarbon, and it was now only necessary to know this hydrocarbon. On reducing a specimen of natural alizarine, a substance of the composition $C_{14}H_{10}$ was obtained; but this is the formula of anthracene of coal tar, and indeed the substance obtained by the reduction of alizarine possessed all the properties of anthracene. This fact led Graebe and Liebermann to assume alizarine to be the quinone acid of anthracene,—

$C_{14}H_{10}$	$C_{14}H_8\,(O_2)''$	$C_{14}H_6 \left\{ \begin{array}{l} (O_2)'' \\ HO \\ HO \end{array} \right.$
Anthracene	Quinone of anthracene or Anthraquinone.	Anthraquinonic acid or Alizarine.

Having obtained anthracene from alizarine, it now remained to produce alizarine from anthracene. For this purpose it was first required to have the quinone of anthracene. Graebe and Liebermann found the desired substance in the oxygenated compound, $C_{14}H_8O_2$, which had been obtained by Laurent from anthracene. They heated this anthraquinone with bromine, acted upon the dibromanthraquinone thus gained with potash, and decomposed the potash salt thus obtained by hydric chloride. The product of these successive reactions was alizarine. But to turn this beautiful discovery to practical account, it was necessary to replace the bromine required in the process by some cheaper re-agent. A good substitute has been found in sulphuric acid.

When anthraquinone is heated with oil of vitriol, disulphoanthraquinonic acid is formed, and this decomposed by caustic potash yields the potassium salt of alizarine, from which hydric chloride liberates the alizarine. Artificial alizarine is entirely identical with the colouring matter obtained from the madder root. Both of these products crystallise in needles which are usually curved, especially when small. They dissolve in caustic alkalis, forming violet solutions of the same tint. When applied to mordanted fabrics, they produce exactly the same colours, bearing the treatment with soap equally, and resisting in the same degree the influence of light. Their alkaline solutions show identical absoption bands in the spectrum. Both yield phtalic acid when treated with hydric nitrate. As a substitute for madder, artificial alizarine has been objected to, on the ground that pure alizarine alone will not produce the madder colours, other colouring matter being required. But Schunk says that, after a long course of experiments, he has been led to the conclusion that the final result of dyeing with madder is simply the combination of alizarine with the mordants employed; and he recommends extraction from madder prints as the easiest method of preparing pure alizarine on a small scale. Artificial alizarine, as sent to the dyer and printer, is not exactly pure alizarine, and generally produces, with alumina mordants, a somewhat redder shade than madder. This is due to some impurities whose nature is, as yet, not known. A good deal has been said about the supply of anthracene. It must be remembered, however, that tar-distillers have as yet but little experience in separating this substance. Mr. Perkin's investigations on this matter have led him to believe that coal-tar contains considerable quantities of this hydro-carbon. No doubt, the kind of coal used, as well as the temperature employed in the gas-works, influences the quality of the tar as a source of anthracene; but upon these points no definite information has yet been obtained. Mr. Perkin illustrated his interesting lecture by exhibiting samples of fabrics dyed and printed with artificial alizarine, and also by projecting the spectra of some alizarine solutions upon a screen. By producing alizarine from anthracene, Graebe and Liebermann have given the first instance of the artificial formation of a vegetable colouring matter. The way by which the beautiful discovery has been arrived at proves decisively, as the president pointed out, the high importance of studying the molecular arrangements of chemical compounds.

Entomological Society, March 21.—Mr. H. W. Bates, vice-president, in the chair. The first part of the "Transactions" for the present year was placed on the table. The attention of the meeting was devoted exclusively to *Lepidoptera*. Specimens were exhibited by Messrs. Howard, W. J. Vaughan, Bond, Frederick Smith, and Stainton. An interesting discussion on dimorphic forms of the larva and imago was participated in by Messrs. Albert Müller, A. G. Butler, Pascoe, J. Jenner Weir, Stainton, McLachlan, and the chairman. The paper read was by Mr. W. F. Kirby, "Notes on the butterflies described by Linnæus."

BRIGHTON

Brighton and Sussex Natural History Society, March 10.—The president, Mr. T. H. Hennah, in the chair. A report from the committee was received, urging the advisability of forming a microscopical section. On the motion of Mr. Hazlewood, seconded by Mr. Wonfor, it was resolved that the report of the committee be received, entered on the minutes, and approved, the effect of which is to establish a microscopical section, and instead of one meeting on the second Thursday in each month, to have a second meeting for strictly microscopical objects on the fourth Thursday in each month.—A paper by Mr. Clifton Ward, F.G.S., "A sketch of the Geological History of England, so far as it is at present known," was read by Mr. Wonfor, hon. sec., in which, from the earliest dawn of the Cambrian period down to the present day, the changes produced by depression, deposition, elevation, denudation, &c., together with an account of the various types of animal and vegetable life during each period, were graphically described, and the amount of land above water in England at each period was represented by a series of fifteen charts.—It was announced that the Bryological Flora of the county of Sussex would soon be ready for distribution, the Society having determined to publish it at once, instead of waiting for the issue of the annual report in September.

EDINBURGH

Royal Physical Society, February 23rd.—Mr. C. W. Peach, president, in the chair. The following papers were read:—

1. Note on the Klipspringer Antelope (*Oreotragus saltatrix*). By Mr. D. R. Kannemeyer. A skin of this antelope was exhibited, and its various peculiarities pointed out and described—the long, wiry, and close hair with which it was covered, and the remarkable structure of its strong limbs and feet. Major Harris, in his work on the wild animals of South Africa, described it as having jagged edges to its hoofs; there was really a long, narrow depression or oval-shaped hollow on each of the divisions of the hoof. These peculiarities were admirably suited to the habits of the animal, which lived on the tops of high mountains, and was remarkable for the speed, agility, and sureness of foot with which it could leap from rock to rock up and down the face of inaccessible precipices; and also for the great distance of its leaps, and the small surface of some projecting ledge or pinnacle of rock upon which it could suddenly arrest its course, even when in full career. Mr. Kannemeyer described the various enemies the animal had to defend itself from—the eagle, the panther, and man—and referred to the manner in which it was hunted by the colonists, and his own experience in stalking it.

2. On the Deposits of Clay in the Neighbourhood of Stirling. By Rev. James Brodie, A.M., Monimail.

3. Specimens of Polyzoa, &c., from the Faroe Islands, were exhibited and described by Mr. C. W. Peach, A.L.S., &c. The author stated that the specimens were from Stromoe, one of the Faroe Islands, and not gathered by himself, but were given to him by a person who had been there. They consisted of sixteen species of Polyzoa, four of Mollusca, three of Hydrozoa, two Sponges, three Annelide cases, with Foraminifera and Diatomacea. A portion of one of the shells shows the marks of rasping by limpets when feeding on the leathery disks of Hydrozoa. He remarked on this as a curious instance of vegetable-eating animals being able to put up with such tough and hard fare when out of their native home, and thus accommodating themselves to their changed circumstances. He considered that the specimens were not got in deep water, nor far from land, as not a single really deep-sea form occurred amongst them. All of the species are to be got in our own seas, and with two exceptions (at present northern forms from Shetland and Wick, N.B.) have been collected by the author from Land's End to John o' Groats.

4. Dr. J. A. Smith exhibited a head of a red deer, the property of Mr. T. O. Horne, which was killed in the end of January near Kingussie, Inverness-shire. Instead of the usual well-developed brow and bez-antler which marked the red deer, this animal had on the right side two small and very short antlers springing close to the root of the horn, and on the left side a very small brow-antler, and then a large second antler springing from near the root of the horn, and running nearly parallel to the beam. It measured about a foot in length. The beam of the same horn measured one foot ten inches long, terminating in a couple of forked antlers above. The other horn was rather shorter, and also terminated in two antlers. The variety was probably due to some local injury sustained by the deer when the horns were beginning to sprout, the soft horn of the left side having apparently been split in two. Dr. Smith stated he was indebted to Mr. Muirhead, Queen Street, for recently sending him a specimen of the *Ballan Wrasse*, measuring 18½in. in length, taken in the Firth of Forth, where it is by no means common; also, a very large specimen of the Lump-sucker or Hen-padle, *Cyclopterus lumpus*. The fish was full of roe; it measured 20½in. in length by a foot in depth, and weighed 10lb. 13oz. He also noticed the very large male salmon taken on the 11th February. Mr. Anderson informed him it weighed a little over 56lb., and measured 4ft. 2in. in length by 2ft. 7in. in greatest girth. The salmon was taken along with several others at Mr. Anderson's fishing station, near Stirling.

PARIS

Academy of Sciences, March 28.—M. Darroux communicated a paper on Equations, with partial derivations of the second order, and M. Tisseraud a note on a point in the differential calculus.—A memoir was read by M. J. Jamin, on the employment of the electric current in calorimetry, in which the author described a method of applying the heat produced by an electric current to the determination of the specific heat of various bodies.—M. Jamin also communicated, on his own behalf and that of M. Amaury, a memoir on the specific heat of water between zero (32° F.) and 100° C. (212° F.) The authors showed that the specific heat of water undergoes no particular alteration about 39·6° Fahr., and that from upwards it increases with the temperature.—M. A. Trécul presented the sixth portion of his memoir on the position of the tracheæ in ferns, in which he described the ramification of the petioles in various plants of that group, including several species of *Asplenium*, *Aspidium*, and *Polypodium*. — A note was read on the organs and phenomena of fecundation in the genus *Lemanea*, by M. Sirodot. The *Lemaneæ*, although among the highest of the fresh-water Algæ, were described by M. Rabenherst in 1868 as producing "spores germinating without fecundation." The author described what he regards as antheridia in two species (*L. catenata* and *L. fluviatilis*), and indicated the mode of fecundation as observed by him. — M. Ducharter communicated an abstract of two Greek papers by M. Koressios, in which the author expressed the opinion that the disease now ravaging the vines in France attacks them from the roots, and recommended a certain mode of treatment.—M. Leymerie presented, through M. Elie de Beaumont, some observations on the conclusions lately put forward by M. Magnau, with regard to the lower cretaceous formation of the Pyrenees. He maintained that there is no evidence of the existence of the Albian stage in the Pyrenees, and also objects to the admission of the Muschelkalk as existing in the Zechstein in the departments of the Tarn and Aveyron. The same author addressed a note on the fragmentary state of the higher summits of the Pyrenees, in which he maintained that the broken state of the rocks forming these summits must be due to the effects of the force exerted during their elevation, and concluded therefrom that the summits of these and other mountains cannot have lost much of their original heights by subaerial action. M. Elie de Beaumont made some remarks on the permanence of artificial earthworks, as confirmatory of the author's views.—Papers on medical subjects were also read.

PHILADELPHIA

American Philosophical Society, February 4.—Pliny E. Chase presented tables of rainfall, and described them. The most interesting deductions were, as far as related to Philadelphia, that the spring and summer will be alike, and the autumn and winter alike. The tables are for 45 years up to date, from observations at the Pennsylvania Hospital. Dr. Brinton made observations on the zealous and long-continued studies of the language of the Choctaw Indians, made by the missionary Mr. Byington, who died a year ago. Dr. Brinton has a list of over 75 works, including the Bible, printed in Choctaw. Mr. Byington's Choctaw Grammar has been revised four times, and at his death he had progressed with his fifth revision. The MS. of this work was in Dr. Brinton's hands, and was presented to the Society for publication.

February 18.—Prof. Cope read a paper intitled, "Fourth contribution to the Fauna of the Miocene period in the United States." He exhibited the periotic bones of a large whale from the miocene of North Carolina, which had been discovered by Prof. W. C. Kerr, State Geologist. The part of the skeleton found consisted of the left side of the cranium to the temporal fossa, mandible, and many vertebræ, ribs, &c. It was found 30 feet below the surface in the bank of a stream. It represented a type near the true *Balænæ*, but partaking of the characters of the *Balænopteræ*. One peculiarity was the enormous thickening of the supraorbital process of the frontal, which was 17 inches deep. This individual was 17 inches deep. Vertebræ of two other individuals were found in other places, and a complete vertebral column of the same extended across a stream 20 miles distant from Kerr's specimen. Vertebræ taken from the last, referred it to the same species. This specimen was 50 or 60 feet long, and extended across the stream in such a way as to serve as a foot-crossing when the water was very low. The species was named *Mesoteras kerrianus*. Prof. Cope mentioned the discovery of the genus *Sus* for the first time in the United States, in the neighbourhood of Squankum, N.J. He said it agreed with the occurrence of the dugong noticed by himself and the rhinoceros by Marsh in giving an Asiatic character to that extinct Fauna. The hog he called *Sus vagrans*, and said it was as large as the common *S. scrofa*. He called attention to the abundance of the species of the *Pythonomorpha* in the United States, and described two new species from New Jersey, viz., *Mosasaurus fulciatus* and *M. varthrus*. The first with round curtra and an additional rib on the asquadratum, the second with depressed ceutra, and a quadrate bone more like that of *M. dekayi* than *M. depressus*. He said he knew 27 species of *Mosasauroids*. In the last work on the subject, only three species were described.

DIARY

THURSDAY, April 7.

Royal Society, at 8.30.—On supra-annual Cycles of Temperature in the Earth's Surface Crust: Prof. Piazzi Smyth.—Researches in Animal Electricity: Dr. C. B. Radcliffe.
Society of Antiquaries, at 8.30.
Linnean Society, at 8.—On new species of Annelids, &c.: Dr. Baird —On Algæ from the North-Atlantic Ocean: Dr. Dickie.
Royal Institution, at 3.—Chemistry of Vegetable Products: Prof. Odling.
Chemical Society, at 8.—On the Analysis of Deep-sea Water: Dr. John Hunter.—On the refraction equivalents of the aromatic Hydrocarbons and their derivatives: Dr. J. H. Gladstone.—On an acid Feed-water from the Coal-fields of Shellarton, N.S., and the results of its use: Prof. How.
London Institution, at 7.30.—Geology: Dr. Cobbold.

FRIDAY, April 8.

Royal Institution, at 8.—Pedigree of the Horse: Prof. Huxley.
Royal Astronomical Society, at 8.
Quekett Microscopical Society, at 8.

SATURDAY, April 9.

Royal Institution, at 3.—The Sun: J. Norman Lockyer, F.R.S.

MONDAY, April 11.

London Institution, at 4.—Chemistry: Prof. Bloxam.
Royal Geographical Society, at 8.30.
Royal Institute of British Architects, at 8.

TUESDAY, April 12.

Ethnological Society, at 8.—On the Danish Elements in the population of Cleveland: Rev. J. C. Atkinson.—On the Ancient Tribal System of Ireland: H. M. Westropp.—On the Brain in the Study of Ethnology: Dr. Donovan.
Photographic Society, at 8.
Institution of Civil Engineers, at 8.—Dressing of Lead Ores.—Maintenance and Renewal of Railway Rolling Stock: Mr. R. Price Williams.

WEDNESDAY, April 13.

Royal Geological Society, at 8.—On the Fossil Remains of Mammals found in China: Prof. Owen, F.R.S., F.G.S., &c. — Further Discovery of the Fossil Elephants of Malta: Dr. A. A. Caruana. Communicated by Dr. A. Leith Adams, F.G.S. – Brief preliminary Notes on a large Coal-measure Reptile from the Low Main Coal Shale: T. P. Barkas, F.G.S.
Royal Microscopical Society, at 8.

THURSDAY, April 14.

Mathematical Society, at 8.—On the Mechanical Description of a Nodal Bicircular Quartic: Prof. Cayley.

BOOKS RECEIVED

English.—Birds of Marlborough: E. F. Im Thurn (Marlborough, Perkins; London, Simpkin and Marshall).

Foreign.—Die Alterthümer unserer heidnischen Vorzeit, vols. i. and ii. (Mayence, V. V. Zabern).—Journal für Ornithologie, Jan. 1870.—Om Vegetationsforholdene ved Sognefjorden: A. Blytt (Christiania, J. Dahl).—Lichenes Daniæ, eller Danmarks Laver: J. G. Deichmann Branth og E. Rostrup (Copenhagen, Gads). — Undersogelser over Christiniafjordens Dybvandsfauna: G. O. Sars (Christiania, Dahl).—Zeitschrift für Parasitenkunde, vol. ii. pt. i. (Jena, Mauke).—Naturwissenshaftliche Reisen im tropischen Amerika: Dr. Wagner (Stuttgart, Cotta).—Archivio per la Zoologia l'Anatomia e la Fisiologia, Series ii. vol. i. (Turin, Loescher).—Reisen im Archipel der Philippinen: Dr. Semper, Æolidien (Wiesbaden, Kreidel).—Through Williams and Norgate.

CONTENTS

Errata.—In No. 21, page 539, first column, line 21 from bottom: for "Perth," read "Pesth."—In No. 22, page 557, first column, line 3 from bottom: for "Sir Sidney Smith," read "Mr. Sidney Smith."

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH

No. 24] THURSDAY, APRIL 14, 1870

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THURSDAY, APRIL 14, 1870

THE TOTAL SOLAR ECLIPSE OF DECEMBER NEXT

ON Friday last, Mr. Lassell, the president, brought before the Royal Astronomical Society the subject of the total solar eclipse of December next, with a view to eliciting information as to the steps necessary for observing it. A most interesting discussion ensued, in which the Astronomer Royal, the president, Messrs. De la Rue, Stone, and Huggins, Admiral Ommaney, Colonel Strange, and Lieutenant Browne, R.A., took part. The line of totality passes near the following places :—Odemira, in Portugal, Cadiz, Estepona (about twenty miles north of Gibraltar), Oran, on the Algerine coast, Syracuse, and the region including Mount Etna in Sicily.

The duration of totality will be a little over two minutes of time. It is proposed that an endeavour shall be made to equip two expeditions to observe the phenomena of the eclipse at two of these points, in order that, should adverse weather occur at one station, results may be, perhaps, obtained at the other. It is thought probable that the station of Oran, in Algeria, will be occupied by a French party of astronomers. The choice for English observers seems to be between Cadiz, Gibraltar, and Syracuse. Both Admiral Ommaney and Lieut. Browne, R.A., spoke from personal experience favourably of the climate of Gibraltar at that time of the year. The speakers were unanimous in considering that both parties ought to be equipped for the following main objects:—(1) Photography; (2) Spectrometry; (3) Polarisation. Other objects of subsidiary importance, as Photometry and Meteorology, would also receive due attention. An approximate estimate of personal and instrumental force gives from 20 to 25 skilled observers, and about 10 telescopes of from 4 to 6 inches aperture, as the complement necessary for *each* of the two expeditions.

The first step which the Council propose to take is to invite, by circular and other means, those prepared to volunteer for this service to send in their names at once, specifying the particular class of observation which the observer desires to be engaged in. The number of actually available telescopes and instruments will also be ascertained.

When this preliminary information has been acquired, the Council of the Royal Astronomical Society, which has resolved itself into a committee for the purpose, will then consider whether they should apply to Government for such assistance as may enable them to utilise, with the utmost advantage, their own resources. Pending the collection of this information, it would be premature to attempt any estimate of the public assistance which may be required to guarantee the success of this enterprise. But it is not too early to lay before our readers some idea of its character and importance.

The systematic examination of the solar surface is emphatically a modern study, which has, even during the last twelve months, advanced with enormous strides. Until recently these researches were limited to the ocular inspection and photographic representation of features rendered visible at ordinary times by our improved telescopic power, and to similar modes of examining certain other features developed during eclipses. Subsequently, with the wonderful aid afforded by the spectroscope, a new class of phenomena was brought under examination, but only momentarily, on the rare occasions of total solar eclipses. Only last year M. Janssen and Mr. Lockyer, labouring independently, showed that many of the spectroscopic observations, for securing which an eclipse had been believed to be indispensable, could be made without the aid of that phenomenon,—a discovery second, in dignity and value, to none that this age has achieved. But these very methods have opened out inquiries and doubts which again require for their solution the peculiar circumstances attending total obscuration of the sun's disc.

For instance, the corona which has been seen at times to extend to a distance beyond the sun greater even than the sun's diameter, has been very generally stated to indicate a solar atmosphere, a conclusion not entirely borne out, however, by the spectroscopic method of investigation; and Dr. Frankland and Mr. Lockyer have stated their opinion that the *whole* of the corona can hardly be solar—this opinion being based partly on their approximate determination of the pressure in these regions. This question was manfully attacked during the eclipse observed last year in America, but the results, which will be found most carefully detailed in the report printed by the American Government, were not conclusive.

Again, it has been shown that the solar chromosphere is not entirely seen by the new method of observation; away from the sun its light is ordinarily so feeble that it cannot be detected through our brighter atmosphere, but during eclipses it is seen; and in this matter the American astronomers did admirable work, which, however, requires strengthening, for many still hold that the radiance depicted on the photographic plates immediately round the moon in the photographs, is not the chromosphere, as stated by Dr. Gould and others, although there are very many arguments which can be brought forward in favour of their idea that it is that envelope. Other points might easily be brought forward to show the extreme and, in fact, special importance of eclipse observations at the present time.

If researches such as these yielded no fruits beyond the satisfaction of our craving desire to know more of the structure and constitution of the sun, they would still be prosecuted with ardour. But the knowledge they are calculated to advance has a much wider range and a more tangible character than the gratification of philosophical curiosity. Sabine, Lamont, and Wolf many years ago detected the contemporaneity of magnetic disturbances and the maximum outbreak of spots on the sun's surface. More recently De la Rue, Stewart, and Loewy have established a relation between the sun spot maxima and the configuration of the planets Venus and Jupiter. Systematic observations have been carried on at the Kew Observatory continuously for nine years for the express purpose of throwing light on the apparent connection of the sun spots with magnetic and planetary phenomena. During this period upwards of nine thousand photographic pictures of the solar disc have been taken. These researches, and those of Carrington, extending over many years, have shown that though the spots, if observed from day to day and month to month, appear to break out capriciously both in point of size and position, yet when observed perseveringly for a series of years, a recurrence of phenomena, so far at least as the total area covered by spots is concerned, becomes evident. The period required to complete this cycle is variously estimated, a little over eleven years being that most generally accepted. On Thursday last, a remarkable paper by Prof. Piazzi Smyth, Director of the Royal Observatory, Edinburgh, was read at the Royal Society, in which the results given by thermometers, buried at different depths in the earth and observed for upwards of thirty years, were tabulated and discussed. The main deduction from these observations was that the temperature of the earth, divested of the effects of transient atmospheric changes, seemed subject to a secular law. This secular variation in the earth's temperature may of course be due to secular changes going on deep in the structure of the globe itself; but it may be ascribed also, and with a far higher degree of probability, to changes in the heat-supplying power of the sun.

There is one extremely important fact connected with these changes, namely, that one of them is accomplished in $11\frac{1}{10}$ years; that is, exactly in the sun spot periods as determined by Wolf, and identical, or nearly so, with the period obtained from the Kew observations.

But the spots are only one of the known evidences of changeful activity going on in the great central luminary. The form, disposition, and dimensions of the prominences, and the distribution of the chromosphere, are visibly undergoing constant alteration. May these phenomena not also have their period of recurrence? And may not they, equally with the spot outbreaks, stand in some relation to what formerly used to be considered purely terrestrial phenomena, namely, magnetism, electricity, humidity, temperature, and rainfall? To carry the hypothesis one step further: if there is a physical relation between the solar changes and meteorological occurrences, and if the solar changes are subject to laws which cause them to recur in regular series, have we not in this secular arrangement a clue by means of which climatic variations may be studied with greatly increased effect? Is not, in short, the systematic study of solar phenomena extremely important from a meteorological point of view?

If this hypothesis, which is one daily gaining strength, be but probably sound, the careful observation of the physical phenomena of solar eclipses becomes an urgent necessity, as calculated not only to afford more just and more noble views of the constitution of the universe, but to confer on mankind the same power with respect to climatal vicissitudes, which we already possess with respect to astronomical phenomena, the power of confident prediction, which will never be ours until we have a firm grasp of the secular laws by which those vicissitudes are governed.

If these views be generally accepted, as we know they will be by those acquainted with the subject, we need not fear that anything which the knowledge and devotion of our astronomical physicists, or the power of the Government, can supply, will be wanting to effect the due observation of the Solar Eclipse of December in a manner creditable to our age and our country.

A.

ON THE BASIS OF CHEMICAL NOTATION

CHEMISTS are so much in the habit of employing what are called chemical symbols, that they are liable occasionally to forget the realities symbolised; while persons interested in the realities of chemistry, but not themselves chemists, are apt to call in question the propriety of employing any such symbols at all,—looking upon the entire system of chemical expression as an arbitrary one, having its chief warrant from authority, and not only throwing an unwarrantable gloss upon the facts, but frequently overshadowing them. That the accepted system of chemical notation is, indeed, to some extent arbitrary, and that it does throw more or less gloss upon the facts, may be admitted at once as indisputable; but nevertheless its relation to the facts is so simple and direct, and its utility as a means of illustrating and classifying the facts is so remarkable, that its justification ought not to prove a seriously difficult labour.

It being the especial business of chemists to consider every material object in relation to the kind of matter of which it is composed, they have gradually become acquainted with about sixty different kinds of matter that are unalterable in their kind by way of subtraction. The entire matter of a piece of iron, for instance, may cease to exist as iron, and, by an accretion of other matter, appear in the form of rust. But, though alterable in this way by the addition of other matter than iron to it, it is experimentally unalterable by the subtraction of other matter than iron from it. Now the sixty or more different kinds of matter having this property of unalterability by subtraction, though never declared to be in their essence elementary, are always tacitly assumed to be so; and chemical changes are accordingly interpreted in a definite way which, on this particular assumption, would appear to be the only legitimately possible way, but which, irrespective of this particular assumption, can only be regarded as one of several more or less probable ways.

Making the assumption, however, with eyes shut or open, as the case may be, chemists are able to learn, by analysis, the respective weights of the different elementary substances constituting a given weight of any compound substance. The results of the analyses are, of course, expressible in various modes; the most obvious, and, so to speak, impersonal mode, being the centesimal one—the setting forth of so many parts by weights of the respective constituents in 100 parts by weight of the particular compound. But in the case of several different compounds having one or more common constituent, the relationship of composition subsisting between the different compounds is much better brought out by taking some common constituent as a constant, and the other constituents as variable in relation thereto, rather than by taking all the constituents alike as variable.

Now, among the sixty or so elements, hydrogen is characterised by this peculiarity, that in nearly all the compounds of which it is a constituent, it exists in a smaller proportion by weight than any other constituent, while in absolutely all its compounds it exists in a smaller proportion by weight than some other constituent; so that in the compounds which it forms with but one other kind of elementary matter, its proportion by weight is always less than that of the other elementary matter with which it is combined. Even in that particular hydrogen compound, namely, marsh-gas, in which the amount of constituent hydrogen is largest, its proportion reaches only to 25 per cent., while among the many thousands of hydrogen compounds known to chemists, the following, and certain of their immediate congeners and isomers, are almost the only ones containing hydrogen to the extent of 11 per cent. and upwards :—

	Per-centage of constituent hydrogen.
Marsh-gas	25·0
Higher paraffins	14 to 20·0
Ammonia	17·6
Methylamine	16·1
Higher alcohol bases	14 to 15·5
Olefiant gas and homologues	14·3
Higher alcohols	13 to 14·0
Wood-spirit	12·5
Water	11·1

From the circumstances, then, of hydrogen forming so small a proportion by weight of the compounds it helps to constitute, its proportion may conveniently be taken as unity, and the composition by weight of the above tabulated hydrogen compounds be preferably expressed as follows :—

	Parts by weight.		
Marsh-gas	1 hydrogen	to	3·0 carbon
Ethyl hydride	1	,,	4·0 carbon
Ammonia	1	,,	4·7 nitrogen
Methylamine	1	,,	5·2 nitrogen + carbon
Ethylamine	1	,,	5·4 nitrogen + carbon
Olefiant gas	1	,,	6·0 carbon
Alcohol	1	,,	6·6 oxygen + carbon
Wood-spirit	1	,,	7·0 oxygen + carbon
Water	1	,,	8·0 oxygen

Now, while hydrogen is thus the least weighty, it is usually also the most mobile constituent of its several compounds. Accordingly, by acting on its several compounds with various reagents, it is possible to effect a removal of more or less hydrogen from them, often in the form of free hydrogen gas, more often in the form of some familiar hydrogen compound, such as water or muriatic acid. For instance, if muriatic acid itself, formic acid, ortho-phosphoric acid, and acetic acid, be each of them acted upon with either metallic sodium or caustic soda, taking care to keep the acid in excess, new compounds are produced, the composition of which in relation to that of the original acids may be expressed as follows :—

Muriatic acid and sodium chloride.

1 hydrogen + 35·5 chlorine
23 sodium + 0 hydrogen + 35·5 chlorine

Formic acid and sodium formiate.

1 hydrogen + 6 carbon + 16 oxygen
11·5 sodium + $\frac{1}{2}$ hydrogen + 6 carbon + 16 oxygen

Phosphoric acid and sodium phosphate.

1 hydrogen + 10·3 phosphorus + 21·3 oxygen
7·6 sodium + $\frac{2}{3}$ hydrogen + 10·3 phosphorus + 21·3 oxygen

Acetic acid and sodium acetate.

1 hydrogen + 6 carbon + 8 oxygen
5·7 sodium + $\frac{3}{4}$ hydrogen + 6 carbon + 8 oxygen

It is observable that the new compounds differ in composition from the original acids by a consecutively decreasing gain of sodium, and by a corresponding loss of the whole, of one-half, of one-third, and of one-fourth the original hydrogen respectively; and there is this additional point for consideration, that while in the case of formic acid and acetic acid it is not possible to obtain a compound differing from the original acid by a removal of one-third of its hydrogen, in the case of phosphoric acid it is not possible to obtain a compound differing from the original acid by a removal of one-half or one-fourth of its hydrogen. But, by further treatment of phosphoric acid with caustic soda, another compound may be obtained, differing in composition from the original acid by a removal of two-thirds, instead of one-third, the original hydrogen; while, by treatment of acetic acid with chlorine, a series of new compounds may be obtained, differing in composition from the original acid by a removal of one-fourth, and two-fourths, and three-fourths successively of the original hydrogen. Anyhow, the tendency of the hydrogen of formic acid is manifestly to break into halves, that of the hydrogen of phosphoric acid to break into thirds, and that of the hydrogen of acetic acid to break into quarters.

Now, assuming the reacting units of the four acids to contain each but a single proportion, or one part by weight of hydrogen, there seems no reason why this hydrogen should in each case break up in a specifically different manner; and, in other cases, in yet different manners, as into sixths, eighths, twelfths, and so on. But assuming the re-acting unit of formic acid to contain two proportions, that of phosphoric acid to contain three proportions, and that of acetic acid to contain four proportions of hydrogen, the reason of the different mode of breaking up becomes perfectly obvious, as shown in the following comparison with respect to composition of the original acids and their produced sodium salts; whereby it appears that a similar exchange of twenty-three parts by weight of sodium for one part by weight of hydrogen is effected in each of the four reactions.

Muriatic acid and sodium chloride.

1 hydrogen + 35·5 chlorine
23 sodium + 0 hydrogen + 35·5 chlorine

Formic acid and sodium formiate.

2 hydrogen + 12 carbon + 32 oxygen
23 sodium + 1 hydrogen + 12 carbon + 32 oxygen

Phosphoric acid and sodium phosphates.

3 hydrogen + 31 phosphorus + 64 oxygen
23 sodium + 2 hydrogen + 31 phosphorus + 64 oxygen
46 sodium + 1 hydrogen + 31 phosphorus + 64 oxygen

Acetic acid and sodium acetate.

4 hydrogen + 24 carbon + 32 oxygen
23 sodium + 3 hydrogen + 24 carbon + 32 oxygen

This, then, is the assumption actually made by chemists, and further warranted by many important considerations. For example, ammonia has the property of forming compounds with the above acids by direct combination or addition; and the respective maximum quantities of the formic, phosphoric, and acetic acids, with which a given weight of ammonia can so combine, do actually yield twice, three times, and four times respectively the particular weight of hydrogen that is yielded by the maximum quantity of muriatic acid with which that same weight of ammonia can combine. Instead, therefore, of regarding the unit weights of all hydrogen compounds as including alike a single proportion of hydrogen, chemists regard them as including 1, 2, 3, 4, ... and x proportions of hydrogen respectively, accordingly as their constituent hydrogen is capable of removal in the ratios $\frac{H}{1}, \frac{H}{2}, \frac{H}{3}, \frac{H}{4}, \ldots$ and $\frac{H}{x}$, respectively. And this position, as to the relative unit weights of different chemical substances, arrived at by the above or by some other method of attack, is the gist of the whole question. Admitted, the rest follows as a matter of course: and it will hardly be arguing in a circle to adduce the simplicity of what follows as a reason for admitting the position on which it is consequent.

The relative unit weights of different hydrogen compounds being determinable in this way, certain relations of quantity subsisting among other common constituents of the different compounds become very quickly apparent, as shown in the following examples:—

Caustic potash.
1 hydrogen + 39 potassium + 16 oxygen

Formic acid.
2 hydrogen + 12 carbon + 32 oxygen

Nitric acid.
1 hydrogen + 14 nitrogen + 48 oxygen

Phosphoric acid.
3 hydrogen + 31 phosphorus + 64 oxygen

It is obvious that in the units of these different compounds, determined with respect to their constituent hydrogen, their constituent oxygen amounts to one, two, three, and four times sixteen parts by weight respectively; and it further appears that, whenever the units of different compounds differ from one another by their amounts of constituent oxygen, the increment or decrement of oxygen is always sixteen parts or some multiple of sixteen parts, as exemplified in the case of mono-potassic succinate, malate, and tartrate, for instance—

Potassium	39 +	hydrogen	5 +	carbon	48 +	oxygen	64
,,	39 +	,,	5 +	,,	48 +	,,	80
,,	39 +	,,	5 +	,,	48 +	,,	96

Thus, from an examination of the above, and of thousands of other instances, it would appear that the proportion by weight of constituent oxygen present in the reacting unit of any chemical substance is invariably sixteen parts, or some multiple of sixteen parts; that when two or more units of chemical substance differ from one another by the weight of their constituent oxygen, the difference always amounts to sixteen parts, or some multiple of sixteen parts; and, in fact, that sixteen parts by weight of oxygen constitute the smallest proportion by weight of oxygen, relatively to one part by weight of hydrogen, that can be introduced into, or educed from, any unit of chemical substance.

Similarly it may be shown that twelve parts by weight of carbon constitute the smallest combining proportion of carbon, relatively to one part by weight of hydrogen, and to sixteen parts by weight of oxygen; and so, not only to carbon and to oxygen, but to every presumed elementary body, there may be assigned a particular number, termed its proportional number, expressing the smallest proportion by weight of the particular body, relatively to one part by weight of hydrogen, that is found to exist in any unit of chemical substance. These relative quantities of the different elements, namely, one part by weight of hydrogen, sixteen parts by weight of oxygen, twelve parts by weight of carbon, fourteen parts by weight of nitrogen, twenty-three parts by weight of sodium (natrium), thirty-nine parts by weight of potassium (kalium), &c., &c., are denoted by the initial letter or letters of the names of the respective elements; so that the following composite expressions for the previously adduced potassium salts,

Succinate	$KH_5C_4O_4$
Malate	$KH_5C_4O_5$
Tartrate	$KH_5C_4O_6$

indicate the unit weights of the several salts to consist of once thirty-nine parts by weight of potassium, of five times one part by weight of hydrogen, of four times twelve parts by weight of carbon, and of four, five, and six times sixteen parts by weight of oxygen respectively.

To say that the relative proportions by weight of the different elements, expressed as above by the initial letters of their respective names, constitute the smallest proportions of them that are existent in and transferable to or from any unit of chemical substance, is tantamount to saying that they constitute indivisible or atomic proportions. Accordingly, the relative weights of these proportions are very commonly spoken of as atomic weights, and the proportions themselves as atomic proportions. Some most distinguished chemists maintain, indeed, that these atomic weights are really the relative weights of distinct physical particles, or atoms. Other chemists, while not denying that this may be so, do not admit that it necessarily must be so, and, when using the word "atom" at all, employ it simply as a convenient synonyme or abbreviation of the phrase "atomic combining proportion."

It is further noteworthy, that the above deduced elementary atomic weights, or smallest relative weights of different elementary matter that are found to exist in a unit of chemical substance, also constitute the relative weights of different elementary matter which are specially comparable with one another in regard to space, to diffusive movement, to heat, and to single and multiple powers of colligation and mutual replacement.

WILLIAM ODLING

THE VOYAGE OF THE NOVARA

Reise der Osterreichischen Frigatte "Novara" um die Erde, in den Jahren 1857-58-59, *unter den Befehlen des Commodore B. von Wüllerstorf-Urbair.* Anthropologische Theil. Bearbeitet von Dr. Fried. Müller. (Vienna. 1868.)

THIS important work scarcely appears to have attracted the attention it deserves, and we propose referring to a few of the more interesting facts it contains.

The object of ethnography, Dr. Müller observes, is not to regard man as an individual, but as a member of a family, and hence to consider him by such light as can be gained from the investigation of his speech, his thoughts, his feelings, and his entire mode of living. He thinks the classification of the different races of man in accordance with the colour of the skin and the characters of the hair, extremely unsatisfactory, though adopted by many of the best anthropologists of modern times, as Linnæus, Blumenbach, Cuvier, Pickering, &c., nor less so the method of Retzius, who attended exclusively to the form of the skull and face. Race and language, or form of speech, on the other hand, he thinks, are associated by the closest and profoundest ties. The persistence of some of the races whose contours have been handed down to us by the artists of the ancient Egyptians and Persians may, he considers, at a low estimate, be placed at 8,000 years, since it is likely that they had endured at least as long previously to their being fixed in stone as they have done since. Everything, he thinks, serves to show the persistence and invariability of race. But if we pass from man regarded from an anthropological to an ethnographical point of view, his unchangeability is no longer perceptible. The form of the land, the climate, the Flora and Fauna by which he is surrounded, all exert a powerful influence upon him. The low grade of mental development on which the Australian stands, may easily be attributed to the singular dearth of useful plants and useful animals by which he is surrounded; and the Polynesian would undoubtedly have advanced to a higher level, if the plants and animals around him had been appropriate objects to stimulate and extend his intellectual faculties. The views here expressed, it will be seen, are curiously in accordance with those expressed by Buckle.

Dr. Müller estimates the total number of inhabitants on the earth at 1,342 millions, an estimate which differs from that of Behm by only five millions. He divides them into the following races:—1. Australian; 2. Japanese; 3. Malays; 4. Ballaks; 5. African Negroes; 6. Central Africans; 7. Hottentots; 8. Caffres; 9. Americans; 10. Northern Asiatics; 11. South Asiatics; 12. High Asiatics; 13. Europeans.

A general view of the ethnology and language of each of these is given, with details of those subdivisions that were encountered by the *Novara* in her voyage. Some of these are excellently drawn up, and contain much original and interesting matter. To take one as a specimen—the Chinese.

These he regards as representing the highest type to which the Mongolian type can attain, and standing to the yellow races in the position that the Greeks of old did, and the Germans, French, and English of the present day, do to the nations of Europe.

The physical features of the country and the characters of the climate are lightly sketched. Their Fauna and Flora are stated to be richer in useful animals and plants than any other region of the earth. Their clothing, dwelling, food, amusements, and arms are then described. The character of the modern Chinese is hit off in a few happy touches. The basis of his character is rest. Hence his condition of stagnation. His knowledge leads always to the same results; the present is still the best, and for the ideal, and the improvement and advance of the future, be it never so golden, he has no aspirations. The ceremonies of marriage and the occupations of daily life are detailed. The children are stated to be well educated, and it is noticeable that in the better families even the girls are taught general literature, music, and painting. Their trade, religion, and, finally, their language, are considered. The same plan is pursued with the other divisions, and the reader is presented with a very entertaining, though highly condensed, account of the principal types of mankind.

OUR BOOK SHELF

Alpine Flowers for English Gardens. By W. Robinson, F.L.S. (London: J. Murray. 1870.)

THE author of "The Parks, Promenades, and Gardens of Paris," presents us here with a work which will be of great value to every lover of gardening. Although the formal and unsightly monstrosities of Loudon's "Landscape and Suburban Gardener" are now happily out of date, there is probably no department of landscape gardening in which a cruder and more artificial taste is still displayed than in the construction of rock-work. Not only is the prevalent style of rockery faulty from an æsthetic point of view, but, as Mr. Robinson shows, it is eminently unfitted for the growth of Alpine plants, which, even when their stems reach only a few inches above the ground, strike their roots feet, and even yards, into the soil with which the crevices in the rock are filled, in order to enable them to withstand the sudden droughts to which they are subject. Messrs. Backhouse, of York, have shown how, by careful attention to the conditions under which plants thrive in their native habitats, many ferns and flowering plants which are usually seen only in greenhouses, can be successfully grown on out-of-door rockeries; and if the directions given by Mr. Robinson are carefully followed, any professional gardener or private gentleman, with the appliances ordinarily found in a moderately-sized garden, will be able to produce results which will astonish his friends and neighbours. The descriptive list of Alpine flowers, with the soil and treatment suited to each, is complete and valuable; some of the illustrations are pretty, others are on too small a scale to be effective.

Systematisches Verzeichniss der in Deutschland lebenden Binnen-Mollusken, zusammengestellt, von Carl Kreglinger. 8vo. (Wiesbaden, 1870.)

A BOOK of 403 pages, and merely a list of the inland (or land and freshwater) Mollusca of Germany, without any description or figure. Nearly one-half of this extensive compilation is taken up with useless synonyms of the species. Among the chaff there is some good grain in the nature of geographical and geological distribution. The author does not seem to be a species-maker; although in some cases he attaches, in my opinion, too much importance to slight and local differences. However, there is unfortunately no court of appeal. He evidently has not consulted all the works which he cites; or he would not have adopted Dr. J. E. Gray's specific name of *striatula* for the *Zonites radiatulus* of Alder, the former having described or rather indicated the species as "*Helix Zonites striatula*," and thus contravened the established rules of nomenclature. Nor do we find any reference to works which were published last year before the date of his preface, for instance, the concluding volume of "British Conchology." Herr Kreglinger enumerates 347 species as inhabiting Germany—a wide range, extending from Schleswig-Holstein to Dalmatia (a distance of between 800 and 900 miles), and comprising every variety of situation and soil, mountain, forest, pasture, woodland, lake, river, marsh, and the sea-coast. Indeed, in the last respect, he has "travelled out of the record" by adding some unquestionably marine species belonging to the genera *Melampus* and *Truncatella.* The number of British inland species is 125. Of *Clausilia* we have 4 only, while Germany boasts of 54; of *Vitrina* and its allies we possess but 1 out of 9, of *Neritina* 1 out of 5, and of *Hydrobia* (or *Paludinella*) 1 out of 18; the genera *Zospeum* and *Lithoglyphus*, which are peculiar to South Germany, and the family of *Melania* are utter strangers to our country. It is to be regretted that the author has without inquiry followed L. Pfeiffer in recognising such genera as *Azeca* and *Ferussacia.* Those few workers, to whom the high price of 20*s.* may not be an object, will be glad to have this *catalogue raisonnée* in their libraries.

J. GWYN JEFFREYS

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

The Dinornis

I OBSERVE in your interesting paper of Feb. 17th, a statement that the larger varieties of Dinornis had, in all probability, become extinct before the occupation of the Middle Island of New Zealand by the present race of natives. I have observed previous statements to the same effect, supported by the authority of gentlemen whose opinions deserve the highest consideration, and by the assertion that no tradition of the existence of such birds has been found amongst the present representatives of the native race. I have good reason to question the accuracy of the latter assertion, at any rate.

I was myself in New Zealand for nearly seven years, from 1841 to 1848, and I had unusual opportunities of becoming acquainted with the condition of the Middle Island as it then was, having been in the service of the New Zealand Company as a surveyor and explorer in the settlement of Nelson, and subsequently in the other districts now known as Canterbury, Otakou, and Southland. I can state positively that some of the natives then resident in the Motueka and Motupippi districts of the Nelson settlement, at a time when the actual existence of such birds past or present had not been suspected, told us what appeared to us to be foolish stories about large birds which their immediate ancestors had been in the habit of hunting. One of them described to us most vividly the manner in which they beset these birds with dogs, and the mode in which the birds defended themselves by kicking. He stated that the dogs were frequently killed by a single kick, and that men not unfrequently had limbs broken in the same way. Other stories there were of an extravagant character, indicating perhaps a more remote origin—about birds so very large that one of them was said to have pulled down out of a tall tree an unfortunate hunter who had endeavoured to conceal himself there, and had *eaten* him on the spot; and these latter stories, no doubt, induced us to treat the others with less consideration.

I never met a native chief who told me that he had himself seen such a bird alive, and I do not think that any native whom I should have been inclined to trust ever told me even that his *father* had seen such birds, but they did assert expressly that their fathers—by which they would mean immediate ancestors, had so hunted and killed these large birds. I was further assured, at a later period, by a native chief named Teraki, who resided near the mouth of the Taieri River in the Otakou district, that he believed such birds still existed in the interior of the country, and that if I would go with him for a month he thought that he could show them to me. The same man told me curious stories about the existence, in the interior, of a quadruped whose habits he described, and which, if it did really exist at all, must, I think, have been a description of beaver. That fact may possibly tend to discredit his evidence, but I can only say that if it had been possible for me, consistently with my duties at that time, to go with him, I should have been very glad to do so.

The country to which he referred as the interior was the country to the west of the Taieri River, towards the source of that and of the Matou, or Molyneaux. It has, since that time, been fully explored, in consequence of the discovery of gold there, and it does not appear probable that he was correct in supposing that such birds still lived, though there are stories among the early explorers of having seen and heard strange things.

The rarity of these birds was attributed by Teraki and other natives of that district in which they were once abundant to over hunting, and to the fires, which, sweeping across a country covered principally with coarse grasses, had destroyed nests and eggs, and driven the birds themselves into the swamps for refuge, to meet death by suffocation from smoke and water.

Such an explanation appears to me to be probably correct, and the fact that complete skeletons have been found in the Taieri swamp, in a situation to which no existing stream of water could have carried so large a carcase, appears to lend weight to it. I have myself found on the low hills to the south of the river Matou the charred remains of egg-shells and bones of some variety of that genus, but not of the largest. I was instrumental in obtaining the first specimens of bones of such large varieties of the Dinornis as were discovered in the Middle Island. They were procured from a bed of peaty soil beneath the sands at the ancient embouchure of the Waikouaite River near Otakou, on an occasion when extraordinary low tides followed a strong south-east wind. They were forwarded from Waikouaite to Colonel Wakefield, and sent by him to Professor Owen, but there was not among them any complete skeleton, or any complete head.

Halstead WILLIAM DAVISON

The Earthquake at Manilla: its Theoretical Significance

THE first section of my Outline of a Theory of Earthquakes and Volcanic Eruptions,* which appeared in March 1869, concluded with the words, "At the same time we take advantage of this opportunity to refer to the catastrophe which, according to our theory, must occur on the 30th of September or the 1st of October of this year, and to call the attention of the inhabitants of those countries which are more especially exposed to earthquakes—that is to say, equatorial lands, particularly Peru, the East Indies, &c.—to the danger which threatens them." I wrote these words under the immediate impression of the results derived from my strict investigation of the earthquakes from 1848 to 1868—an investigation which awakened in me the firm conviction that the influence of the moon upon earthquakes is an incontestable fact. As these results were then known to me only, the prediction referred to must have surprised those scientific men who may consider themselves authorities on this subject. There was nothing peculiar in this. But the remarkable circumstance was that, although *before* the 1st of October not a single voice was raised against my theory, after that day (which passed in Peru without an earthquake) there appeared in the *Cologne Gazette* an anonymous article laden with the most vehement abuse of myself. I was able to take it quietly, because I knew I was in the right. For I had nowhere mentioned the localities to be visited by the threatened earthquake so exactly, nowhere defined the limits of it so closely, as the public thought fit to assume. In every passage I made use of the *vague* expression, "*Equatorial countries*," adding, by way of example, Peru, Mexico, Equador, the East Indies, &c.; in fact, at present, my theory does not admit of my explaining myself otherwise. People overlooked, or wished to overlook, the fact that in this case stress was laid upon *the time* and not *the place*. In the same way the earthquake in the Rhine country on the 2nd October, and the devastating outbreak of the volcano Puraie in Columbia on the 4th October,† were passed over with the most marvellous silence. I comforted myself, however, with the hope that later intelligence would afford me satisfaction, and I was not mistaken. Early in November a telegram announced that a "severe earthquake" had caused great destruction in Manilla; still no date was added, and for a few days I was only able to say that I supposed this earthquake took place on the 1st October. (See "Sirius," vol. iii. p. 7.) But the *Bulletin Hebdomadaire*, of the 9th January last, brought the following decisive intelligence of extraordinary importance for the earthquake theory:—"We learn from the *Courier* of the Philippine Islands that an earthquake took place at Manilla on the 1st October last. It was about half-past eleven in the morning when the first shocks were felt. Then followed the most frightful oscillations which lasted forty-five or fifty seconds, or, according to other observers, even over a minute. These oscillations were regular measured cadences, and violent, like the rocking of a ship in a storm. According to the indications of the pendulum, they were first in the direction S.E.—N.W., later N.E.—S.W. Many persons became sea-sick. The terror of the inhabitants during these anxious moments was fearful. They thought of the earthquake in the year 1863," &c., &c.

In accordance with the foregoing is the following information in the *Gazette* of the Eastern Seas—"Manilla, Oct. 2: The earth shook during yesterday's earthquake in the most alarming manner, like a ship in a violent storm; walls and beams cracked; all the walls in the rooms showed splits, and the ground was everywhere covered with chalk and mortar. In the garrison town of Manilla itself, the entire façade of the Augustine

* Three sections have appeared up to the present time.

† The newspapers give the following account of the catastrophe:—"Intelligence has been received of a violent eruption of the volcano Puraie in Columbia, accompanied by terrible devastation and loss of human life. Towards three o'clock on the fourth of October, the mountain began with violent eruption to throw up immense masses of ashes and lava. Two or three villages at its foot are said to have been entirely destroyed, with their inhabitants. The water of the River Canoa rose at Popayan a foot above its usual height, and the rapid current thus occasioned brought down lava and the bodies of men and animals from the devastated localities. At eleven o'clock on the morning of the same day the river was almost dried up."

Church is split, but still standing. In the old palace of the Governor, one part of the building fell in. There is hardly a house that has not been more or less seriously injured. The earthquake is said to have been more violent still in the neighbouring places, Balacan and Cavite, where also a lamentable loss of human life took place. Except the first two shocks, with which the earthquake began, the movement of the earth's surface was horizontal, but the *violence was not less than that in the year* 1863. If *the shocks from below* had recurred, Manilla would in all probability have been to-day but a heap of ruins.—3rd October: Yesterday evening, at six o'clock, we had a second earthquake with horizontal movement, and of rather long duration.—4th October: Yesterday evening, at eight o'clock, another earthquake of short duration. The original news from Balacan and Cavite is confirmed: in the first locality nearly all the stone houses fell in; amongst them the church, the town-hall, the parsonage, &c. — 11th October: The shocks were repeated on the two following days—(on the 4th and 5th) so that we have been visited with earthquakes on five consecutive days. Since then there has been quiet. According to the accounts received to-day from the provinces, the earthquake was felt throughout the whole of the Island of Luzon, that is to say, over an extent of country six times larger than Wales. The earthquake is said to have been most destructive in the southern province of Albay." It is evident from all this that we have here no mere ordinary earthquake, but, in point of fact, an event resembling the earthquake of 1863, as expressly observed in the passages cited.

The question will now occur to every thinking man: Is this exact concurrence of prediction with observation only an accident, or the actual expression of a law of nature? Is the circumstance that the catastrophe happened *two hours and a half after the culmination of the Moon*, which took place on that day *in the zenith of Manilla*, only a playful freak of the subterranean goblins, or is it connected with that theory according to which earthquakes occur, under favourable circumstances, at those places situated immediately over the summit of the tidal wave*? He who answers the question without previously examining into the matter, adopts certainly the most convenient method. But such is not the conduct of a friend of truth. I have derived my answer from the investigation mentioned in the commencement of this communication, and believe that what I have published is a sufficient justification for the prediction I have made; at the same time I consider that I may, in reliance upon their professional feeling, venture to demand from the representatives of science that they pass no judgment on my views, without knowing them in their entirety.

Prague RUDOLF FALB, Editor of "Sirius"

* The point of greatest pressure outwards against the earth's crust—such pressure being caused, according to my theory, by the action of the tide of the semi-fluid central mass of the earth—is situated mathematically under the place in the zenith of which the moon is at the time. Local circumstances unfavourable to the occurrence of earthquakes *can*, and in most cases, *will*, modify the observed result, so as to cause it to vary more or less from the mathematical calculation.

Right-Handedness

IF asked what part of the human body seems chiefly affected by advancing civilisation, I would be inclined to reply that it is the right hand.

At first sight the four-handed mammals might be thought to have an advantage; but because four hands are employed both for prehension and locomotion, while in man there is one pair of organs for each, man's two hands are worth more than the ape's four. As man rises from the rudest stages—such as digging roots, hunting, and tending cattle, to arts which are highly mechanical—the right hand becomes a more special and serviceable organ than the left, so that the loss of it to an engraver, a clerk, or an artist, compared to the loss of the left, would be a much more serious affair than it would be to a drover, who could clutch his stick or gesticulate to his dog almost as well with the one hand as the other. Admitting that, physiologically, there is a slight reason for the preference of the right hand, all our tools and fashions lend themselves to encourage its further dexterity. Screws, gimblets, &c., are made to suit the supinating motion of the right hand. Tools of the scissor kind are also made for the right hand, and I have seen a print-cutter's gauge made specially for a left-handed person fetch a very low price when it came to be sold. The slant in writing, the shed of the hair in boys, the manner in which buttons and hooks are placed on clothes, and the system of writing from left to right, all seem related to right-handedness.

In drawing, the pupil is recommended to begin at the uppermost corner on the left hand side, where the ornament is of a small and repeating character, so as to avoid fingering the part already finished. A schoolmaster I knew was able to detect left-handed boys, when they used the pen with the left against orders, by the writing either being straight or sloped the wrong way. Most boys know that it is easier to draw a profile with the face looking towards the left hand; yet on looking over the hieroglyphs in the British Museum the faces will be generally found towards the right. The normal way of writing the hieroglyphs is from right to left, though frequent instances occur of their being written from left to right.

I believe there is a constitutional reason for the preference given to the right hand, but I also believe that habit has strengthened nature's tendency, and that as the touch of the hereditary Hindoo weaver has become proverbially fine, so the aptitude of the right hand over the left is greater, with advancing civilisation, than in a state utterly savage. At that period of a child's life when creeping seems a more natural mode of progression than walking, there is no apparent dexterity in the right hand more than the left, and when man was almost utterly without arts, I can believe his state to have been ambidexter or ambisinister.

The elephant is known to employ one tusk more than another in rooting, &c., and when I asked Sir Samuel Baker which tusk went by the name of the "servant," he informed me that it was the right tusk generally, but the exceptions to the rule were far more numerous than was the phenomenon of left-handedness with human beings.

We have no reliable statistics of the proportion of left-handed persons to right in ancient or in savage nations. If Judges xx. 15, 16, is to have any weight in the matter, the proportion of left-handed in the tribe of Benjamin seems to have been greater than at the present day.

Left-handedness is very mysterious; it seems quite against physiological deductions and the whole tendency of arts and fashion. Prof. Buchanan, of Glasgow, who wrote an able memoir on right-handedness in 1862, thinks that left-handedness may be due to transposition of the viscera, and tells me that his friend Dr. Aitken found such a case. But surely transposition of the viscera must be far rarer than obstinate left-handedness. In cases of left-handed persons which I have examined, the limbs of the left side were proportionally larger, just as those of the right side are in normal cases. I have also found that left-handedness is hereditary. J. S.

The Balance of Nature

PREVIOUSLY to the recent wonderful Spectrum discoveries the sun's energy attracted more attention from *savans*, and many apparently extravagant theories were offered in explanation of this most wonderful of all physical phenomena; it is probable that the few remarks I have to make may appear equally extravagant.

As my intention is to allude more especially to the maintenance of the sun's energy, I will only make a passing observation as to its origin. The two conditions in which we find matter in the solar system are that of orbital motion and central repose; in the latter condition matter exhibits its energy in the form of light and heat; whilst in the former the light and heat are transformed into motion. If the earth was suddenly brought to a condition of rest, its energy, hitherto under the form of motion, would be exhibited as light and heat, and it would in a certain degree be converted into a sun.

If it could be shown that the sun was surrounded by an absolute non-conductor of its forces, it evidently would retain its energy for ever. As there would be no exhaustion, the sensations of light and heat would no longer exist. Now we reasonably believe that all space is filled with a highly elastic fluid or ether—this ether in a state of constant and intense action giving rise to the phenomena of solar light and heat. But if no obstacle existed to check or interfere with this action of the ether, it would, like any other body moving in space, retain its action for ever, without the necessity of a continuously acting agency or cause. If this can be granted, then it follows that the energy of the sun—which may have been necessary in the beginning to give this action to the ether—is no longer exhausted when the ether is once in motion. Hence this active ether is really an absolute preserver or non-conductor of the solar power or force, exhibiting itself as light, heat, &c.

But certain obstacles do exist to check the action of the ether. These are the various bodies which move in space and revolve round the sun, one of which is the earth we inhabit. But the resistance which the earth offers to the motion of the ether is the cause which converts this motion into that which gives the sensation of light, heat, &c., just in the same way that other matter in motion is transformed by resistance into heat and light. A more simple illustration of what I mean would be given by supposing a current of sea-water to give out a phosphorescent light only when an obstacle to its motion is introduced, such as a stone or stick, or when the waves of the ocean give out light by dashing upon a rock or the sea-shore.

From this line of argument it will be concluded that the only causes which exhaust the sun's energy are the several planetary and other bodies, moving in space, upon which the waves of ether dash, thus transforming their energy into the sensational forces of light, heat, &c.; but the area of these resisting bodies is exceedingly small in comparison with the rest of space, in which the ether is acting by its own energy, and without coming in contact with any resisting or exhausting obstacle.

It remains, then, to account only for the amount of the sun's energy which is absorbed or transformed by these planetary and other bodies. Although we may have thus reduced the solution of this mighty problem to a narrower space, yet it is just as difficult to account for the maintenance of the exhausted energy occasioned by a single grain of sand moving in space as by all the planetary and other bodies together.

Seeing that constant exhaustion or transfer of the sun's energy does take place, although in a much less degree than would be the case if it were not confined to the moving bodies in space alone, it remains then to account for its maintenance. The first question we should ask ourselves is this: Is there any evident or known force tending towards the sun as a centre? The immediate reply will be gravitation; and although in the present state of scientific knowledge it may be difficult or impossible to define what gravitation is, yet there cannot be a doubt that it is a force acting on all matter, with a tendency to carry all material bodies direct to the sun. As such force dashes into or upon the sun, it becomes in its turn transformed into light, heat, &c. It is indeed not improbable that future discovery may teach us that gravitation may have its origin from and bear some certain proportion to the resistance presented by the several bodies in space, which are illuminated by the sun's energy; thus establishing the beautiful law of light and heat being transformed into the force of gravitation—gravitation again into light and heat; thus sustaining and maintaining, for all time, the sublime fountain of motion and life, thought, and every sensation and action that organic matter is able to experience. W. L.

Sir W. Thomson and Geological Time

THE strongest statement about the retardation of the earth's motion of rotation by tidal friction, supposing the earth had been for so long a time provided with an ocean, is to be found in the appendix to a sermon preached by Professor Pritchard, F.R.S., then president of the Royal Astronomical Society, before the British Association at Nottingham. He there, in combating Darwin, says, "One million of million years ago, if the solid earth could then have been provided with an ocean, the length of the day would probably have been less than the flash of the hundredth of a second of time!"

I announced to the Literary and Scientific Society of Nottingham that this was an error in calculation, and based on a fallacy in reasoning; and Mr. Pritchard withdrew the result, while maintaining the method, in a letter read to the meeting after a lecture on the subject that I subsequently gave. But I am informed that it has since been republished in its old shape.

There is a still more amazing statement put forward in this appendix by the champion of Anti-Darwinism. Mr. Pritchard says he is familiar with the optical structure of the human eye. He dwells on the wonderful mechanism, and hints at the wonderful chemistry of it; and quotes the well-known passage from Darwin (Ed. 1. p. 188) in which, while he gives up all attempt at showing gradation in the structure of the eye of Vertebrata, recent and fossil, yet he shows that in the Articulata the series is more complete. He quotes this, I say, to show that Darwin undertakes to explain by natural selection the structure of the *human* eye, which is precisely what he declines to do. "Let us attend," he says, "to the process of natural selection by which this marvellous organ is said to have come into being." '"I can see," says Mr. Darwin, "no very great difficulty . . . in believing that natural selection has converted the simple apparatus of an optic nerve into an optical instrument as perfect as is possessed by any member of the great Articulate class," i.e. *as perfect as the human eye.*' Is not this amazing?

Rugby, March 22 J. M. WILSON

The Moon's Diameter

WILL you permit me to say a few words on the interesting question raised by Dr. Ingleby in your last? The sun, moon, and all the heavenly bodies appear set, as it were, in the blue sky when the weather is clear; and as they are rarely visible unless when surrounded by at least a small space of blue sky, it seems to me that they will be naturally judged to be at the same distance from us that the sky is. But what is this distance? What, in other words, is the mean distance from which the blue light diffused or reflected from the air or vapour comes to us? Prof. Tyndall, who has devoted much attention to the causes of this blue appearance, may perhaps be able to tell us. The problem, of course, is rather an indefinite one, but an approximate solution might assist us in determining the question.

As to the heavenly bodies appearing larger when nearer the horizon, I shall leave some one else to settle the angular magnitudes in the case. Mr. Abbott, to whom Dr. Ingleby refers, proves that the fact is not confined to the heavenly bodies, but that portions of the sky seen under the same angle appear at least three times as large when near the horizon as when near the zenith ("Sight and Touch," pp. 136-7). But then, does the blue light come to us from the same mean distance when we look towards the zenith and when we look towards the horizon? or does it come from a much greater distance in the latter case, and thus apparently increase the magnitude of a portion of it whose size remains unchanged? In other words, is the sky seen as a hemisphere, or as a much smaller segment of a spherical surface (the observer being at the centre, not of a sphere, but of a small circle, the plane of which coincides with the horizon)? Most persons who look at a clear sky will, I think, adopt the latter alternative. It will be interesting to know if scientific research bears out natural impression in the case.

Other solutions of the difficulty might undoubtedly be proposed. Association of ideas, which is now the favourite device for helping a lame dog over a style, might be called to the rescue, and with some plausibility. Clouds and birds—everything, in fact, that passes above us—are nearest to us and look largest when most elevated. Elevation is thus associated with comparative nearness, and approach to the horizon with comparative distance. It is, however, simpler, if correct, to maintain that we see the sky as it really is, and that the apparent distances and magnitudes of the heavenly bodies are determined by the fact that they appear to be set in the sky, not placed at a great distance beyond it. W. H. STANLEY MONCK

Trin. Coll. Dublin, April 2

Heat Units

THE science of heat, which is capable of being made and is rapidly becoming one of the most exact of the experimental sciences, seems to labour unnecessarily under an excessive variety of units of measurement. At present there are used—

Units of Mass.	Thermometric Degrees.
Grain,	
Pound,	Centigrade,
Gramme,	Fahrenheit.
Kilogramme.	

Whence, evidently, there result *eight* different thermal units, to all of which the common name "unit of heat" is applied, or, at least, names inadequately distinctive. In the face of this it would really seem that some such suggestion as I here proceed to make must eventually be adopted.

Define, first, as follows:—A *therm* is the quantity of heat necessary to raise the temperature of 1 gramme of water from 0° C to 1° C. Secondly, 1 kilotherm = 10 hectotherms = 1000 therms = ... , thus having kilotherm, hectotherm, &c. suggestively corresponding to kilogramme, hectogramme, &c., in name as well as in nature.

Therms and kilotherms, which would probably alone be required in practice, would thus take the place of "thermal units, centigrade," "gramme-water-units," "kilogramme-units of heat," and others more or less lengthy and inexact at present to be found in writings on Heat and Energy.

College Hall, St. Andrew's, April 4. THOMAS MUIR

The Solar Prominences

It may interest some of your readers to hear that the bright lines of the hydrogen "flames" extending beyond the sun's disc can be seen with much less instrumental aid than has hitherto been considered indispensable. I have succeeded in seeing them quite unmistakably by the following very simple means. I fixed one of Mr. Browning's direct vision spectroscopes (having seven prisms) on a board which also carried a two-inch object-glass belonging to a good field telescope. I mounted the instrument thus arranged (shall I say as an altazimuth) on the back of an ordinary bed-room mirror, and directed it at the sun. The slit was set so as nicely to divide the D line, and a blue glass was generally interposed in front of the slit to sift the light. As the image of the sun traversed the slit at intervals, the flames appeared as bright prolongations of the F line extending beyond the sun's limb. It was also clearly seen at times that these prolongations were narrower than the F line and were not in the centre of it, also that they were frequently detached from the sun's limb, and sometimes they were not straight: appearances depending as is generally supposed on the velocity and pressure of the gas in the flame. The flames were also readily seen in the C line. In observing the solar spectrum I have found coloured glasses in front of the slit very useful to shut out as much as possible of the light from the parts of the spectrum not under observation. By using the spectroscope without its slit and collimating lens, and directing it towards the great nebula in Orion, it shows close together three bright images of the nebula exhibited on a continuous spectrum.

Streatham Hill, April 8. ERNEST CARPMAEL

Modern Geometry and the University of London

The letter entitled "Euclid as a Text-book," which appeared in last week's NATURE, seems to me to call for immediate reply. Many students about to present themselves for examination at the University of London and other places during the next year have been told by their tutors that a thorough and accurate knowledge of geometry would be better appreciated than the power to make verbal transcriptions of Euclid; and the letter referred to is calculated to shake the confidence of such students in the method they have been advised to pursue, and to produce a feeling of uncertainty as to the way in which demonstrations differing from Euclid's will be received by the examiners. But I think that an inspection of the calendars will re-assure them, and show that they have no cause to fear the result of examination, especially when the University of London is the examining body.

The papers consist of certain propositions common to Euclid and modern text-books, and a number of problems readily solved by a student of modern geometry, but almost impossible to one who has simply committed to memory Euclid's text. My own strong conviction is, that the latter would find some difficulty in passing the recent examinations. The questions given fall strictly within the University programme, and treat of important properties of geometrical figures which no student possessing a knowledge of approved modern methods could possibly be ignorant of. The "alternative" or modern side has been carefully kept in view and placed on a footing of equality with the ancient system.

During the year 1869 eight of my pupils who had *not* read Euclid were candidates for matriculation; all passed, and none were placed lower than the first class; so that I cannot see the advisability of boys returning to Euclid "in order that their prospect of good places may be enhanced."

Mr. Tucker apparently desires a series of questions which could only be answered on modern principles. This would amount to a system of protection, and could not fail to be objectionable.

The student of the New Geometry has, in fact, a great advantage. To the learner of Euclid a fact clothed in terms slightly varying from Euclid's is often new and startling, but to the modern student who learns every proposition in its most general form, and assimilates the idea apart from the external or verbal form in which it may accidentally be presented, it is already familiar and trite. The statement that a change in the London syllabus has been or will be made "as a sop to Cerberus," will strike many as singularly infelicitous and ungenerous. The Senate of the University does not say one thing and mean another; it has always shown unflinching courage in the reform of English methods of education, legislating as an initiator rather than as a follower. The tendency of the University throughout its existence has been to discourage cramming in every shape and form, in the teeth of numerous difficulties and influences to which the term "obstructive" rightly applies rather than to the University itself. It is to be regretted that a letter dating from University College School should show so little confidence in the intrinsic superiority of modern methods, and still more that it should impeach the integrity of men who have not so deserved.

Brixton, March 28 RICHARD WORMELL

DEATH OF PROFESSOR MAGNUS

On the 4th of April, 1870, at a quarter-past 10 p.m., died peacefully, after a long illness, Dr. Gustav Magnus, Professor of Physics, and Director of the Physical Cabinet in the University of Berlin. He was an experimental philosopher of great and varied excellence, executing his work with the choicest apparatus and with the most conscientious care. His numerous labours are known to all students of physics, and they are such as to secure for him an enduring fame. On the 28th of April, 1851, I first saw Professor Magnus on his own doorstep in Berlin. His aspect won my immediate regard, which was strengthened to affection by our subsequent intercourse. He gave me a working place in his laboratory, and it was there I carried out the investigation on Diamagnetism and Magne-crystallic Action, which is published in the *Philosophical Magazine* for Sept. 1851. In 1853 I was again in Berlin, and found under his roof the same ready help and sympathy. Professor Hirst and myself paid him a visit last summer; and he afterwards attended the Exeter Meeting of the British Association, where his frank, genial, and gentlemanly demeanour were conspicuous to all. Over and above his direct contributions to Science, Prof. Magnus exercised a powerful indirect influence, through the kindly aid and countenance which he lent to young inquirers. When I bade him good-bye in 1851 his last words to me were, "If you should meet any really able young fellow, willing to work, and to whom such assistance as I can render would be valuable, send him to me." There are many such, now no longer young, who, like myself, will mingle a grateful memory of his goodness with their grief for his loss.

Royal Institution, 11th April JOHN TYNDALL

THE SOURCES OF THE NILE *

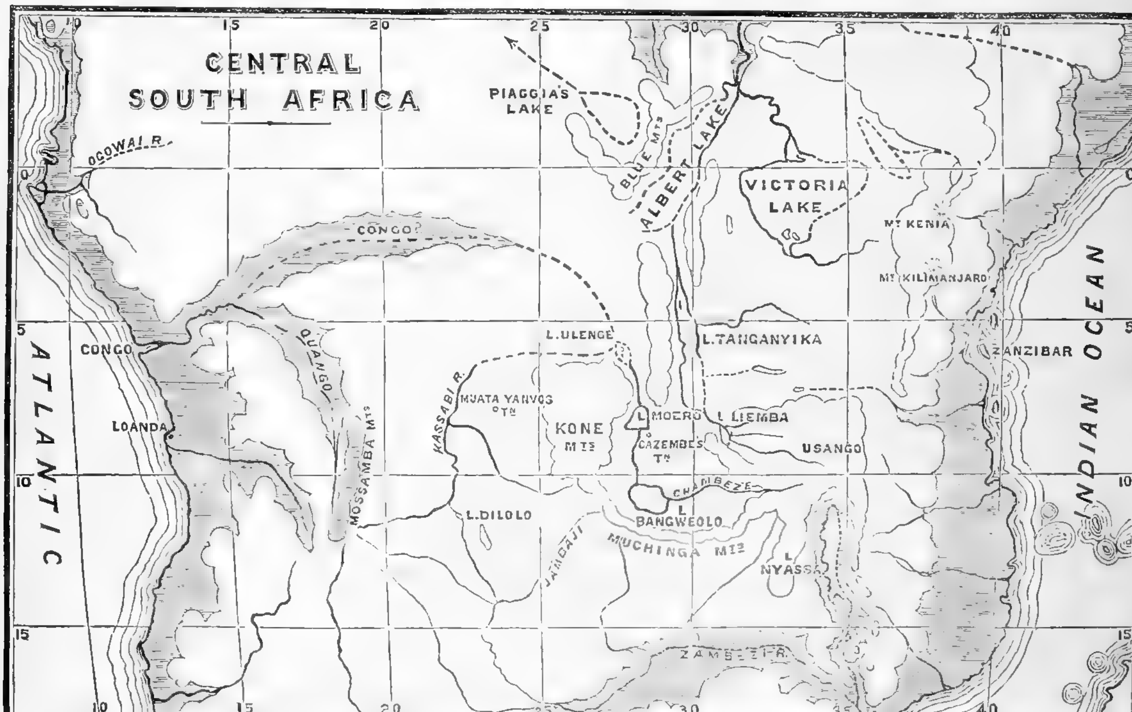
The main point of interest in the latest travels of Livingstone, and that which gives to them a distinctive importance over the great accomplishments of his former journeys, is, that in these, Livingstone has undoubtedly visited and beheld the long-sought-for sources of the Nile. It is true that there still remains considerable doubt as to which of the basins that he has explored will ultimately be acknowledged as the cradle of the Nile, but this at least is certain, that the real head streams have been seen by him, and the vexed question has by these explorations resolved itself into a choice between two or perhaps three streams. Livingstone himself has apparently no bias in favour of one or other, so that the discussion is a perfectly open one. The three rival head streams are, first, the feeders of Lake Liemba, and second the Chambeze River and its lake chain, both of which rise near the eastern edge of the great longitudinal plateau of the side of Africa next the Indian Ocean; the third is the source recently claimed for the Nile by

* An abstract of part of a paper read before the Royal Society of Edinburgh, March 21st.

Dr. Beke, in his solution of the Nile Problem, the great* Casai, or Kassabi River, which rises nearer the Atlantic side of the continent.

Of the first of these presumptive sources, the feeders of Lake Liemba, it may be said with almost absolute certainty that they are tributaries of the Nile, and it seems most probable that they are the sources of that river. Livingstone has found these "four considerable streams" flowing into Lake Liemba; a river-like prolongation unites Liemba and Tanganyika, these two lakes appearing thus to be at the same level; then Tanganyika and Nyige Chowambe, which is evidently the Albert N'yanza, are "one water," and that this last is a reservoir of the Nile is undoubted.

The union of the second possible head stream, the Chambeze, with the Nile, is less apparent; indeed the balance of evidence seems to show that it must be the head of another great river of Africa, the Congo or Zaire. If the Chambeze prove to join the Nile, then the streams to Lake Liemba become mere tributaries, since the course of the Chambeze is by far the longer of the two. The Chambeze flows down into the central valley through lake Bangweolo, and then northward through Lake Moero. Livingstone describes Lake Moero as beginning twelve miles below the position of the town of Lunda, the capital of the Cazembe (lat. 8° 40′ S., long. 28° 20′ E.), whose position may be laid down with tolerable accuracy from the former journeys of the Portuguese travellers. Since Livingstone proceeded north from Cazembe's town along the eastern shore of the Moero in his attempt to reach Ujiji in 1867, the great bulk of this lake must lie to westward of the meridian of Lunda, or about 120 miles west of Tanganyika. Dr. Livingstone has seen the river at its outflow from the lake, and also at the point where it emerged from the crack in the mountains of Rua, when, according to his own observation, the river turned north-north-west to form Ulenge, a third lake or marsh in the country west of Tanganyika. This north-westerly turn would carry the river quite out of the direction of the Nile basin, and the higher side of the continent being to the east, the probability is that the river would continue to curve to the westward. If, however, the Albert Lake prove to have a great south-westerly extension, this one difficulty is overcome. Again, the valley of the Chambeze in the plateau where Livingstone crossed it, is no doubt one of the greatest hollows in the highland, so that the height of the river bed here may be taken at 3,000 feet, the lowest level of the limits which Livingstone gives to the undulation of the plateau, or only 200 feet above Tanganyika. Descending into the "great valley"* to Lake Bangweolo from the plateau, the Chambeze must have a considerable fall, from Bangweolo to Moero there must be a second descent. The Cazembe's country, which extends round to the south of Tanganyika, is described as flat, and its rivers are currentless and stagnant. If Moero were at a higher level than Tanganyika, would not the river which leaves it take a course over this flat country instead of facing towards and making its way through a "crack in the mountains northward?" Seeing that the river does force its way through the mountains of Rua (which appear to be a continuation of the "ranges of tree-covered mountains" which "flank Lake Moero on both sides") the presumption is that Moero is at a lower level than Tanganyika; and if this be the case, the river which descends from it through the mountains cannot ascend to the level of any one of the Nile lakes to join them, but must find some other course. With regard to the third advocated source, the Kassabi River, of which Dr. Beke affirms it to be his belief that it is the head stream of the Nile of Egypt, the difficulties of its joining the Nile appear to be even greater than the last. The upper course only of this river has been explored.



MAP OF EQUATORIAL AFRICA WITH CONTOUR LINES

* *Athenæum* of February 5th, 1870.

* It has been objected that Lake Bangweolo does not lie in a valley, but on the plateau; but Livingstone's letters could scarcely be clearer on this point, since he speaks of "the great valley enclosed between Usango (the eastern plateau) and the Kone range."]

It springs in the Mossamba Mountains, which are on the inner borders of Angola and Benguela, its sources being close to those of the Quango River, a tributary of the Congo. The Kassabi is known to flow northward as far as the 8th parallel of latitude, and to the westward of the capital of the Muata Yanvo, the great negro potentate of Central South Africa. Livingstone crossed its head on his journey from the Zambesi to Loanda, and reports which he collected from the subjects of the Yanvo's kingdom all tend to prove that whatever direction its middle course may take, in its lower course the Kassabi flows round to westward, and is joined by the Quango. The trader Graça, who penetrated to the Muata Yanvo's capital in 1846, says that the territory of this chief is "shut in" by the great rivers Kassabi and Lurua (a tributary of the Kassabi), and he affirms that the Kassabi has an easterly direction beyond this.

The Hungarian traveller, Ladislaus Magyar, has penetrated furthest of the three Europeans who have visited this region, and his report agrees well with this last. He states that the Kassabi, after forming the waterfall of Muewe (in about 11° S.) bends gently to northward, but further on takes an easterly direction in its lower course, and attains a great breadth at the place where it "*touches upon*" the extensive lake Mouva, or Uhanja.* Now if we turn the Kassabi River eastward in latitude 8° south, in agreement with the above description, we find that it meets the position which Dr. Livingstone's letters give to Ulenge, the lake or marsh to which the Chambeze ultimately flows, and whose waters Livingstone tells us by report are "*taken up*" by the Lufira, a "large river which by many confluents drains the western side of the great valley." Is not the Lufira, then, the lower course of the Kassabi River, and Lake Ulenge of Livingstone, the Uhanja of Magyar? If this be the case, the same difficulties which appear in the way of the Chambeze River joining the Nile, hold also against the Kassabi, which would seem to join this river at Lake Ulenge.

Next, the question arises, If these rivers do not form a part of the Nile system, where shall we find an outlet for them? The answer to this is plainly, in the Congo River.

The Congo was described by the Jesuit missionaries who first visited its mouth as "so violent and so powerful from the quantity of its waters and the rapidity of its current, that it enters the sea on the west side of Africa, forcing a broad and free passage (in spite of the ocean) with so much violence that for the space of twenty leagues it preserves its fresh waters unbroken by the briny billows which encompass it on each side." In the introduction to his narrative of the British expedition to the Congo River in 1816, Tuckey says: "If the calculation be true that the Congo at its lowest state discharges into the sea two millions of cubic feet of water in a second, the Nile, the Indus, and the Ganges are but rivulets compared with it, as the Ganges, which is the largest of the three, discharges only about one-fifth of that quantity at its highest flood." This statement may be somewhat exaggerated, but Tuckey actually found that this vast river has a width of two, three, or even four miles, whilst flowing with a current of two or three miles an hour,† and this not at its mouth, but inland beyond the mountainous coast region. The northward wall-like continuation of the Mossamba mountains, on the 20th meridian, to beyond the equator, which Dr. Beke supposes to exist,‡ would not admit of a longer course than about 500 miles for the Congo, and a basin of that extent is utterly inadequate to collect and maintain such a body of water as that which this river is known to have, in a region where the annual rainfall averages only 12 to 15 inches (Livingstone's observation at Loanda). Such a vast river cannot be formed in a short course, but must have its rise far in the interior of the continent; and if the Kassabi River and its drainage be taken to the Nile, where shall we find a sufficiently lengthened course for the Congo?

Tuckey's unelaborated notes give the opinion that the "extraordinarily quiet rise * of the river (Congo) shows it to issue from some lake which had received almost the whole of its waters from the north of the line;" and again he says, "I cannot help thinking that the Congo will be found to issue from some large lake or chain of lakes considerably to northward of the equator." The reason of Tuckey's supposition that the lakes, which are evidently necessary to maintain the volume of water in the Congo throughout the year, would be found north of the equator, is, that he found the rising of the river beginning on the first days of September. At the time of his journey little or nothing was known of the times of the rainy seasons in Central Africa from actual experience. The observations of travellers in the continent since that time have greatly increased our knowledge of these seasons, and show them to be regulated by the apparent movement of the sun between the tropics. An area of low atmospheric pressure, with its attendant inflowing winds and rains, is constantly moving up and down the part of Africa which lies between the tropics, following the vertical sun. If every part of Africa were level and equally surrounded by water, it would result from this movement of the area of low pressure, that a rainy season would begin at each point shortly after its latitude had passed vertically beneath the sun, and a double rainy season would thus be produced: a *greater* when the low pressure area is moving equatorward in each hemisphere drawing in the sea winds; and a *lesser* when that area is passing north or south outward from the equator towards the extremities of the continent, inducing rather the land winds, whose moisture is already in great part spent. This rule holds good on the low coast lands, where other exterior influences do not disturb the arrangement, but over the high plateau of the interior of South Africa, † the commencement of the rains seems rather to precede than to follow the vertical sun, and in the equatorial regions two of the rainy seasons are prolonged into one, which lasts for eight months of the year. Under the equator at the mouth of the Ogowai River, on the west coast, Du Chaillu found the rainy season beginning in October; farther inland, in the Fan country, the rains set in in September, and in the same latitude, between Victoria Lake and Tanganyika, Burton tells us that the rainy season begins in August. Between 5° and 10° south latitude Livingstone's observation shows that on the west coast at St. Paul de Loanda the lesser rains begin in November, but in the same latitude in the centre of the continent Burton reports the rains of the Tanganyika basin beginning in September, or two months earlier; and Livingstone in his latest journey could not proceed to Lake Bangweolo from the Cazembe's town, where he arrived about the middle of September, because the rains had set in. Lake Ulenge lies between these latitudes, or in about 5° south, so that the rise of the waters of the Congo River, if its upper course be through this lake, is perfectly explicable, without the necessity of taking its reservoir lakes to the north of the equator. The lower course of the Congo is probably in a curve to north-westward from Ulenge, afterward turning south-west to meet the farthest point which Tuckey reached, where it was flowing from north-east. The rains would begin to fill Lake Ulenge, as well as the part of its lower course below this which is in the centre of the continent, in

* Magyar's journey in Petermann's Mittheilungen, 1860.
† P. 342 of the Narrative.
‡ Map to accompany a paper on Dr. Livingstone's discoveries in "Illustrated Travels," Part xv.

* The maximum rise of the Congo was observed to be only 11 feet, generally 8 or 9, or less than that of perhaps any river of equal magnitude. That of the Zambezi (above the confluence of the Shiré), a lakeless basin, has been found by Livingstone to be as much as 80 feet perpendicularly; and at Khartoum the White Nile rises nearly 18 feet.
† As also in the Abyssinian highland.

August; lower down still the rains apparently begin in September, but, as before noticed, towards the coast they are later, and so do not begin at the mouth of the river till well on in September, after the river has begun to rise. The dry season in the country west of Ulenge also agrees well with the movements of the Congo river, for Dr. Livingstone remarks that the floods in the country between Moero and Ulenge last till May or June, and the lowest state of the Congo was observed to occur in July and August.

With the Kassabi and Chambeze for its head streams, the Congo has a sufficient, though not too great area of drainage to collect the vast quantity of water which it returns to the ocean. On this supposition the area of its basin measures about 800,000 square miles, and that of the Nile nearly 1,300,000 square miles; so that the great African rivers stand in order thus:—Nile, Congo, Niger, and Zambezi. KEITH JOHNSTON, JUN.

NOTES

WE are informed that the Duke of Devonshire will probably be the President of the Royal Commission to inquire into the Present State of Science in this country.

THERE is so little evidence of scientific training or thought in most things which are done in high places, that it is almost pleasant to be taxed even by a Chancellor of the Exchequer who attempts to do it on scientific principles, or at all events quotes scientific authority as Mr. Lowe does, who, referring to the results of the recent Deep-Sea Dredging Expedition in his Budget speech, compared the British taxpayer to the frail animals which enjoy life at the bottom of the Atlantic at a pressure of three tons to the square inch. We strongly advise Mr. Lowe to sanction another dredging expedition during the present autumn, not that it may be shown how much more vitality there is at a reduced pressure—a vitality more approaching that of "My Lords"—but that even greater pressures may be found and quoted as precedents should the next Budget prove a less satisfactory one. There is a point in the Budget, moreover, of the greatest importance to men of science. The postage on printed matter not exceeding 2 oz., and on newspapers not exceeding 6 oz., is to be reduced to one halfpenny. We have waited a long time for this change: not too long, however, to welcome it warmly now it has come, for the tax on all authors of the postage of scientific papers, copies of which they wish to distribute, has been very great.

THE following are the lecture arrangements at the Royal Institution after Easter:—Four lectures by Prof. Blackie on the Principles of Moral and Political Philosophy, on Tuesdays, April 26th to May 17th. Seven lectures by Prof. Tyndall (subject not announced), on Thursdays, April 28th to June 9th. Seven lectures by Prof. Robert Grant, on Comets, on Saturdays, April 30th to June 11th. Three lectures by Prof. Seeley on History, on Tuesdays, May 24th to June 7th. The *probable* arrangements for the Friday evening meetings are as follows, viz.: April 29th, Prof. Blackie—The Interpretation of Popular Myths. May 6th, Mr. R. A. Proctor—Star Grouping, Star Drifts, Star Mist. May 13th, Rev. Canon Moseley—The cause of the Descent of Glaciers. May 20th, Prof. Williamson—On Atoms. May 27th, Principal Dawson—The Primitive Vegetation of the Earth. June 3rd, Prof. Max Müller—The Migration of Fables. June 10th, Prof Odling (subject not fixed).

THE *Pall Mall Gazette*, which gives so much space to all matters of scientific or general interest, quoting from the St. John's (New Brunswick) *Telegraph* of the 18th of March, describes an extraordinary phenomenon which took place in the harbour of that city on the previous day. Early in the morning, just before the commencement of a snowstorm, while the wind was rising so as to be heard within doors, a strange noise, similar to that accompanying the earthquake on the 22nd of October last, was heard by the residents near the harbour. It was then seen that the old ferry, which should be several feet above water, had vanished. A piece about twenty feet by seventy broke off and settled squarely down into the water. A frontage several hundred feet in extent, running from the line of the demolished wharf towards the breakwater, had also gone down, leaving a steep embankment. The soundings since made show that where the old ballast or reefer was the day before, rising above the water eight feet, were found six fathoms of water, the bottom had settled just thirty-two feet. Near where the portion of the wharf settled away, or where a moderately sized vessel used to ground at low water, there is now between six and seven fathoms at low tide. One of Messrs. Adams's buoys, moored about four or five hundred feet from the shore, had disappeared; and last evening, when the tide was at its lowest level, the current was just showing a ripple over the top of it. As the tides rise and fall about thirty feet in St. John's harbour, and the chain of this buoy had several fathoms of scope, it may be inferred that the bottom sank as much as nine or ten fathoms at this point. So far as could be ascertained, the *Telegraph* states this subsidence took place over an area of about three acres in extent.

MR. ARCHIBALD GEIKIE, F.R.S., the director of the Geological Survey of Scotland, is now at the Lipari Islands, his object being to study the volcanic phenomena of those Islands, and of some adjacent parts of Italy. He anticipates that the numerous coast sections of these islands will furnish evidence from which light may be thrown on the history of the volcanic rocks of the British Islands; the manner in which different volcanic rocks yield to the forces of denudation, subaerial and marine, is also a matter of importance that will be carefully studied.

ON Monday evening a distribution of prizes (certificates of merit) took place at the South London Working Men's College, Professor Huxley being in the chair. Previous to the distribution a lecture on the "Biography of a Plant" was given by Mr. Harland Coultas. Professor Huxley, in the course of his remarks, said that they had presented to them an analogy between vegetable and human life, and that analogy he would carry a little further, by reminding them that there was nothing more poisonous or dangerous than an uncultivated mind. He hoped that these educational establishments would do for society what the plant does for the air; namely, absorb all the poison of ignorance, and, by a similar change to that exercised in the chemical action of the plant, give off those benefits which education alone could diffuse.

IT is not often that the daily newspaper press invades a college in search of an editor, and still less often is a learned scientific professor the elect one. We have a case in point, however, of such a condition of things. Professor Jack, M.A., who has for several years held the chair of Natural Philosophy in Owens College, Manchester, has been requested, and has consented, to take the editorial management of one of the oldest and most successful papers north of the Tweed, the *Glasgow Daily Herald*, a paper which frequently discusses scientific subjects with a fulness of knowledge. Mr. Jack has not hitherto been in the toils of daily newspaper life, but he ought to have no mean qualifications for his new vocation, considering the literary and scientific culture and worldly experience which he has acquired as an alumnus of Glasgow College and of St. Peter's College, Oxford; as one of Her Majesty's Inspectors of Schools in the West of Scotland, and as a scientific professor in Cottonopolis.

THE wave of low temperature which passed over the South of England during the latter half of March, was a very remarkable one. From the 22nd of March till the 6th of April the thermometer fell below the freezing point every night, with scarcely any intermission. For the week ending April 2nd the mean temperature at Blackheath was 37·2°, or about 8° below the average of the corresponding week in the last fifty years. From the reports for sixteen different stations in England, eight in Scotland, and one in Ireland, forwarded every week by Mr. Glaisher to the *Gardener's Chronicle*, it appears that the temperature was much lower in the South than in the North of England, or in Scotland. The lowest averages are given at Portsmouth and London (Blackheath); the highest for England at Liverpool, Salford, and Newcastle; while these latter are several degrees lower than the lowest mean in Scotland. The average temperature for that week in London was 7° lower than in Edinburgh, and 11° lower than in Dublin.

MR. SYMONS'S "British Rainfall for 1869" contains an enormous mass of information respecting the distribution of the rainfall throughout the kingdom during last year, with other meteorological statistics. The extremes of rainfall during the year at the places of observation in England were 198·19 in. at the Stye, in Cumberland, and 20·09 in. at North Sunderland, while many places in the south-east of Scotland enjoy even a dryer climate, the fall at East Linton, Haddington, being only 15·77 in. So much injury is done to science by the publication of statistics based on incorrect data, that Mr. Symons's "Rules for Rainfall Observers" should be in the hands of everyone who possesses a rain-gauge.

M. BOURLOT, Professor of Mathematics in the Lyceum at Colmar, believes he has established the fact, contrary to the opinion of Arago, that during the Middle Ages the climate of Alsace was milder than at present. He traces a relation of chronological coincidence, if not of cause and effect, between the change of climate and the precession of the equinoxes.

THE honour of knighthood has been conferred on Mr. Ronalds for his early researches in telegraphy.

THE execution of the Faraday memorial has been committed to the well-known sculptor, Mr. Foley.

PROF. TYNDALL'S most recent contribution to the "germ-theory" is contained in a letter to the *Times* of the 7th instant. He has observed that the air breathed out of the lungs, especially at the close of a long voluntary exhalation, is "visibly pure," or produces, when passed across a strong beam of light, the familiar black smoke-like clouds caused by the entire absence of organic matter. He confirms the explanation given by many medical men, and especially by Prof. J. Lister, of Edinburgh, for the exclusion of air from fresh wounds, that the putrefaction of wounds is caused by the germination of the germs of organic life contained, under ordinary circumstances, in large numbers in the air. In a reply to this letter in the *Times* of yesterday, Dr. H. C. Bastian makes the startling assertion that, in conjunction with Dr. Frankland, he has met with living organisms in hermetically-sealed vessels, from which all air had been removed, and after the contained fluids had been raised to a very high temperature. Some solutions containing organic matter and other ingredients were prepared in the following manner:—After a perfect vacuum, above the level of the fluid, had been procured in the glass vessels by means of Sprengel's air-pump, the drawn-out necks of the flasks were closed by means of the blow-pipe flame. The airless flasks, containing then the fluid itself as the only possible germ-containing material, were submitted, in a suitable apparatus, by Professor Frankland, to a temperature varying from 148° C. to 152° C. for four hours, and yet, after having been placed under the influence of suitable conditions, in the course of a few weeks, living organisms—many of them altogether new and strange—were found in these fluids. These extremely important results are about to be communicated to the Royal Society.

THE *Soirée* of the Royal Microscopical Society to be held at King's College on the 20th inst., seems likely to be supplied with a large number of objects of interest. Mr. Charles Stewart prints a descriptive catalogue of 100 microscopic objects selected to illustrate the Invertebrate sub-kingdom, to be exhibited on that occasion.

IN an article in the *Artizan*, for April, on the Influence of the Suez Canal on Trade with India, Sir Frederick Arrow states that at the present moment the influence of the Canal is being felt in a decrease of the cost of fuel east of the Isthmus, which will certainly have a great effect on the cost of carriage, and therefore on the cost of laying down produce and goods. The existence of the route, he believes, will stimulate production, not only in India, but in the various countries which it brings into the family of commercial relations.

ON the 12th of March, the *Hougli*, one of the largest of the packet-boats belonging to the Messageries Impériales, of 2,000 tons burden and 500-horse power, entered the quarantine port of Frioul direct from the China seas, having traversed the Suez Canal without encountering the slightest obstacle. The cargo consisted of 1,300 bales of silk, 300 chests of tea, and other valuable freight, and there were in addition seventy passengers.

WE learn from Mr. Worthington G. Smith, in reference to a recent report of the proceedings of the Woolhope Naturalists' Field Club, that he has in preparation a *Clavis Agaricinorum*, which will be an analytical key to the genera and sub-genera of the British *Agaricini;* designed to give an immediate clue to their proper generic and sub-generic position, and thus assist in their ultimate determination.

MR. BENTLEY announces for early publication, "Travels in the Air," by Mr. Glaisher and others, with numerous full-paged coloured lithographs and woodcuts.

A NEW work is preparing for publication by Arthur Scott Donkin, M.D., Lecturer on Forensic Medicine to the University of Durham, &c., being a history of the British Diatomaceæ, with plates illustrative of each species.

THE *New York Technologist*, a new magazine especially devoted to engineering, manufacturing, and building, published in New York, describes a new contrivance for preventing people looking into a room, while light is not excluded. It consists of a number of glass rods arranged either vertically or horizontally, and secured together by appropriate frames, forming a series of cylindrical lenses which break up the light and throw it into every part of the room, thus producing a soft and diffused glow which is very beautiful and pleasant. The glass rods may be of any colour, and by an arrangement of the colours very beautiful effects can be produced. The contrivance is the invention of Mr. Demuth.

THE Pharmaceutical Society offers a silver medal for the best Herbarium collected in any part of the United Kingdom between the 1st of May, 1870, and the 1st of June, 1871, to any associate, registered apprentice, or student of the society, not over thirty-one years of age.

THE *Photographic Art Journal*, No. 2, is a very good number. It contains four excellent illustrations: "The Stirrup Cup," from a painting by Verschur, exquisitely soft in tone, done by the Woodbury process; "Netley Abbey," by Mr. Edwards's new process of printing in printing-ink in a common printing press, which seems to give exceedingly good results; "The Muleteer's Love," an example of Mr. Fruwirth's phototype process, also pulled in a common printing press, from an electrotyped surface-block which was reduced from a woodcut by the sole action of light and chemical agents; and "A Village Street in Switzerland," apparently an ordinary silver-print. The comparison of these photographs certainly gives the palm to the new processes, both as to distinctness and softness of tone.

ON THE MADREPORARIA DREDGED UP IN THE EXPEDITION OF H.M.S. "PORCUPINE."

IN continuation of Dr. Carpenter's Report of the *Porcupine* Dredging Expedition, we now present our readers with an abstract of a paper by Prof. Duncan on the Corals dredged up during the voyage.

Professor Wyville Thomson, Dr. Carpenter, and Mr. Gwyn Jeffreys have placed the collection of stony corals dredged up by them in the *Porcupine* Expedition in my hands for determination. They have kindly afforded me all the information I required concerning the localities, depth, and temperature in which the specimens were found. My report has been rendered rather more elaborate than I had intended in consequence of the great consideration of Professor A. Agassiz and Count de Pourtales in forwarding me their reports* and specimens relating to the deep-sea dredging off Florida and the Havana. They have enabled me to offer a comparison between the British and American species, which I did not hope to have done before the publication of the species noticed, but not described, in this report.

I. List of the species, localities, depths, temperatures.
II. Critical notice of the species.
III. Special and general conclusions.

I. Twelve species of *Madreporaria* were dredged up, and the majority came from midway between Cape Wrath and the Faroe Islands. Others were found off the west coast of Ireland. Many varieties of the species were also obtained, and some forms which hitherto have been considered specifically distinct from others, but which now cease to be so.†

II. Three species were found, known only on the area dredged, or in the neighbouring seas. Three species common to the area and to the Florida and Havana deep-sea faunas only. (These forms are not known in the West Indian Cainozoic fauna, and they have not been discovered in any European deposits.) *Lophohelia prolifera* (var. *affinis*) is common to the British and Florida deep-sea faunas; but it is found fossil in the Sicilian tertiaries, being moreover a member of the Mediterranean recent fauna. Three species common to the area and to the Mediterranean Sea. Five species found on the area dredged, and as fossil elsewhere.

The deep-sea coral fauna of the area dredged in the *Porcupine* and *Lightning* expeditions is therefore composed of—

5 species which have lasted since the early Cainozoic period.
1 Mediterranean species not known in Cainozoic deposits.
3 species of the deep-sea fauna of Florida and Havana.
3 indigenous species.

Two of the fossil species are represented in the recent Mediterranean fauna. If the species which I have absorbed into others (in consequence of the light thrown upon the amount of variation in the deep-sea corals) were counted, the fossil forms would be in all eight. The greatest depth from which *Madreporaria* were dredged was 705 fathoms, and the lowest temperature of the water in which they lived was 29°·9.

Caryophyllia borealis, Fleming.—Having collected a very considerable series of the *Caryophylliæ* from the seas around Great Britain, and having been supplied with several specimens of the Mediterranean species, I had compared the whole with the fossil forms from the Sicilian tertiary deposits and with each other. The numerous specimens of *Caryophylliæ* dredged up in Dingle Bay were especially interesting after I had arrived at satisfactory conclusions respecting the affinities of the above-mentioned British and southern European forms. The Dingle Bay collection presented all the varieties of shape, some of which had been deemed of specific value, which I had observed in the separate assemblages of specimens from the Mediterranean, the Sicilian tertiaries, and the British and Scottish seas. A perfect series of specimens from all these localities can be so arranged as to show a gradual structural transition from form to form, so that the most diversely shaped *Caryophylliæ* can be linked together by intermediate shapes. The *Caryophyllia clavus* and *Caryophyllia cyathus* can be united by intermediate forms, and all of these to *Caryophyllia Smithi* and *Caryophyllia borealis*. It is impossible to determine which is the oldest form, but they all appear to be reproduced by variation on some part of the area tenanted by the section of the genus. The variability of the *Caryophylliæ* of the Sicilian tertiary deposits is very marked, and it is equally so in the groups which live on disconnected spots in our waters. The Dingle Bay series presents the greatest amount of variability, and indeed is most instructive, for by applying the range of it to the classification of such genera as *Trochocyathus* and *Montlivaltia* a great absorption of species must ensue. The Dingle Bay *Caryophylliæ* are evidently the descendants of those which lived in the western and southern European seas before those great terrestrial elevations took place which were connected with the corresponding subsidence of the circumpolar land and the subsequent emigration of Arctic Mollusca. They are not closely allied to the recent West Indian species, but they occupy a position in the coral fauna representative of them. The same remark holds good with reference to the affinities of the recent and the cretaceous *Caryophylliæ*. They are not closely allied, and they belong to different sections of the genus, but in the economy of the old and new distribution of animal life they hold the same positions, and the recent forms are representative of the older. The Dingle *Caryophylliæ* prove the purely arbitrary nature of species, and that what we term one is really the sum of the variation of a series of forms.

Ceratocyathus ornatus, Seguenza.—A beautiful specimen of this rare form was dredged up from a depth of 705 fathoms with some *Caryophyllia* and a small *Isis*. The species is hitherto unknown except in the Sicilian miocene.*

Flabellum Sarsii, Sars, sp.—This is the *Ulocyathus arcticus* of the late Prof. Sars. Many specimens were dredged up, but most of them were broken in consequence of the extreme fragility and delicacy of the theca. The species links *Flabellum* to *Dermophyllum*: it is not known in the recent Mediterranean fauna.

Lophohelia prolifera, Pallas, sp., is apparently a common coral in the north-western British seas. A separate corallum, which must be referred to *Lophohelia anthophyllites*, Ellis and Solander, was dredged up in No. 54. *Lophohelia prolifera* exists in the Mediterranean Sea and the sea between Scotland and Norway. *Lophohelia anthophyllites* is an East Indian form, but its absorption into *Lophohelia prolifera* suggests explanations, considering the Cainozoic progenitor, and how it migrated eastwards. The relation of the recent East Indian coral faunas to those of the European and West Indian Cainozoic deposits has been noticed and admitted for some years past. The Cainozoic *Lophohelia* of Sicily is the earliest form of the genus, and those which are found in such remote parts of the world as the East Indies, the Florida coast, the Norwegian coast and the Mediterranean, and which have been determined to belong to different species, are, from the study of the curious assemblage of variable forms now under consideration, evidently varieties of the old type, *Lophohelia prolifera*. I have therefore absorbed the old species *L. anthophyllites*, *L. subcostata*, *L. affinis*, *L. Defrancei*, and *L. gracilis*. Two genera of the *Oculinidæ* in the classification of MM. Milne-Edwards and Jules Haime have always been most difficult to distinguish; and now the results of the dredging off the north of Scotland and off Florida and the Havana necessitate the absorption of one of them.

Amphihelia and Diplohelia.—The first, containing recent species only at the time of the enunciation of the classification just referred to, and the last, having fossil species only, were very likely to be considered separate genera. *Diplohelia* had species in the Eocene seas and in the Cainozoic also. *Amphihelia* was known to have species in the Mediterranean fauna, and in that of Australia also. Seguenza, however, described some *Amphiheliæ* and *Diploheliæ* from the Sicilian tertiary deposits which were identical, so far as generic attributes are considered, the only distinction being a doubtful raggedness of the septal edges. The habit and the method or growth and gemmation of the forms were the same. M. de Pourtales dredged up a branching form from off the Harena in 350 fathoms, and from off Bahia Houde, near Florida, in 324 fathoms, and also in lat. 28° 24′ N., long. 79° 13′ W., in 1,050 fathoms (came up with the lead). This he named *Diplohelia profunda*. On referring† to Seguenza's plates and descriptions of the fossil corals from the Sicilian tertiary deposits, there is no difficulty in deciding upon the very close affinity of the species described by Pourtales and *Diplohelia Meneghiniana*, Seg., and *Diplohelia Doderleiniana*, Seg., fossil forms from the mud-tertiary deposits. But on comparing these

* Contributions to the Fauna of the Gulf Stream at great depths by L. F. de Pourtales, 1st and 2nd Series, 1868. Bull. Mus. Comp. Zool., Harvard College, Cambridge, Mass., Nos. 6 and 7.

† One specimen came from the *Lightning* Expedition. It must be remembered that all the deep-sea corals known to British naturalists were not dredged up. The *Stylaster rosea*, for instance, was not amongst the collection.

* Seguenza, "Disquisiz. Paleont. int. ai Corall. Foss.," Mem. della Reale Accad. dell. Sci. Torino, serie ii. tomo xxi. 1864.

† Seguenza, "Disquiz. Paleont. int. ai Corall. Foss.," Mem. della Reale Accad. dell. Sci. Torino, serie ii. tomo xxi. 1864.

forms with one exquisitely figured by Seguenza, and which he calls *Amphihelia miocenica*, Seg., the generic affinities of all become startlingly evident. The very numerous specimens of small branching *Oculinidæ*, which were dredged up in the *Porcupine* Expedition (No. 54) and to the north-west of the spot in the cold area, at a depth from 363 to 600 fathoms, present singular variations of structure in the buds and calices upon the same stems. A careful examination of them, assisted by a comparison between them and the well-known recent and fossil *Amphiheliæ*, the fossil and recent *Diploheliæ*, and the smaller specimens of *Lophoheliæ*, leads to the belief that *Amphihelia* is identical generically with *Diplohelia*, and very closely allied with *Lophohelia*. Indeed, the distinction between the *Lophoheliæ* and *Amphiheliæ* is of the slightest kind. The species of the genus *Amphihelia* dredged up in the *Porcupine* Expedition are numerous:—

1. Amphihelia (Diplohelia) profunda, *Pourtales*, sp.
2. —— oculata, *Linneus*, sp.
3. —— miocenica, *Seguenza*.
4. —— Atlantica, *nobis*.
5. —— ornata, *nobis*.

The distinction between these massive and densely hard corals (whose calices are principally on one side of the cœnenchyma of the stem) and the *Stylasters* is very evident. M. de Pourtales has described a pretty red-coloured *Allopora miniata* dredged in 100 to 324 fathoms off the Florida Reef; but it is very distinct from the species discovered in the late deep-sea dredging expeditions. *Allopora* has no fossil representatives.

Balanophyllia (*Thecopsammia*) *socialis*, Pourtales.—Six specimens of a simple perforate coral were dredged up in lat. 59° 56′ N., long. 6° 27′ W., 363 fathoms, temperature 31°·8 (No. 54), and one in lat. 61° 10′ N., long. 2° 21′ W., 345 fathoms, temperature 29°·9 (No. 65). The six specimens are of different sizes and ages; and although they present considerable variation in shape and septal development, they evidently belong to one type. The solitary coral form (No. 65) is larger than the others, but it belongs to the same species. Notwithstanding the temperature in which the corals were found, and the depth of the sea, they are strong and well-developed forms, evidencing an active and abundant nutrition. There is no difficulty in classifying the specimens with the *Thecopsammiæ* of Pourtales. *Thecopsammia socialis*, Pourtales, was dredged up in from 100 to 300 fathoms, off Sombrero, near Florida, in the course of the Gulf Stream.

The varieties and the original type are very isolated forms in the great genus *Balanophyllia*. They have only a very remote affinity with the West Indian recent *Balanophylliæ*, with those of the Crag, the Faluns, and the Eastern tertiaries. The British forms appear to have emigrated from the south-west, and probably the original type wandered, through the agency of the Gulf Stream, which carried ova and deposited them in our northern sea, where they have propagated, varied, and thriven.

Pliobothrus symmetricus, Pourtales.—A specimen of this doubtful coral, which had been described by M. de Pourtales, from the results of dredging in from 100 to 200 fathoms, was sent to me by Dr. Carpenter. It came from the cold area, in from 500 to 600 fathoms. There is no doubt that this very polyzoic-looking mass belongs to the American type. The tabulæ are hardly worthy to be called such, and I place the form amongst the Zoantharia provisionally.

III. The species of *Madreporaria* belong to genera which do not and have not contributed to coral-reef faunas. None of them are reef-builders; but all are essentially formed to live where rapid growth and delicately cellular structures are not required. The forms are strong, solid, and large; and their rapid and repeated gemmation proves that their nutritive processes were active and continuous. All the species are very much disposed to produce variations; and this is especially true as regards those which have outlived the long age of the crag, the glacial period, and the subsequent time of elevations and subsidences. The least variable species are those which are not known on other areas. Two of the three species which are common to the West Indian deep-sea fauna and that of our north-western coasts are also variable. The persistence of *Madreporaria*, from the earlier Cainozoic period to the present time, has been an established fact for several years. Some of the forms which are common to the deep sea of the British area and to the so-called miocene of Sicily, are still existing in the Mediterranean. None of the species of corals found in the British crag are represented in the deep-sea fauna. The existence of Mediterranean forms in the north-west British area is in keeping with the discoveries of Forbes. It has, however, a double significance, and bears upon the presence of West Indian forms on the north-west British marine area. There was a community of species between the Mediterranean and the West Indies in the Cainozoic period, and especially of Echinodermata, Mollusca, Madreporaria, and Foraminifera. After the great alterations of the mutual relations of land and sea which took place before the cold affected the fauna of the Franco-Italian seas, this community of species diminished; but it lasted through all the period of northern glacialisation, and is proved still to exist slightly by comparing the Algæ, the corals, the Echinodermata, and the Mollusca. The presence of two very characteristic Floridan species, and one less so, off the north of Scotland, is particularly interesting, because they all live in the cold area and flourish there; whilst they appear to be less vigorous in the warmer Gulf Stream near Florida. It is impossible to fail to recognise the operation of this stream in producing the emigration of these three species, which are essentially American. It must be remembered, however, that the Cainozoic *Balanophylliæ* were very numerous in the European area, but not in the American. The solidity and the power of gemmation of the corals within the cold area appear to be greater than elsewhere. Depth does not appear to have much effect upon the nutrition of the *Madreporaria*; for those dredged up at 600 fathoms are quite as hard and solid as those dredged up at 300 fathoms. All the calices were stuffed with small Foraminifera, and there was evidently a great abundance of food.

There were numerous polyzoa, sponges, Foraminifera, Diatomaceæ, and delicate bivalves associated with or fixed upon the corals at all depths. Moreover, at from 300 to 400 fathoms a perforating mollusc had worked its way up the stems of some of the hardest specimens of *Amphihelia* and *Lophohelia*. One had left its excavation, which had been taken possession of by a small Brittle Star, and at a depth of 705 fathoms there was a pretty Isis. *Serpulæ*, moreover, abound upon the corals. This is a fauna which, if covered up and presented to the palæontologist, would be, and would have been for some years past, considered a deep-sea one. It is a fauna which indicates the existence of the same processes of nutrition and of destructive assimilation and reproduction which are recognised in association with corresponding forms at less depths and in higher temperatures. The great lesson which it reads is, that vital processes can go on in certain animals at prodigious depths and in considerable cold, quite as well as in less depths and in considerable heat. It suggests that a great number of the Invertebrata are not much affected by temperature, and that the supply of food is the most important matter in their economy.

The researches of the naturalist who obtained Polyzoa and Foraminifera in soundings at a depth of nearly 400 fathoms off the icy barrier of the South Pacific, of Wallich in the Atlantic, and of Alphonse Milne-Edwards in the Mediterranean, have had much influence upon geological thought in this age, which, so far as geologists are concerned, is remarkably averse to theory. For many years before any very deep soundings had been taken with a view of searching the sea-bottom for life, geologists had more or less definite opinions concerning the deposition of organisms in sediments at great depths. Certainly, more than thirty years ago, deep-sea deposits were separated by geologists from those which they considered to have been formed in shallower seas. The finely-divided sediment of strata containing Crinoids, Brachiopods, Foraminifera, and simple Madreporaria, was supposed to have been deposited in deeper water than formations containing large pebbles, stones, and the mollusca, whose representatives now live in shallows. The relations of such strata to each other, the first being found to overlap the last, proved that there was a deeper sea-fauna in the offing of the old shores tenanted by littoral and shallow-water species. The deposition of strata containing Foraminifera, Madreporaria, and Echinodermata, whose limestone is remarkably free from any foreign substances, has been considered to have taken place in very deep water; this theory has been founded upon the observations of the naturalist and mineralogist. Indeed, no geologist has hesitated in assigning a great depth to the origin of some deposits in the Laurentian, Silurian, or in any other formation. The "flysch," a great sediment of the Eocene formation, has been considered to have been formed at a great depth and under great pressure. Its singular unfossiliferous character was supposed to be due to the absence of life at the depths of the ocean where the sediment collected. But this was a theory of the early days of geology, when the destructive influence of chemical processes in strata upon the remains of organisms in them was hardly admitted.

The great value of such researches as those so ably carried out by Thomson, Carpenter, and Jeffreys, is the definite knowledge they impart to the geologist who is theorising in the right direction, but whose notions of the depths at which the sediments containing Invertebrata can be deposited, are indefinite. The researches contribute to more exact knowledge, and they will materially assist the development of those hypotheses which are current amongst advanced geologists into fixed theories. I do not think that any geological theory worthy of the term, and which has originated from geological induction, will be upset by these careful investigations into the bathymetrical distribution of life and temperature. Physicists have propounded theories which have been accepted by some geologists; but they are looked upon as doubtful hypotheses by others. Palæontologists and such theories have constantly been at issue. The theories involving pressure and the intensity of the hardness of deep-sea deposits will suffer from the researches; but many difficulties in the way of the palæontologist will be removed. The researches explain the occurrence of a magnificent deep-coral fauna in the Palæozoic times in high latitudes, and of Jurassic and Cainozoic faunas on the same area, and they tend more than ever to the doctrines of uniformity. They explain the cosmopolitan nature of many organisms, past and present, which were credited with a deep-sea habitat, and they afford the foundations for a theory upon the world-wide distribution of many forms during every geological formation. It is not advisable, however, to make too much of the interesting identities and resemblances of some of the deep-sea and abyssal forms with those of such periods as the Cretaceous, for instance. In the early days of geological science there was a favourite theory that at the expiration of a period the whole of the life of the globe was destroyed, and that at the commencement of the succeeding, a new creation took place. There were as many destructions and creations as periods, or, to use the words of an American geologist, there was a succession of platforms. This theory held back the science, just as the theory that the sun revolved round the earth retarded the progress of astronomy. Moreover, it had that armour of sanctity to protect it which is so hard to pierce by the most reasonable opposition. Nevertheless every now and then a geologist recognised the same fossils in rocks which belonged to different periods. A magnificent essay by Edward Forbes on the Cretaceous Fossils of Southern India, a wonderful production and far before its age,* gave hope and confidence to the few palæontologists who began to assert that periods were perfectly artificial notions; that it did not follow because one set of deposits was forming in one part of the world, others exactly corresponding to it elsewhere, so far as the organic remains are concerned, were contemporaneous; and that life had progressed on the globe continuously and without a break from the dawn of it to the present time. The persistence of some species through great vertical ranges of strata, and the relation between the world-wide distribution of forms and this persistence, were noticed by d'Archiac, de Verneuil, Forbes, and others. The identity of some species in the remote natural-history provinces of the existing state of things, was established in spite of the dogmatic opposition of authorities; and these geologists accepted the theories that there were several natural-history provinces during every artificial period; that some species lived longer and wandered more than others; and that some have lasted even from the Palæozoic age to the present. Persistence of type was the title of a lecture delivered by Professor Huxley† many years ago; and this persistence has been admitted by every palæontologist who has had the opportunity of examining large series of fossils from every formation from all parts of the world.

Geological ages are characterised by a number of organisms which are not found in others, and by the grouping of numerous species which are allied to those of preceding and succeeding times, but which are not identical. Certain portions of the world's surface were tenanted by particular groups of forms during every geological age, and there was a similarity of arrangement in this grouping under the same external physical conditions. To use Huxley's term, the "homotaxis" of certain natural history provinces during the successive geological ages has been very exact. The species differed, but there was a philosophy in the consecutive arrangements of high-land and low-land faunas and floras, and of those of shallow seas, deep seas, oceans, and reef-areas. The oceanic* conditions, for instance, can be traced by organic remains from the Laurentian to the present time, and the deep-sea corals now under consideration are representative of those of older deep seas. The species which are new, and the varieties of those which have been already noticed, will be described and drawn in other communications. It is not a matter for surprise, then, that there being such a thing as persistence of type and of species, some very old forms should have lived on through the ages whilst their surroundings were changed over and over again. But this persistence does not indicate that there have not been sufficient physical and biological changes during its lasting to alter the face of all things enough to give geologists the right of asserting the constant succession of periods. The occurrence of early Cainozoic Madreporaria in the deep sea to the north-west of Great Britain only proves that certain forms of life have persisted during the vast changes in the physical geography of the world which were initiated by the upheaval of the Alps, the Himalayas, and large masses of the Andes. To say that we are therefore still in the Cainozoic age would hardly be consistent with the necessary terminology of geological science.

During the end of the Miocene age, and the whole of the Pliocene, the Sicilian area was occupied by a deep sea. The distinction between the faunas of those times and the present becomes less, year after year, as science progresses; and it is evident that a great number of existing species of nearly every class flourished before the occurrence of the great changes in physical geology which have become the artificial breaks of classificatory geologists. That the Cainozoic deep-sea corals should resemble, and in some instances should be identical in species with, the forms now inhabiting vast depths, is therefore quite according to the philosophy of modern geology. Before the deposition of the Cainozoic strata, and whilst the deep-sea deposits of the Eocene age were collecting in the Franco-British area, there was a Madreporarian fauna there which was singularly like unto that which followed it, both as regards the shape of the forms and their genera. Still earlier, during the slow subsidence of the great Upper Cretaceous deep-sea area, there was a coral fauna in the north and west of Europe, of which the existing is very representative. The simple forms predominate in both faunas. *Caryophyllia* is a dominant genus in either, and a branching *Synhelia* of the old fauna is replaced in the present state of things by a branching *Lophohelia*. The similarity of deep-sea coral faunas might be carried still further back in the world's history; but it must be enough for my purpose to assert the representative character and the homotaxis of the Upper Cretaceous, the Tertiary, and the existing deep-sea coral faunas. This character is enhanced by the persistence of types; but still the representative faunas are separable by vast intervals of time.

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* Trans. Geol. Soc.
† Royal Institution. See also Pres. Address, Geol. Soc.

* P. M. Duncan, Quart. Journ. Geol. Soc. No. 101.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 31.—"On the relation between sun's altitude and the chemical intensity of total daylight in a cloudless sky." By Henry E. Roscoe, F.R.S., and T. E. Thorpe, Ph.D. In this communication the authors give the results of a series of determinations of the chemical intensity of total daylight made in the autumn of 1867 on the flat tableland on the southern side of the Tagus, about $8\frac{1}{2}$ miles to the south-east of Lisbon, under a cloudless sky, with the object of ascertaining the relation existing between the solar altitude and the chemical intensity. The method of measurement adopted was that described in a previous communication to the Society,† founded upon the exact estimation of the tint which standard sensitive paper assumes when exposed for a given time to the action of daylight. The experiments were made as follows:—1. The chemical action of total daylight was observed in the ordinary manner. 2. The chemical action of the diffused daylight was then observed by throwing on to the exposed paper the shadow of a small blackened brass ball, placed at such a distance that its apparent diameter, seen from the position of the paper, was slightly larger than that of the sun's disk. 3. Observation No. 1 was repeated. 4. Observation No. 2 was repeated.

† Roscoe, Bakerian Lecture, 1865.

The means of observations 1 and 3 and of 2 and 4 were then taken. The sun's altitude was determined by a sextant and artificial horizon, immediately before and immediately after the observations of chemical intensity, the altitude at the time of observation being ascertained by interpolation.

It was first shown that an accidental variation in the position of the brass ball within limits of distance from the paper, varying from 140 millimetres to 230 millimetres, was without any appreciable effect on the results. One of the 134 sets of observations was made as nearly as possible every hour, and they thus naturally fall into seven groups, viz. :—

(1) Six hours from noon, (2) five hours from noon, (3) four hours from noon, (4) three hours from noon, (5) two hours from noon, (6) one hour from noon, (7) noon.

Each of the first six of these groups contain two separate sets of observations, (1) those made before noon, (2) those made after noon. It has already been pointed out,* from experiments made at Kew, that the mean chemical intensity of total daylight for hours equidistant from noon is constant. The results of the present series of experiments proves that this conclusion holds good generally, and a Table is given showing the close approximation of the numbers obtained at hours equidistant from noon.

Curves are given showing the daily march of chemical intensity at Lisbon in August, compared with that at Kew for the preceding August, and at Parà for the preceding April. The value of the mean chemical intensity at Kew is represented by the number 94·5, that at Lisbon by 110, and that at Parà by 313·3, light of the intensity 1·0 acting for 24 hours being taken as 1,000.

The following Table gives the results of the observations arranged according to the sun's altitude :—

No. of Observations.	Mean Altitude. ° ′	Chemical Intensity. Sun.	Sky.	Total.
15 . .	9 51	0·000	0·038	0·038
18 . .	19 41	0·023	0·063	0·085
22 . .	31 14	0·052	0·100	0·152
22 . .	42 13	0·100	0·115	0·215
19 . .	53 09	0·136	0·126	0·262
24 . .	61 08	0·195	0·132	0·327
11 . .	64 14	0·221	0·138	0·359

Curves are given showing the relation between the direct sunlight (column 3) and diffuse daylight (column 4) in terms of the altitude. The curve of direct sunlight cuts the base line at 10°, showing that the conclusion formerly arrived at by one of the authors is correct, and that at altitudes below 10° the direct sunlight is robbed of almost all its chemically active rays. The relation between the total chemical intensity and the solar altitude is shown to be represented graphically by a straight line for altitudes above 10°, the position of the experimentally determined points lying closely on to the straight line.

A similar relation has already† been shown to exist (by a far less complete series of experiments than the present) for Kew, Heidelberg, and Parà; so that although the chemical intensity for the same altitude at different places and at different times of the year varies according to the varying transparency of the atmosphere, yet the relation at the same place between altitude and intensity is always represented by a straight line. This variation in the direction of the straight line is due to the opalescence of the atmosphere; and the authors show that, for equal altitudes, the higher intensity is always found where the mean temperature of the air is greater, as in summer, when observations at the same place at different seasons are compared, or as the equator is approached when the actions at different places are examined. The differences in the observed actions for equal altitudes, which may amount to more than 100 per cent. at different places, and to nearly as much at the same place at different times of the year, serve as exact measurements of the transparency of the atmosphere.

The authors conclude by calling attention to the close agreement between the curve of daily intensity obtained by the above-mentioned method at Lisbon, and that calculated for Naples by a totally different method.

"On the acids contained in crab oil." By William J. Wonfor, Student in the Laboratory of the Government School of Science, Dublin. Communicated by Dr. Maxwell Simpson.

* Phil. Trans. 1867, p. 558.
† Phil. Trans. 1867, p. 555.

Crab-oil is obtained from the nuts of a tree named by botanists *Hylocarpus carapa* and also *Carapa Guianensis.* The tree grows abundantly in the forests of British Guiana; the oil is prepared by the Indians, who bring it to George Town for sale. The oil is obtained from the kernels by boiling them for some time, and then placing them in heaps and leaving them for some days; they are then skinned, and afterwards triturated in wooden mortars until reduced to a paste, which is spread on inclined boards and exposed to the sun; the oil is thus melted out, and trickles into receiving vessels.

As no investigation, so far as I have been able to ascertain, has ever been made of the acids contained in this oil, Professor Galloway, to whom I am indebted for the samples of the oil, recommended me to examine them, and the examination was conducted under his direction. The acid, when pure, presents the appearance of a white glistening radiated crystalline mass. The percentage composition obtained was as follows :—

Carbon	74·856
Hydrogen	12·570
Oxygen	12·574
	100·000

These analyses agree very closely with the formula for palmitic acid, $C_{16}H_{32}O_4$.

Royal Geographical Society, March 28.—The president, Sir R. Murchison, in the chair. A paper was read by Sir Charles Nicholson, Bart., on Forrest's Journey in Western Australia; Goyder's survey of the neighbourhood of Port Darwin, and on the recent progress of discovery in Western Australia, and remarks on Papua or New Guinea. Intense interest had been felt in the fate of Leichhardt and his party, who were last heard of in 1849 S.W. of the Gulf Carpentaria; a report was brought to the government of Swan River, of the existence of the remains of two white men and horses in the unexplored region N.E. of the colony. An expedition was fitted out, under Mr. Forrest, with whom Mr. Monger and Mr. M. Hamersley were associated, and the native Jimmy Mungaro acted as guide. The place indicated was Koolanobbing, lat. 30° 53′ S., and long. 109° 14′ E. The expedition was exceedingly well managed, and the country was thoroughly examined. They left Newcastle April 19, 1869; passed through a sandy country without grass; water was scarce; salt lakes nearly dried up were met with; from the limit of Gregory's exploration, 118 long., they travelled north; found granite hills, with spearwood and acacias; in May 5 they reached Lake Moore, and learned that the remains were those of horses which had been poisoned, having strayed from an out station; some unfriendly natives, who threatened to kill and eat the white men, were met with; several large dry salt lakes were discovered, one of which, named Lake Barlee, was conjectured to be 80 miles in length, the farthest point, 28° lat. 41′ S., and 122° 50′ E. long., was reached July 2nd. The country throughout of the same barren worthless character, granite hills, no grass, and scanty supplies of water. The return journey was made to north of Lake Barlee, westward to Bunnaroo, and southward to Mount Singleton on July 23rd; the result was that no traces of Leichhardt were found, and the country explored was pronounced unfit for either pasture or agriculture. In the sea board districts and about Mount Singleton there was excellent land, all Western Australia wanted was population. Sir Charles Nicholson then proceeded to notice the recent survey of Port Darwin, in North Australia, which region, between 128° and 138° E. long., and north of 26° S. lat., had been most unreasonably annexed to South Australia. The South Australian attempt to open communication through the interior, and found a colony at Port Essington, had failed, and the colony had been abandoned. Port Darwin lies to west of Adelaide River, on northern coast, opposite Melville Island; it possesses a good harbour, a million acres of good land have been surveyed, fit for horses and cattle, not for sheep, climate from May to September is good, then moist and hot; intercourse by sea between the Malays of Macassar and this port exists. Port Darwin has been recommended as a port for shipping horses for the Indian market, the central region is impracticable, but the route followed by M'Kinlay from Northern Queensland is, in the opinion of Mr. Goyder, Colonial surveyor, the best; this, Sir Charles Nicholson thought showed that North Australia ought to form part of Queensland. Sir Charles gave a rapid *résumé* of the progress of discovery in Australia from Captain Cook's voyage, and the foundation of Port Jackson in 1788; the labours and journeys of Dr. Bass, Sturt, Mitchell, Eyre, &c., were glanced at. Dr. Leichhardt was absent two years on his first expedition to Port Essington, and was given up for lost, a monument, with an epitaph composed by a friend, having been erected to him. In conclusion a hope was expressed that geographical discovery would be still prosecuted, especially with reference to the magnificent but almost unknown Papua or New Guinea, the position, fauna, and flora of which constitute it a natural appendage to Australia, a line of small islands connecting it with our settlement at Cape York. Captain Blackwood in H.M.S. *Fly*, in 1845, examined 140 miles of coast, lat. S. 8° 45', long. E. 143° 35', to 7° 40' lat. 144° 30' long., containing the delta of a large river. In the south-eastern peninsula, mountains 11,000 ft. to 13,000 ft. high, were observed by Captain Stanley, these were in sight for several days coasting, with richly wooded slopes. The Government survey vessel at Cape York might be used for exploration of this country. The natives were hostile, and had the reputation of being fierce and warlike. The president said that he had urged on the Government the impolicy of uniting North and South Australia, and the necessity of forming a port of refuge, and a naval station at Port Darwin. He alluded to Mr. Crawford's estimate of the Papuan climate as most unhealthy. General Lefroy reminded the meeting of the omitted name of his brother, a successful explorer of Western Australia. The question of the suitability of Port Darwin as a depôt for the horses to be sent to India was discussed. The project had been favourably reported on to Lord Mayo by Sir James Ferguson, the North-eastern or Flinders river route being preferred. With regard to the climate, Mr. Findlay mentioned the excellence of the Timor ponies. Mr. Saunders pointed out that the navigation would be much safer if a port were selected in the Gulf of Carpentaria.

Chemical Society, March 30.—Anniversary meeting, Prof. Williamson, F.R.S., President, in the chair. The following officers have been elected for the ensuing year:—President, Dr. A. W. Williamson; Vice-presidents who have filled the office of president, Sir B. C. Brodie, Warren De la Rue, A. W. Hofmann, Dr. W. A. Miller, Dr. Lyon Playfair, Col. P. Yorke; Vice-presidents, Dr. J. H. Gilbert, Dr. E. Frankland, Dr. A. Matthiessen, Dr. H. M. Noad, Prof. W. Odling, Dr. T. Redwood; Secretaries, A. Vernon Harcourt, W. H. Perkin; Foreign Secretary, Dr. H. Müller; Treasurer, F. A. Abel; ordinary members of the Council, Dr. E. Atkinson, H. Bassett, E. T. Chapman, F. Field, David Forbes, Dr. M. Holzmann, Dr. E. J. Mills, Dr. W. J. Russell, Dr. Maxwell Simpson, Dr. R. Angus Smith, Dr. John Tyndall, Dr. A. Voelcker. After communication of the above list the president delivered the following address:—"Gentlemen,—On behalf of the council I feel very great pleasure in congratulating you on the rapidly increasing usefulness and prosperity of our Society. The most interesting incident in the history of the past year has been the delivery by M. Dumas of the inaugural Faraday lecture. It was indeed an impressive tribute to the memory of our great countryman which was paid by that noble veteran of science, and one of which the record ought to occupy a place of honour in our journal. We still hope to receive from M. Dumas a manuscript of his classical discourse. The council have had the pleasure of accepting the offer of a munificent donation of Palladium from Messrs. Johnstone and Matthey to be used for the preparation of the ten first Faraday medals. Your council have felt it to be of considerable importance to give greater publicity to the proceedings of the society, and they have accordingly made provisional arrangements for the preparation of abstracts of the papers, and in some cases of the discussions, for transmission to such papers as desire to publish them. These abstracts already appear in several papers and are read with interest. Another matter of considerable importance has been brought under the notice of your council, and has been by them referred to the careful consideration of a sub-committee who will report to the new council. The great activity of chemists in France and Germany leads to the publication of vast quantities of important matter in languages not easily intelligible to many of our members, and a feeling has been entertained for some time past that the progress of our science and of its applications would be greatly promoted by the regular publication in the English language of accurate reports of all chemical papers. For many years past annual reports of this kind have been published in Germany, first under the auspices of the great Berzelius, and latterly under those of Liebig and Kopp. The French Chemical Society has also added very greatly to the value of their journal by publishing in it reports of a great number of important papers from various sources, and I am happy to say that the eminent chemists who are at the head of that society concur with us in desiring to publish reports combining the completeness of the "Jahresberichte" with a much greater celerity of appearance, so that our respective members may have presented to them every month an outline of all that has been done in the science since the last report. It appears that considerable facilities would be afforded for the preparation of such reports by a joint action of the two societies, and our friends in Paris have expressed the utmost readiness to co-operate with us in this important matter. I hope at our next anniversary meeting to be able to congratulate the society on the commencement of a system of international working."

The president proceeded by giving the present number of fellows, of the foreign members, the list of the deceased, and concluded with a commemorative speech on Thomas Graham. The greater part of this speech is to be found in the biographical sketch in the first number of NATURE. The following additional remarks, however, are worthy to be quoted here. "In 1837 Graham was appointed to the chair of chemistry in the newly-founded London University, now called University College, London. It was here that the young philosopher found adequate scope for his abilities. Young men, thirsting for knowledge, crowded to his lectures, and in those lectures he explained the principles of chemical science with an exactness and clearness never before attained. The success of these lectures was not due to eloquence, nor to any smoothness of diction, for all such matters Graham usually neglected to a degree which in an ordinary person would hardly have been excused. He had a truly philosophical method which carried away the listener with irresistible force. The same exactness of thought, the same logical arrangement of matter, in a word, the same purely scientific mind pervades his work, the 'Elements of Chemistry,' a work which is too well-known to chemists all over the world, for it to be necessary to speak here of its great merits." After having sketched the outlines of the most important of Graham's investigations, the president alluded in the following manner to Graham's activity as Master of the Mint:—"He remained at University College till the year 1855, when he was appointed Master of the Mint, an office which Sir John Herschel had recently resigned. His illustrious friend Hofmann, from whom I have already freely quoted, shall tell how he discharged these responsible duties. 'It would be difficult to picture the extensive activity which Graham exercised in the high office entrusted to him. The new master of the mint showed a circumspection, a mastery of details, an amount of industry and energy, and, when occasion required, an impartial severity, which astonished every one, more especially some of the officials of the mint. Such requirements had not hitherto been made, nor such control exercised. A strong resistance was made to the plans of innovation and alteration of the new master.' The author of these lines, Hofmann, at that time held an office in connection with the Mint, and was therefore witness of Graham's struggles in his new position. It was years before he gained a complete victory, and before he was able to return to his favourite study. But at last this longed-for period came, and a series of happy years followed. Not an instant was lost. A convenient laboratory was fitted up in the official residence of the Master of the Mint, whose handsome rooms the simple and independent man never occupied, and there his old labours were resumed with greater zeal than ever. Some of Graham's most beautiful researches date from this period. They sprang from the pure love of science. Graham needed to earn no name or position. Both had long been his undisputed property. But the same earnest desire to study nature, which in early youth had induced him to bear without murmurs the greatest privations and the bitterest sorrows, still animated him and armed him against the new dangers which threatened his scientific labours from the splendour of his official position and the distractions which it entailed on him." The proceedings of the meeting terminated with a vote of thanks to the president for the able and effective manner in which he had discharged his official duties during the past year.

Geological Society, March 23.—Warington W. Smyth, F.R.S., Vice-President, in the chair. Mr. F. A. Potter, B.Sc., Assoc. Royal School of Mines, Cromford, Derbyshire, was elected a Fellow of the Society. The following communications were read:—Professor Huxley communicated a letter received by him from Dr. Emanuel Bunzel, of Vienna, giving a short account, illustrated with figures, of the posterior portion of a skull obtained by Professor Suess from a coalmine of Upper Cretaceous (Gosau) age. Dr. Bunzel stated that at the first glance this skull appeared to possess Reptilian characters, but that the convexity of the occiput, and its gentle passage into the roof of the skull, the presence of a transverse ridge in the occipital region, the absence of sutures, the globular form of the condyle, and some other peculiarities, prevent the animal to which this skull belonged from being referred to any known order of reptiles. The author compared this fragment of a skull with that of a bird, and suggested the establishment of a new order of fossil Reptiles (*Ornithocephala*), closely related to Prof. Huxley's *Ornithoscelida.* He proposed to refer his fossil to a new genus, which he named *Struthiosaurus.*

"On the discovery of organic remains in the Caribean Series of Trinidad." By Mr. R. J. Lechmere Guppy, F.L.S., F.G.S. The author described the rocks of the "Caribean group" as consisting of gneiss, gneissose, talcose, and micaceous slates and crystalline and compact limestones, and remarked upon the probable distribution of rocks of the same series on the continent of South America. In Trinidad the uppermost member of the series is a compact dark blue limestone, which contains obscure, but very abundant fossils; in the subjacent clay-slates and quartz rocks calcareous strings and bands containing more distinct traces of organisms occur. The author believed that he had detected an *Eozoon* (which he called *E. caribeum*), a *Favosites* (named *F. fenestralis*), a coral, and fragments of echinoderms. He considered it probable that the Caribean series was pre-silurian. Dr. Carpenter, from the slight examination he had been able to make of the fossils, was unwilling to speak decidedly about them. There was, however, no doubt of numerous organic remains occurring in the rocks, and among them serpuline shells and echinoderms. As to the supposed *Eozoon*, he had not been able to recognise any of the characteristics of that fossil; and by treating the Trinidad specimens with acid, he found no traces of structure left, and yet there had not been sufficient metamorphism to destroy other organisms. In some dredgings from the Ægean Sea he had found fragments of echinoderms and other organisms, in which a siliceous deposit had replaced the original sarcode in the same manner as had occurred in the Canadian *Eozoon*, thus proving the possibility of this form of substitution, which had been warmly contested. Mr. Tate offered some suggestions as to the age of these beds, which were certainly older than Neocomian. The Californian gold-bearing beds appear to be Jurassic. Similar beds occurred in New Mexico, Guatemala, and were observed by him in Nicaragua and Costa Rica. These present lithological and mineralogical affinities to the Venezuelan and Trinitation metamorphic series, and were conjectured to be of the same age.

"On the Palæontology of the Junction-beds of the Lower and Middle Lias in Gloucestershire." By Mr. R. Tate, A.L.S., F.G.S. The object of this paper was to show that the attachment of the zone of *Ammonites raricostatus* to the lower lias and that of *A. Jamesoni* to the middle lias harmonises with the distribution of the organic remains: 50 species were catalogued from the united zones of *A. oxynotus* and *A. raricostatus*, 8 of which pass up into the middle lias, whilst 13 occur in the lower horizons; 115 species were enumerated as occurring in the zone of *Ammonites Jamesoni*, 60 of which pass to higher zones, whilst 11 made their first appearance in the lower lias; the number of species common to the contiguous zones being 14. The author inferred that, as the conditions of depth and deposit of the upper part of the lower lias are repeated in the lower part of the middle lias, accompanied by a total change in the fauna, a break in the stratigraphical succession existed between the lower and middle lias. This view is supported by the fact of the numerical decrease of species in passing up through the several stages of the lower lias, and that of the introduction of many new generic types with the zone of *Ammonites Jamesoni.* Many new species were described. Prof. Boyd Dawkins had attempted to test these liassic zones as a means of classification of the rocks in Somersetshire, and the result had been that he had been unable to accept them as fixing hard and fast lines of demarcation; for he had found three of the distinctive Ammonites together in one bed. On our present shores the change of one form of molluscan life for another seemed to take place in limited areas, and to be dependent on some slight variation of physical conditions rather than on any great change. He had not been able to trace any stratigraphical unconformity between the middle and lower lias in many parts of England, whatever might be the case in Gloucestershire. Mr. Tate, in reply, gave an account of the manner in which he had arrived at his conclusions, and expressed his assent to the view that ammonite-zones were only of value over limited areas, but considered that a triple division in the lower and a dual division in the middle lias were well established on palæontological and lithological features. The break which he had pointed out was palæontological rather than stratigraphical, though the one might be inferred from the other.

"Geological Observations on the Waipara River, New Zealand." By Mr. T. H. Cockburn Hood, F.R.S. In this paper the author described the general features of the locality from which he has obtained bones of *Plesiosaurus*, *Ichthyosaurus*, and *Teleosaurus.* The bones were not obtained *in situ*, but from large boulders and blocks scattered in the ravines of the Waipara and its tributaries. Professor Boyd Dawkins remarked on the presence of Crocodilia in New Zealand being proved by the procelian vertebra.

Mr. R. H. Scott, F.G.S., communicated an extract from a letter addressed to him by M. Coumbary, Director of the Imperial Observatory of Constantinople, containing an account received from M. L. Carabello of the reported fall of a large meteorite near Mourzouk, in the district of Fezzan, in lat. 26° N., and long. 12° E. of Paris. It fell on the evening of the 25th December last, in the form of a great globe of fire, measuring nearly a metre in diameter; on touching the earth it threw off strong sparks with a noise like the report of a pistol, and exhaled a peculiar odour. It fell near a group of Arabs, who were so much frightened by it that they "immediately discharged their guns at this incomprehensible monster."

PARIS

Academy of Sciences, April 4.—The following mathematical papers were read:—Description, with plans, of an instrument, by which spherical triangles may be solved without the aid of tables of logarithms, by M. Blanqui; On the fundamental points of two surfaces, of which the points correspond one by one, by M. H. G. Zeuthen; on the theory of equations with partial derivatives, by M. G. Darboux (second memoir); and On a mode of approximation of the functions of several variables, by M. Didon.—M. de Saint-Venant presented a memoir on a second approximation in the rational calculation of the pressure exerted against a wall of which the posterior surface has a certain inclination, by incoherent soil rising in a talus from the top of this surface of the wall; and M. Boussinesq an integration of the differential equation which may furnish a second approximation in the calculation of the same pressure.—M. Jamin communicated a note on the latent heat of ice, and presented a note by MM. Wecker and Robin on an objective with prisms, to be used in an ophthalmoscope which will enable two persons to observe the eye at the same time.—M. Phillips presented a memoir by M. Martin de Brettes on an apparatus for the demonstration of the phenenomena of the trajectory of oblong projectiles driven by rifled guns.—M. Delaunay communicated an extract from a letter from M. G. Oltramare on the existence of a law of repartition, analogous to Bode's law, for each of the systems of satellites of Jupiter, Saturn, and Uranus; and a note by M. R. Wolf on the frequency of the sun's spots, and its relation to the variation of magnetic declination. The author gave a table of his observations of solar spots during the years 1864–1869, showing a minimum in 1867, in conformity with his period of $11\frac{1}{9}$ years. He also applied his formula for the calculation of the magnetic variation in relation to the solar spots, to the results of observation at the Observatory of Christiania, and cited the data of several years to show at all events a close approximation.—A paper was read by M. Chapelas on the centres of mean position of shooting stars, which is the name he gives to the points from which the groups of meteors seem to issue.—M. C. Viollette presented a paper on the existence of selenium in commercial copper. The author stated that by oxydising copper in a muffle-furnace and then heating the oxide to redness for several hours in a current of dry pure air, crystals of selenious acid are obtained. The copper operated upon by lime was probably from Chili; he proposes to examine other coppers, and requests manufacturers to forward to him, at the Faculty of Sciences of Lille, specimens of copper of known origin. M. Viollette also presented a note on the cause of the acidity of the water of organic analyses, which he ascribes to the presence of selenious acid in the oxide of copper employed in the combustion tubes.—M. E. Royer read a paper on the reduction of carbonic acid into formic acid. The author, having found that formic acid is produced by the reduction tof oxalic acid in the porous vessel of a Bunsen's battery in presence of hydrogen, has subjected carbonic acid to the same treatment, and found that this also furnishes formic acid.—M. Mauméné forwarded a further note on his general theory of chemical action; and M. Dubrunfaut a paper on the law of dilatation of gases.—M. Guyon communicated some remarks on a paper by M. Ramon de la Sagra, describing an anomalously branched structure in the stem of a palm-tree (*Oredaxa regia*). M. Guyon stated that a similar anomaly is very common in the date palm.—In a note presented by M. de Quatrefages, on the inversion of the viscera and its artificial production, by M. C. Dareste, the author stated that he had produced this condition in young chicks, by maintaining a temperature at the heating point of 105·8°—107·6° F., whilst the surrounding temperature was allowed to oscillate from 21° to 28°.—M. Bouley communicated an important report on the results of the inquiry instituted by the Ministry of Agriculture into the occurrence of hydrophobia in France during the years 1863-1868. From his statements, which unfortunately rest on rather imperfect documents, it appears that a large number of persons bitten by dogs supposed to be rabid, escape all serious consequences of the bites; that the summer is not more dangerous than any other season; and that immediate cauterisation of the bite appears to be the only sure remedy.—M. H. Sainte-Claire Deville presented a note by M. Piarron de Montdésir on ventilation by means of compressed air, accompanied by a purification and cooling of the new air, and a disinfection of the vitiated air. The author proposed to employ strong jets of compressed air, which would carry with them a considerable body of uncompressed air; the cooling and purification of this air from dust is to be effected by means of a small jet of water in the midst of each air-jet; and the purification of the vitiated air by substituting a disinfecting liquid for the water in the jets of compressed air in action at the bottom of the ventilating flues. With regard to M. Wœstyn's recent proposal to purify the vitiated air of hospitals, &c., by burning it, which is rejected on the score of expense by the author, M. Montanier remarked that in 1864 he had suggested a similar plan.—MM. Mille and Durand Claye presented a memoir giving the results of the experiments made for the utilisation of the sewage waters flowing into the Seine, which they propose to divert entirely from their direct influx into the river, and to apply as manure to the neighbouring country.

VIENNA

Imperial Academy of Sciences, February 17.—The president noticed the decease of Dr. Franz Unger, the well-known botanist and vegetable palæontologist, on the 13th Feb.—The following papers were read:—1. On the observation of oscillations by Prof. E. Mach of Prague. He stated that a very simple and effective form of vibroscope is obtained by placing a row of König's burners along one side of an organ pipe, and described some of the effects observable by means of this instrument.—2. On the intestinal movements, by Dr. S. Mayer, containing the results of a series of experiments, relating especially to the innervation of the intestines, which had been made by him in conjunction with Dr. S. von Basch.—3. Dr. Boué completed his address on the petrographic and geognostic results of his travels in European Turkey.—The reports of observations at the Central Institution for meteorology and terrestrial magnetism during the month of January, were communicated.

March 10.—The president announced the death of Professor Joseph Redtenbacher on the 5th March. The following papers were read:—1. On the renal pelvis of the mammalia and of man, by Professor Hyrtl, in which the author described in detail the structure of the urine-secreting organs in a great number of mammals.—2. Phanological studies, by M. Karl Fritsch, containing the results of observations made in Austria and Hungary on the blooming and maturity of plants, and on the first and last appearances of periodically occurring animals.—3. On the after-pictures of excitant changes, by M. V. Dvorák, showing that the after-pictures of movements observed by Plateau and Oppel are not isolated phenomena, but that similar effects are produced by changes of brightness.—4. On the rational triangle by M. H. Rath.—5. On the simple construction of obliquely turned hyperboloids and paraboloids by Professor R. Niemtschik.—6. On a cosmical attraction exerted by the sun through its rays, by M. C. Puschl, in which the author sought to prove that by means of the æther-waves issuing from it the sun exerts an attraction upon opaque bodies, equivalent to the repulsion which it must have produced, according to the hypothesis of emanation, by the material particles emitted by it.—7. On the atomic heat of oxygen in its solid compounds, by M. J. Tollinger.—8. On the action of *Digitalis* and *Tinct. Veratri viridis* upon the temperature in crupose pneumonia, by Dr. L. von Schrötten.—9. Prof. V. von Lang delivered an address upon a new method of investigating the diffusion of gases through porous septa. His apparatus consists of a porous cell united by a thin caoutchouc tube with the air-tube of a Mariotte's bottle, so arranged that the gas in the cell is always under the atmospheric pressure, and as soon as an increase of volume takes place in it the excess flows over into the bottle, displacing an equivalent amount of water, which is determined by weighing.—10. The second part of investigations on ammonites by Prof. Suess, in which the author treated chiefly of the structure of the shell in the Cephalopodous mollusca. He showed that the shell which exists in the females of the existing genus *Argonauta*, is to be regarded as a rudimentary ammonite shell, consisting of an ostracum or outer layer without a nacreous layer, and that *Argonauta* belongs to a great group, commencing with *Trachiceras* and including *Cosmoceras*, *Toxoceras*, *Crioceras*, many *Scaphites*, and the *Flexuosi*.

DIARY

THURSDAY, April 14.

Mathematical Society, at 8.—On the Mechanical Description of a Nodal Bicircular Quartic: Prof. Cayley.

MONDAY, April 18.

Royal Asiatic Society, at 3.

TUESDAY, April 19.

Anthropological Society, at 8.—On the Hypothesis of Pangenesis applied to the Faculty of Memory: Mr. Alfred Saunders.—Note on Consanguineous marriages: Mr. G. C. Thompson.

WEDNESDAY, April 20.

Meteorological Society, at 7.
Society of Arts, at 8.

THURSDAY, April 21.

Linnean Society, at 8.—On the Vertebrate Skeleton: Mr. St. George J. Mivart.
Chemical Society, at 8.

BOOKS RECEIVED

English.—Forms of Animal Life: Prof. Rolleston (Clarendon Press).—Manual of Zoology: Dr. Nicholson (Hardwicke).—Alpine Flowers for English Gardens: W. Robinson (Murray).

Foreign.—Ueber Gährung und die Quelle der Muskelkraft, und Ernährung: Liebig.—Through Williams and Norgate.

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Errata.—In No. 23, page 580, second column, line 1: for "Langel," read "Laugel;" for "Lartel," read "Lactet."—Line 3: for "carnulorum," read "carnutorum."—Line 4: for "Trojonotherium," read "Trogontherium."

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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THURSDAY, APRIL 21, 1870.

ON ORIGINAL EXPERIMENTAL RESEARCH IN RELATION TO EMPLOYMENT FOR WORKMEN.

IT is an important national question, "By what means can employment for workmen in this country be increased?" My reply is, "By encouragement of experimental scientific research."

I have observed that increased employment of workmen constantly results from original experimental research in science in the following order: Experimental researches in science lead to scientific discoveries; scientific discoveries lead to practical inventions; and practical inventions lead to increase of employment. Usually, a scientific investigator first discovers some new fact or principle in science; next, an inventor applies this discovery, in the form of an invention, to some useful purpose; and then a manufacturer or man of business brings it into general use, and employs workmen or servants to assist him. In some cases, however, the discovery of a new truth in science, its application by invention, and its practical carrying out, are all effected by the same individual.

The following examples will illustrate the foregoing observation:—The discoveries of voltaic electricity, electro-magnetism, and magneto-electricity, by Volta, Oersted, and Faraday, led to the invention of electric telegraphy by Wheatstone and others, and to the great manufactures of telegraph cables and telegraph wire, and of the materials required for them. The value of the cargo of the *Great Eastern* alone in the present Bombay telegraph expedition is calculated at three millions of pounds sterling. It also led to the employment of thousands of operators to transmit the telegraphic messages, and to a great increase of our commerce in nearly all its branches by the more rapid means of communication. The discovery of voltaic electricity further led to the invention of electro-plating, and to the employment of a large number of persons in that business. The numerous experimental researches on specific heat, latent heat, the tension of vapours, the properties of water, the mechanical effect of heat, &c., resulted in the development of steam-engines and railways, and the almost endless employments depending upon their construction and use. About a quarter of a million of persons are employed on railways alone in Great Britain. The various original investigations on the chemical effects of light led to the invention of photography, and have given employment to thousands of persons who practise that process, or manufacture and prepare the various materials and articles required in it. The discovery of chlorine by Scheele led to the invention of the modern processes of bleaching, and to various improvements in the dyeing of textile fabrics, and has given employment to a very large number of our Lancashire operatives. The discovery of chlorine has also contributed to the employment of thousands of printers, by enabling Esparto grass to be bleached and formed into paper for the use of our daily press. The numerous experimental investigations in relation to coal-gas have largely been the means of extending the use of that substance and of increasing the employment of workmen and others connected with its manufacture. The discovery of the alkali metals by Davy, of cyanide of potassium, of nickel, phosphorus, the common acids, and a multitude of other substances, have led to the employment of a whole army of workmen in the conversion of those substances into articles of utility.

The foregoing examples might be greatly enlarged upon, and a great many others might be selected from the sciences of physics and chemistry, but those mentioned will suffice. There is not a force of nature, nor scarcely a material substance that we employ, which has not been the subject of several, and in some cases of numerous original experimental researches, many of which have resulted, in a greater or less degree, in increasing the employment for workmen and others.

The variety and extent of the employments which have resulted from scientific research are so great that they ramify in some form or other through nearly all our manufacturing, artistic, and commercial occupations, our social relations, and our every-day life; and those employments have become of such common occurrence that we are apt scarcely to think how much experimental research has had to do with their production, and we are thus led to undervalue original experimental investigation as a means of producing employment. Persons in general can easily understand that an acorn planted in the ground will, in the course of time, become an oak, because it is a palpable and visible effect; but they cannot so readily perceive that the abstract scientific fact discovered by experiment to-day will probably soon become an invention of practical daily use, not because it is less real, but simply because it is a phenomenon less evident to the senses, and requires a greater exercise of intellect to perceive it.

In many instances the application of original experimental science in new inventions has superseded, and in a limited sense diminished, manual labour, but it has in such cases either substituted more intellectual occupation for it, or has opened up new sources of employment to a far greater extent by increasing trade and manufacture. For example, the number of waggoners and horses now employed to collect and deliver all the goods for railways is much greater than the whole of those employed for conveying the goods of the country before railways were constructed.

The capability of developing increased employment by the means proposed is immense, and practically unlimited, because scientific discovery is quite in its infancy, and we are at present only on the very threshold of a knowledge of the forces of nature and of the constitution of material substances; in this sense, therefore, experimental scientific research may be viewed as *the* great fountain-head of employment for workmen.

The reason why original experimental science is the great fountain-head of industry in manufactures and trades trades is, that it is only by means of such research that we can become accurately acquainted with the forces and substances involved in manufactures, and be enabled to use them to the greatest advantage. The intimate connection between science and industry is shown by the fact that when new scientific discoveries are published there are numerous inventors who immediately endeavour to apply them to useful purposes, and men of business ready to carry out the inventions practically.

The great and important results already obtained by the cultivation of original experimental research show that it is a national necessity, and naturally suggests the idea, can we not by a greater degree of encouragement of such research still further increase employment for working men, and still further elevate their intellectual condition?

At the present time there is in this country no recognised payment for the labours of scientific discovery, and no provision for the support of men who investigate science; any person is at liberty to take the published results of scientific men from the Transactions of the Royal Society, the Chemical Society, and other learned bodies, and employ them as the basis of inventions and patents, without the slightest payment, notwithstanding these results have been obtained at an immense cost of study, time, and labour, and a large amount of money. I do not mean by these remarks to conclude that scientific discoveries should not, on publication, become at once public property, but that some means of support should be provided for the men who make them, and thus the development of employment for workmen be increased.

Experimental scientific research, in the stricter sense of the words, is a comparatively modern thing, and though it has existed in a more limited degree during many centuries, it can only freely exist and thrive in civilised countries. Even at the present time, in consequence of the peculiar nature of the occupation, its hopelessness as a source of emolument to the investigator, the great skill and extreme self-denial required, and frequently danger incurred in its pursuit, and the consequent great difficulty of achieving success in it, *scarcely one person in one million of the population of England is exclusively devoted to it*, although a much greater proportion occupy a small amount of their time in its advancement.

The extension of physical and chemical knowledge by means of experiments and observations is *national* work: it benefits the nation, but does not pay the investigator. The various scientific men who discovered the chief facts and principles of science upon which steam-engines, electric telegraphs, and all the modern applications of science are based, received no remuneration for their researches. The results of purely scientific investigations are generally unsaleable, because, instead of benefiting a single manufacturer only, they benefit the whole nation; the nation, therefore, being the gainer, should pay and provide for those who make such researches. And when we consider that in this country upwards of 576 millions of pounds have been expended in the construction of railways alone, and immense sums upon electric telegraphs, which would never have been expended but for such labours, and nearly all of which have given employment to numberless workmen, it is evident that the magnitude and national character of the results would fully justify national encouragement of original experimental research.

The more abstract an experimental investigation is, the more important and widely diffused are its practical results. Who would have thought, when Oersted in his original abstract research in electro-magnetism first made a magnetized needle move by the influence of an electric current, that his labours would lead to the expenditure of many millions of pounds in the laying of telegraphs all over the earth, and the employment of many thousands of persons in their construction, maintenance, and use? And who can tell how many similar important discoveries have been lost to the nation, and how much of the present deficiency of employment for workmen has arisen, in consequence of experimental scientific investigators not having been paid for their labours?

At present, original experimental researches are generally made by teachers of science who expend a portion of their incomes in making experiments and observations; but the very limited means of such men is a serious loss to the nation by greatly retarding the progress of discovery, and consequently also of improvements in manufactures. Many of the experiments, also, necessary for the development of new discoveries are beyond the means of such persons at present, and cannot be made without the command of greater wealth.

If England is to keep pace with the progress of foreign intellect and of foreign manufacture, and keep her workmen fully employed, there must not only be a general diffusion of scientific knowledge throughout this country, but there must also be national encouragement of original scientific investigation.

Has it been wise in our Governments thus to overlook a great source of the nation's wealth, to disregard a most important means of national economy, to neglect the great fountain-head of industry? Shall we allow foreigners to supplant us in manufactures, and shall our fellow-men continue to be driven to emigration by want of employment? or shall we develope for them new sources of labour by means of original experimental research? It needs only to bring the subject fairly and effectually before the attention of our present enlightened and progressive Government, to ensure its careful and early consideration.

The neglect of original experimental science in this country by our Governments has long been noticed by scientific men and others, and a suggestion has been made to the British Association by Lieut.-Colonel Strange, to found "National Colleges of Original Research," in which science should be investigated, but not taught. This would be *one* way of supplying the want; the funds for supporting such colleges might with propriety be obtained from the fees paid for patents, because patents are in many cases based upon the published results of original experimental researches; other ways of supplying the want might also be indicated.

GEORGE GORE.

OUR DOMESTIC FIRE-PLACES

Our Domestic Fire-places. By Frederick Edwards, jun. A new edition, &c. (London: Longmans, Green, and Co. 1870.)

THIS book, although bearing considerable traces of having for its object the advocacy of a particular manufactured article—nevertheless shows the author to have so much mastery over his subject as to justify its publication; and if the work be considered merely as the contribution of a highly qualified producer, the duty of the reviewer would be almost entirely to commend it; but if it is proposed as a complete and unbiassed treatise on the domestic fire-place he finds a good deal of reason to dissent.

After a somewhat diffuse essay on the hearth of the ancients—in which, by the way, the theory is too easily adopted that the Romans were entirely ignorant of the chimney—we come to the methods of our ancestors. Why the cosy folding screen must henceforth be given up, and why, in speaking of the introduction of the smoke-jack, the past services of the turnspit dog are entirely ignored, may be asked in passing.

Page 17 introduces some interesting particulars of the first use of coal, and page 30 a well-merited eulogium on the labours of Count Rumford in the improvement of fire-grates, and we now approach the pith of the whole matter, namely—how to burn our coal so as to get the maximum of heat with the minimum of smoke and soot. (pp. 44 *et. seq.*) Here the author, having one excellent contrivance to recommend (namely, Dr. Arnott's smoke-consuming grate), has allowed himself to be unfair to other inventors whose grates for certain purposes are preferable. Of this class perhaps the most conspicuous example is the manner in which Taylor's stove, manufactured by the Coalbrookdale Co., is treated in the work before us. It is indeed mentioned (page 51) as an ingenious contrivance but full of deficiencies in practice, and as one which "now appears to have become forgotten." As respects its deficiencies, several instances are well known to us in which this grate of Mr. Taylor's has given the greatest satisfaction. No unsightly contrivances—no troublesome machinery—a bright fire—the whole apartment pervaded by the fresh warm air brought from an external source to the back of the stove, and emitted from the radiating tiles—the chimney-sweeper's visits for years dispensed with—such are some of its characteristics; and as to its "having become forgotten," assurance has been received from good authority that the demand for these grates is well kept up.

There are also several stoves which in a work like the present should have been noticed, *e.g.* Wright's, Woodcock's, Rosser's, and especially Galton's.

At page 54 the author discusses the recommendations of the committee appointed by the Board of Health, and gives some valuable comments upon them, and then proceeds to consider the question of the *Stove of the Future*, in its materials and management. Nothing has been more clearly established than the superiority of fire-brick over iron for the "fire-pot," or actual inclosure of the fuel. But the benefit of this discovery has, as yet, only reached the upper and middle classes of society, "but," says the author, p. 66, "in small houses and in the apartments occupied by skilled and unskilled workmen, the use of fire-brick is unknown, so that those who most require to use economical grates are those who are most ill provided. The working classes have either the most trumpery contrivances that Thames-street can furnish, and which are put into the fire-place at the smallest possible expense for labour and materials; or they use, in streets which have become gradually deserted by the classes which once lived in them, the badly arranged fire-places of thirty or fifty years ago."

We hope that these valuable observations will not be lost. Such fire-places as Pierce's Cottage Grate, described p. 39, are scarcely more expensive than the cheap and trumpery contrivances referred to, and if the proper arrangement of the chimney throat could also be secured in all newly constructed houses for the working-classes, the effect would be soon apparent both in favour of their health and of their pockets.

This improvement of the chimney throat is described by the author p. 73, and consists in contracting the flue to its ordinary capacity at once at the top of the fire-place opening, instead of the more common practice of gathering it in by degrees.

In p. 85, the plan of having a single main chimney-shaft for all fire-places which are situated in the same part of the house is advocated. It is not evident, from the text, whether the author is aware that this plan has been carried out, in several instances, in different parts of the country. It is a subject, certainly, which deserves more attention than it has yet received.

In the last chapter (p. 90), the general warming of halls, corridors, &c., is considered. It may be mentioned in connection with the Russian and Swedish method referred to, that the Germans, who have hitherto adopted generally the same plan, are beginning to place the fire-front of the stove in the apartment that is to be warmed by it, instead of in the corridor, with the stove surface only in the apartment, and, as may be supposed, with a manifest improvement in the ventilation.

This chapter is well worth attention: exception must, however, be taken to the way in which Gurney's stove is mentioned, p. 108. "The prestige attaching to the name of its producer," may, indeed, have not been without its use in obtaining for these stoves their first trial, but would hardly have been sufficient, apart from their intrinsic good qualities, to have obtained for them the wide reception both at home and abroad which they have had; or to have created the almost invariable satisfaction with which their use has been attended.

The book is a useful contribution to the literature of the subject, and well illustrated by engravings. F.C.P.

OUR BOOK SHELF

The Mammalia of Massachusetts. By J. A. Allen. (Trubner & Co.)

FROM this carefully drawn-up report we learn that there are sixty-five mammals at present indigenous to this American State. The common ones, with a few exceptions—as the mink (*Putorius lutreolus*), weazel (*P. erminеus*), and skunk (*Mefitis mephitica*), among the carnivores; *Vespertilio subulatus* and *Lasiurus noveboracensis* among the bats—belong to the families of the rodents, the squirrels, mice, and hares, and to the *Balænidæ* and *Delphinidæ*, which latter are of course marine. The panther, moose, reindeer, elk, and beaver have comparatively recently become extinct. A notice is appended to the work by Prof. Agassiz, earnestly requesting friends to forward to him males, females, and young of almost any of the European mammals. Books on mammalia would be equally valued, and in exchange he offers on the part of the museum at Cambridge, U.S., representatives of the North American fauna and American books.

Effects of Climate and Soil upon Plants.—*Die Abhängigkeit der Pflanzengestalt von Klima und Boden.* Von A. Kerner. Pp. 48. (Innsbruck, 1869. London: Williams and Norgate.)

THIS pamphlet is of greater importance than would be indicated by its mere size, as a contribution towards an investigation of the causes which lead to the diversities of floras, and hence towards a knowledge of the laws on which depends the great problem of the origin of species. M. Kerner has made a special study of the flora of the

Tyrolese Alps, and has even attempted to introduce into a small plot of ground in the mountains surrounding Innsbruck, a number of plants indigenous to the lowlands of the Tyrol. In this enterprise, however, he met with no very encouraging success; "the greater number of the plants which I brought to those heights with inexpressible toil, succumbed to the uncongenial Alpine climate; and in the remaining small portion, I have noticed at present only very unimportant changes." His conclusion from these experiments is "that changed conditions of life can kill the species, or they can reduce it to a starved existence, but can in no case produce a *direct* change into a new permanent species adapted to its altered conditions." Such change can only take place by the slow process of natural selection among slightly varying offspring from the parent species. The writer notices a number of interesting features that characterise the Alpine flora with which he is familiar, as contrasted with those found under other climatal conditions. One of these is the very small number of annual plants, which bear to perennials the proportion of 4 to 96, as contrasted with that of 42 to 58 in the Mediterranean district, and of 56 to 44 in that of south-eastern Europe; a result of the very short period of summer warmth, varying from $1\frac{1}{2}$ to $3\frac{1}{2}$ months, which does not allow time for the seeds to ripen. The same cause produces also the appearance in many Alpine species of the flower-buds at the close of the summer, ready to burst into blossom during the first days of returning warmth in the spring. The remarkably large proportion of Alpine plants with evergreen rosettes of fleshy or succulent leaves, *Primulas*, *Gentianas*, *Androsaces*, *Saxifragas*, *Drabas*, &c., he attributes to the advantages of some contrivance for obviating the effects of the intense heat of the sun during the long days in their short summers, and also to the necessity that the plant should possess leaves at the very commencement of the warm season, in order to afford it a store of nourishment, and thus economise the whole of the brief period of vegetation. With this peculiarity he contrasts the poverty of the Alpine flora in plants possessing stores of *underground* nourishment in the form of bulbs, a class so abundant and prominent in the south of Europe. The necessity for great caution in deriving general conclusions from a small array of facts, is shown by the mention by M. Kerner, among the plants well adapted by their constitution to withstand the great alternations of an Alpine climate, of *Dryas octopetala*, a species which flourishes equally well in the remarkably uniform climate of the west coasts of Ireland and Scotland. The want of any considerable number of large shrubs and forest trees is obviously due to the rigours of the climate; and the almost entire absence of climbing and creeping plants indicates that protection from the sun is not one of the first conditions of existence, as it is in tropical forests. The large proportion of plants with flowers of intense hues, and the deficiency of spiny and stinging species, are not so easy to account for, though the author attributes the latter to the comparative absence of destructive animals; and the former may possibly have some connection with the advantage derived from the speedy attraction of insects, after the flowers expand, to assist in their fertilisation. We can conceive no greater service to biological science than a series of observations on the floras of limited areas, both with respect to what they possess and to what they are deficient in, carried out with the care of those recorded in the work before us.

A. W. B.

The fourth volume of the *Atti della R. Accademia delle Scienze di Torino*, contains several important papers on various departments of science. We may notice especially Prof. Salvadori's memoir on some birds from Costa Rica, and the same author's monograph of the genus *Ceyx;* a memoir by M. F. Giordano, on the orography and geological constitution of the Gran Cervino; and mineralogical papers by Prof. Strüver and Dr. Cossa.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Evidence concerning Heterogeny

THE question of the truth or falsity of "heterogeny," as it is called, is perpetually recurring both in your columns * and elsewhere, in connection with several of the most important scientific controversies of the day. It is a subject which has engaged my attention for several years, and I am anxious to be permitted to lay before your readers as concisely as possible a statement of what appears to me to be its present position.

I think the impression which most recent references to it are likely to leave on the minds of readers is this—viz., that while amongst the most advanced thinkers there is a gradually strengthening conviction that the weight of theoretical considerations is in favour of the actual existence of heterogeny as a real mode of origin of living beings, yet that the authority of M. Pasteur's famous researches inclines the balance of experimental evidence heavily the other way.

I am perfectly willing to admit the principle of authority in matters scientific as far as any reasonable person can admit it—that is to say, I believe it is natural and right that when a scientific man of so deservedly high reputation as M. Pasteur publishes a long series of carefully conducted researches, and announces the conclusions to which they lead him, and when no evident flaw can be shown in his processes, either of experimentation or of reasoning, his conclusions should be accepted as against those of another comparatively unknown experimenter. But in the present case neither of these conditions is fulfilled. In the first place, instead of merely an unknown experimenter we have in this case a consensus of at least eight experimenters—some of them by no means unknown—who have given their best attention to the same investigation in different parts of the world and under widely differing conditions, and who agree in disputing M. Pasteur's results.†

In the next place, there is a step in M. Pasteur's experimentation which has been pointed out as a flaw, and of which it is in the power of any one of your readers to judge for himself by a process of simple inspection as to whether it really be a flaw or not. I refer to the subject of the microscopic power used by M. Pasteur in his investigation. The organisms which I found during my own experiments on this subject appeared often but little larger than a full point in the type used in your columns, even when seen with a power of 1700 diameters. In the woodcuts attached to my paper in the Proceedings of the Royal Society (April, 1865), they may be seen as they were kindly drawn for me by my friend Dr. Beale, who, though an uncompromising opponent of the doctrine of heterogeny in all its forms, is a very high authority in microscopy; there can therefore be no question as to their size, nor as to their actual presence in the experimental vessels. Now under the power used by M. Pasteur (350 diam.) these organisms would be about $\frac{1}{25}$ part of the size which they appear in the drawings. Yet it is upon the authority of observations made with such a power that M. Pasteur has pronounced, not upon the *presence* of these objects, but upon their *absence.* It is now nearly five years since my observations were made public. Since that time several critics have noted them as requiring an answer, but, so far as I am aware, no answer has been made to them; and meanwhile naturalists have gone on complacently quoting M. Pasteur's experiments as having settled the question against heterogeny, even though they have not failed to acknowledge the weight of the theoretical considerations which tell in its favour.

The theoretical aspect of the question I have fully discussed elsewhere,‡ and I will only here state my entire agreement with the belief expressed by Dr. Charlton Bastian in your issue of February 24, viz. "that the time is not far distant when the doctrine of the evolution of living things will be as much an

* NATURE, Feb. 1, p. 351; Feb. 24, p. 424.

† 1. Pouchet, "Nouvelles Experiences" passim. 2. and 3. Joly and Musset, *Comptes Rendus*, 1860. 4. Schaafhausen, of Bonn, *Comptes Rendus*, 1860 and 1862. 5. Mantegazza, of Pavia, see *Cosmos*, 1863, p. 630. 6. Wyman, Harvard, U.S., *American Journal of Arts, &c.*, vol. xxxiv., July 1862, vol. xliv., September 1867. 7. Proceedings of Royal Society G. W. Child, Oxford, June 1864 and April 1865. 8. Hughes Bennett, Edinburgh, *Edinburgh Medical Journal*, March 1868.

‡ "Essays on Physiological Subjects," 2nd edition, pp. 137—154.

accredited dictum of science as are the other doctrines of the correlation of the physical forces and of the correlation of the vital and physical forces which have been its necessary predecessors."

GILBERT W. CHILD

Elmhurst, Great Missenden, Bucks.

Prismatic Ice—Sandstone Boulder in Granite.

THE "two phenomena" observed on Dartmoor by Mr. C. Spence Bate and Mr. W. Morrison, and described by the former in NATURE of the 31st ult., have been previously noticed.

The late Rev. Dr. Scoresby, F.R.S., published a paper "On Columnar Crystallisation of Ground Ice," in the *Edinburgh New Philosophical Journal* for January 1850 (vol. xlviii.), and illustrated it with a plate containing eighteen figures. A presentation copy of this paper is now before me.

The so-called *sandstone boulders* in granite are by no means rare. They occur in various parts of Devon and Cornwall. I first noticed them at Shaptor, near Bovey Tracey, in Devonshire, and have subsequently seen them in several other localities, but nowhere in such abundance as at Sennen Cove, near the Land's End, in Cornwall. There are several good specimens in my private collection. The following description of them occurs in a paper on "The Age of the Dartmoor Granites," which I read to the British Association at Manchester, and to the Royal Geological Society of Cornwall in 1861, as well as to the Devonshire Association in 1862. "Nodules, apparently segregative, sometimes occurring in the substance of the ordinary granite, might, from the fineness of their grain, be almost mistaken for sandstone; indeed, I not long since heard them appealed to as proofs of the metamorphic origin of granite. 'Here,' said the appellant, 'are unaltered remnants of the old sandstone rocks, which, with these exceptions, metamorphism has converted into granite. I do not quote this for the purpose of endorsing it, but simply to show the general dissimilarity of the nodules to granite proper. Excepting their darker colour, they reminded me much of the granite veins which pass through the older granite of Goatfell, in the Isle of Arran; nevertheless, they are not veins but nodules, and capable of being extracted as such from the granitic mass containing them. . . . They consist of very fine grains of quartz and schorl in about equal quantities, or with the latter somewhat preponderating."*

Irrespective of the origin of the nodules, it is no doubt "clear that when this granite was formed, the temperature of (the surface of) the earth must have cooled down to below the boiling point of water," for the granite, as has long been established, is of post-carboniferous age; or, in other words, was formed after the rich faunas and floras of the Silurian, Devonian, and Carboniferous periods had successively passed away, to say nothing of the pre-Silurian organic eras.

WM. PENGELLY

Torquay, April 2

* See *Geologist*, 1863, p. 15; Trans. Roy. Geol. Soc. Com., vol. vii., p. 425; or Trans. Dev. Assoc., 1862, p. 50.

The Transits of Venus in 1874 and 1882

IN the paper on this subject by P. L. S., there occurs a remark which is calculated to convey a mistaken impression. He states that "an Antarctic station is only required for the transit of 1882, and there is ample time to make a preparatory Antarctic expedition to ascertain" whether a suitable station can be found. The reverse is the case. No Antarctic expedition can be of any service in 1882, so that in a preparatory expedition the lives of our seamen and men of science would be uselessly risked. On the contrary, there are several Antarctic stations suitable for observing the transit of 1874; and I have shown that the comparison of observations made at such stations with observations made in Siberia would give the most effective means of determining the sun's distance available before the 21st century.

I may remark here, that the choice of stations for observing the transits of 1874 has been founded on calculations admittedly inexact, and it would be to the credit of English astronomy that the whole matter should be re-examined while there is yet time for a change to be made. In saying this, I am not by any means insisting upon the views put forward in my own papers on the subject; though the only error pointed out by the Astronomer Royal in my charts and calculations consists in the fact that they aim at an unnecessary exactness. But the utilisation of the coming transits is a matter too important to be endangered for any personal considerations whatever. If errors have been made it behoves men of science to see that those errors shall not be suffered to prejudice the cause of scientific progress.

RICHARD A. PROCTOR

Euclid as a Text-book

I REGRET that Mr. Wormell has imported so much of a personal nature into his reply to my former letter. Personality and unintentional misrepresentation appear to me to be its predominating features. Unintentional, I say, for I know little of the writer beyond the fact of his being the author of two or more admirable text-books, and that he is a distinguished member of the London University.

Though I feel that the columns of NATURE ought hardly to be taken up with such matter, yet, in self-defence, I am compelled to say a few words. As I have neither time nor inclination for controversy, I hope that the discussion, if continued, will be entirely *ad rem*, and not diverge into personalities. Owing all my geometrical ability (*quod sentio quam sit exiguum*) to a twenty-three years' acquaintance with Euclid, and having had, as a teacher, to use that author for the last fourteen years, it would not be strange if I *were* a favourer of the old system, which I *am not* to the extent Mr. Wormell seems to think.

My plan of teaching geometry under the old system was to overcome Euclid's deficiencies by *viva voce* explanation, and, offering slight assistance, to get my classes to work a number of geometrical exercises. With my sixth class I have generally got well through three or four hundred such exercises as are given in Todhunter's edition of the Elements.

This is not the same as sending out boys who have merely "committed Euclid to memory," and certainly my pupils have found no great difficulty in the matriculation papers. Pupils thus prepared have taken first, second, third, and other high places in the examination, which places, I think, were in a measure due to their "flooring" the geometrical papers—with the exception, perhaps, of a "rider;" also, during the time I have held my present post, my pupils have carried off the Andrews Entrance Exhibition at University College each year, with one exception, when the finest geometer I have had was beaten. This is not the place for chronicling successes in other examinations.

I did not state that it was advisable for students to read Euclid only; what I did say was to the effect that I had heard of boys who were doing this with the idea that such a course would "pay" best. Mr. Wormell charges me with using an "infelicitous and ungenerous expression." That I willingly retract, as it has struck myself as being uncalled for; but Mr. Wormell must have read my purposely concise letter hastily, for I nowhere say that I desire a change in the syllabus; the syllabus is excellent, and I quite agree with him in the remarks he adds about the "unflinching courage in the reform of English methods of education" as far as regards the matter under discussion. But what is possible is, that the examiners, being chosen from the older universities, may overlook this distinction; until now, I have had to regard the papers from the old point of view, in which light they have suited me exactly; Mr. Wormell has viewed them from the modern stand-point, and bears the like testimony; this being so, it must be admitted that the examiners have well carried out the syllabus. That I should "impeach the integrity" of such men as the present examiner, from whom I have always experienced the greatest kindness, or the late examiner, one of the most successful teachers of my own university, would be absurd, were it not that it pains me to have it supposed. To return, I do not want quite such a change as Mr. Wormell thinks; the difficulty in my case has not yet arisen, for I have not yet sent in pupils whose training has been wholly confined to the new Geometry, and I wished to have the change made, if any were necessary, before sending them in. The difficulty will not be so great when we have obtained a thoroughly good modern text-book; ours is a very good one, but there are blemishes which will doubtless be removed in a new edition, and to adapt it to the matriculation scheme more propositions than at present must be proved, as I think, independent of proportion. I applied the term "Euclidean type" to the recent examination paper, because the questions are given in the exact words of Euclid; I would have this changed; they follow in the order assigned in the Elements, and perhaps my experience of

Cambridge Examinations leads me erroneously to think that the proofs are expected to be given in the same order. In drawing this personal statement to a close, I may say that I am not singular in the view I took, as I learn from several gentlemen who have spoken to me on the point, and indeed, had it not been that the authorities* of University College School thought I had some ground for my views, I should have kept silence altogether. I believe the matter will come under the consideration of the proper authorities, and in their hands I am perfectly willing to leave the settlement of the question, if there be any need for a change.

R. TUCKER

University College School

Science and the University of Cambridge

ONE of the last sentences in your paragraph concerning the report of the Syndicate for providing better opportunities for the study of physical science in the University of Cambridge, though founded upon a partial misconception of the state of affairs, suggests what is probably the best solution of the difficulty. The colleges, if polled upon the simple question, "Shall we aid in promoting the study of physical science?" would, I believe, reply by a considerable majority in the affirmative. It is upon the best mode of contributing that there is so much division of opinion; and this has caused the apparently "lame and impotent conclusion."

The question of taxing the college revenues is one of considerable difficulty; some colleges already support out of their corporate funds teachers of natural science, some have recently taxed themselves heavily to improve their buildings. Most would think that non-resident fellows who do little for the college should be taxed more heavily than those who reside to do much work for no great amount of pay; but to bring about this would require much alteration of statutes. The question, therefore, being so complicated, and there being, as I believe, a general willingness to contribute, if only a just and equitable mode of raising the funds can be devised, and proper control retained over them (for the University is not generally considered to manage its property so well as the colleges), I believe that the difficulties would be most simply solved by the appointment of a commission composed of a few well-qualified persons, thoroughly acquainted with the University, to devise a scheme and to draw up an act for carrying it into effect.

T. G. BONNEY

St. John's College, Cambridge

EXPLORATION OF CAVES AT SETTLE, YORKSHIRE

IN the mountain limestone of the West Riding are many caves, some of which are empty, some traversed by water, which is silting up their lower chambers, while others are full up to the very roof with débris of various kinds. All have been, at some time or other, subterranean watercourses, and have been formed, partly by the friction of the substances set in motion by the current, but principally by the chemical action of the carbonic acid of the rain-water by which the insoluble carbonate of lime in the rock is converted into the soluble bicarbonate. Some have been inhabited, at various times, by man, and by wild beasts, and therefore may be expected to furnish valuable evidence of a condition of things that has now passed away. The last recorded case of their being used by man as a place of refuge was during the rebellion of 1745, when the eldest son of one of the gentlemen in the neighbourhood was hidden in a large cave, in the fear that the Scotch would pass southwards in that direction instead of by the Preston route.

The gentlemen of the West Riding have formed a committee for the systematic exploration of these caves, and will doubtless obtain from them evidence of the very highest archæological value, relating to a time of which we know next to nothing,—that begins with the disappearance of the mammoth, hyæna, and lion from Northern Europe, and extends as far down as the dawn of history in Britain, during which the neolithic and bronze-using races spread over Europe from the south-east. The older caves have been explored in many parts of Britain, while the pre-historic of the later have only been systematically examined in Somersetshire and Denbighshire by myself and Mr. Sanford. That the work in Yorkshire is planned well is clear from the following extracts from the Resolutions:—

That the following scheme, proposed by Sir James Kay-Shuttleworth (chairman), be adopted, viz.:—

1. To examine the ground around the mouth of the caves for signs of fire, implements, utensils, remnants of food, or traces of sepulture.
2. To make a survey of the caves in order to provide a plan of the interior drawn to scale, and of a sufficient size to enable a record to be made on it of the situation in which each thing is found.
3. To ascertain by one or more vertical excavations of limited extent what are the deposits chronologically arranged.
4. Then to proceed to examine these strata from the mouth of the cave inwards, so as to secure the discovery of all remains throwing any light on the history of each stratum.
5. To keep a record of the things discovered.

The first cave chosen by the committee is that found by Mr. Jackson, high up in a limestone cliff near Settle, on the coronation-day of our Queen, and which is therefore known as "the Victoria cave." It consists of a series of large chambers and passages, which are nearly filled to the roof with a reddish grey clay and stones. It must at one time have been of wonderful beauty, for there are the remains of massive stalactites, and of thick stalagmitic pavements; but now these are so decomposed by the carbonic acid that they are reduced to the condition of very soft mortar. Curiosity-hunters have also been doing their usual ruthless mischief. When it was first opened, Mr. Jackson obtained from a chamber at the original entrance a large series of ornaments and implements of bronze, iron, and bone, along with pottery and remains of animals. There are in his collection bronze fibulæ, iron spear-heads, iron nails, bone spoons, spindle whorls of stone and pottery, fragments of Samian ware, and other pottery turned in a lathe, cockle-shells, flint flakes, whetstones and stone balls. The remains found with these belong to the red deer, roebuck, pig, horse, and Celtic short-horn (*Bos longifrons*), sheep or goat, badger, fox, otter, and dog. There are also Roman coins of bronze and silver. All these were derived from a superficial deposit, and could not be assigned to an earlier date than that of the Roman occupation. The pottery was of the same kind as that so commonly found in the refuse heaps near Roman villas. It is worthy of note that the two domestic animals, the Celtic short-horn and the sheep or goat, were those that had been most abundantly used for food. The exploration committee resolved to follow up this discovery by a thorough examination of the cave, which they are able to undertake by the courteous permission of the owner, Mr. Stackhouse.

Outside the entrance of the cave, and at a lower level, is a small plateau composed of *débris*, which occupies the exact point where daylight could be seen through chinks, from the inside of one of the large chambers. As both the plateau and the chamber were undisturbed, the committee determined to begin work by removing the *débris* and making a new entrance into the cave. While this was being done, the following section was exposed. On the surface there was a layer of fragments of limestone that had fallen from the cliff above, two feet in thickness. Underneath was a layer of dark earth with stones about eighteen inches in thickness. It furnished large quantities of bones, nearly all of which had been used for food, and several articles of bronze, iron, or bone of the same kind and age as those I have already mentioned. The pottery is also of the same Roman character. Fragments of charcoal were also abundant, and stones bearing the

* What strong views in favour of the modern methods are held by Prof. Key, may be seen from Prof. Hirst's preface to our Geometry.

marks of fire. There can be no doubt that this stratum marks the place where the dwellers in the cave, during Roman or immediately post-Roman times in Britain, kindled their fires and cooked their food. Underneath is a talus of limestone fragments detached from the cliff by atmospheric action, like the superficial accumulation. It is from six to seven feet in thickness. In some places the fragments were cemented together with a soft decomposing stalagmite. It rested on a layer of grey clay, of a thickness which at present has not been ascertained. At the bottom of the talus, and close to the entrance that is now being made into the chamber, there were found two rude flint flakes, a remarkably large lower jaw of bear, the broken bones of the Celtic shorthorn (*Bos longifrons*), and of the red-deer. On the 4th April a most remarkable bone harpoon was dug out from the same horizon. It is between four and five inches in length, and is furnished with two barbs on each side, arranged opposite each other, composing the head of the implement. The base presents a form of attachment to the handle which, so far as my knowedge extends, is new to Britain. Instead of having a mere projection to catch the ligatures, there is a well-cut barb on either side that points in a contrary direction to those on the head. Were the bases of a barbed arrowhead and of a harpoon joined together, the resultant form would be analogous to the one in question. Therecan be no doubt from the position of these remains, that man occupied the spot before the accumulation of the overlying *débris*. Ample use for his harpoon he would find in the mere, now drained and turned into green fields, which are almost overlooked by the cave. So far as the work has proceeded there is no trace of metal at this horizon in the section.

The value of the evidence hitherto obtained lies in the fact that the Roman stratum is separated from the lower level, in which the flints, harpoon, and bear were found by the talus of angular stones. And this in a rough way enables a computation to be made of the date of the lapse of time between them, if we allow that for a considerable time past, immediately outside the historical epoch, the disintegration of the cliff has been equal, in equal times. For since, in twelve hundred years, to put it at the lowest, only a thickness of twenty-four inches has been accumulated above the Roman remains, it would take three thousand six hundred years for a deposit of six feet to be formed, and thus the harpoon and flint stratum would be about four thousand years old. The accuracy of this calculation is indeed injured by the possibility that the winter cold was more intense, and the splitting action of the frost greater in Pre-, than in Post-Roman times. Nevertheless, the change from the Arctic severity of the post-glacial winter, to the climate which we now enjoy in Britain, has been so gradual, and has been spread over so long a period, that it may be assumed to have been very small in so short a time as four or five thousand years.

This account is merely an outline of the results obtained up to April the 4th. The cave promises to be a rich one, and will probably add very much to our knowledge of the Pre-historic dwellers in Yorkshire.

W. BOYD DAWKINS

THE ABRADING AND TRANSPORTING POWER OF WATER

I.—MECHANICAL PROPERTIES OF WATER

IT is not my intention to lay down definite rules or formulæ regarding the flow of water, but rather, by drawing attention to generally-acknowledged facts, to throw out suggestions which may serve to lead to the discovery of some general laws of practical use to the hydraulic engineer.

In 1857 a paper was read by me before the Royal Society of Edinburgh, "On the Delta of the Irrawaddy," in which I expressed an opinion that depth somehow affected the abrading and transporting power of water.

My experience of Indian rivers and canals during the succeeding ten years went to confirm this opinion, and before the Institution of Civil Engineers, as well as on two occasions before the British Association in 1868 and 1869, I ventured to give expression to my views of this law, as affecting artificial rivers for irrigation, and the bridging of rivers which flow through the alluvial plains of Northern India.

In the *Artizan* there have appeared during the last six months several short articles bearing on the same subject, showing how all questions relating to flowing water are affected by this supposed law, which may be stated as follows: "*the abrading and transporting power of water increases in some proportion as the velocity increases, but decreases as the depth increases.*"

The first question that arises in this inquiry is—What is water in a mechanical point of view?

This may be briefly answered by saying that it is a fluid, the particles of which, though easily separated, do again unite, and exert a certain affinity towards each other, and also to other bodies, so that a certain amount of power is necessary to effect a separation. The attraction of the particles of water to other bodies varies with different substances; for instance, in all bodies of a fatty nature the facility for wetting is very slight; and different temperatures also affect this property of water. This attraction or force is technically known as "skin friction," and deserves the most careful investigation; for it is owing chiefly, if not altogether, to the fact that water has the power of abrasion, and it is this property which introduces the most difficult problems that a naval architect has to solve.

The affinity of one set of particles of water to another set, may possibly be measured by noting the size of a drop of water which falls from a wetted surface of a given area. By thus determining accurately the weight of water a given area can support, some approximate results of an instructive character may be arrived at; but what adds to the complication of the question is, that the cohesion of the particles probably differs according to the temperature and the purity of the water experimented on. Thus, when water reaches the boiling point the affinity, it is believed, becomes very much lessened; and, again, it is thought that with pure or distilled water the particles probably have less affinity to each other than with water less pure. This impurity may arise from various causes; sewage, for example, would probably give much heavier drops from the same wetted area than rain water, in the same manner that drops of treacle are much larger than those of water; that is to say, the affinity, attraction, or cohesion of the particles is as a general rule increased by the introduction of foreign matter held in solution. With solid matter held in suspension a similar result is obtained, not by increasing the cohesion of the particles of water, but by increasing the surface area wetted; for each grain of foreign matter, be its shape what it may, must have all its surface in contact with the water. This probably explains how a drop of mud should be so much larger than one of water, and, at the same time, it may possibly explain why thick muddy water, or more properly speaking, liquid mud, with the same section and slope, cannot travel so fast as water.

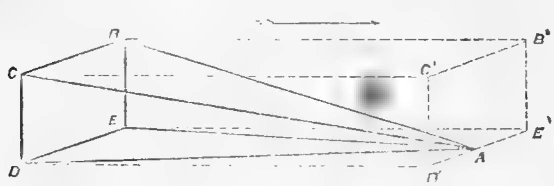
From this it may reasonably be supposed, that when muddy water runs down an inclined plane, the solid particles cannot by their own gravity sink so rapidly towards the bottom as to overcome the power dragging them in a different direction. As a consequence, the flow of water is retarded by having solid matter held in suspension in some proportion according to the load. On large rivers where this proportion may be only $\frac{1}{1000}$ or $\frac{1}{2000}$ part of the weight of water in motion, the retarding force may not be appreciable by the most careful experiments; so when calculating, the discharge may be left out altogether; but with torrents transporting 5 per cent. and more of solid matter, and with the discharge of sewage, it is believed that the retarding power is quite appreciable. The whole question is no doubt a very complicated one; yet by a set of careful experiments, conducted with a view to discover this adhesive power of water, it appears highly probable that an important step would be gained, towards the solution of some other difficult but important problems.

The next point to consider is—How does water travel? This also is a very abstruse question; but I believe that the true answer is given in the brief statement that water *rolls* rather than *slides*.

Were it not so, a ship with a foul bottom could not be so much retarded when passing through the water as experience shows she is. For example, supposing there are two ships in every respect the same, only that the first is covered with a coating of clean pitch a quarter of an inch thick all over her bottom to above her water line; and that the second, in place of the pitch, has got all her bottom covered with marine animals and weeds, so that when this second ship is passing rapidly through the water, none of the sea-weeds or marine animals extend more than this ¼ inch beyond the ship's sides, which is the thickness of the coating of pitch on the first ship: in such a case the displacement and the lines are exactly the same, but it is hardly necessary to ask any sailor which of the two ships, with the same wind and sails, would pass most rapidly through the water, and, in the case of two steamers, the extra resistance caused by the foul bottom could be easily measured in extra horse power required to force the foul vessel through the water at a speed equal to the other.*

If the motion of the water was a *sliding* one only, the speed in both cases would be the same with the same power, for the resistance would be simply the separation of the two films of water, the one in contact with the ship's sides and the other with the surrounding sea; and these, in both cases, would be identical, the displacement being the same. If, however, as is believed, on a body passing through water, or water flowing down a channel, the particles of water are set in motion in a revolving direction, the convolutions increasing directly in proportion to the wetted surface, then by this hypothesis some assignable reason for this retarding of the foul-bottomed ship can be given.

If the particles slid over each other rather than rolled, they would, so to speak, pass each other in parallel straight lines; but any one in a gale of wind, going behind a high square block of building, would very soon discover that, in air, such is not the case: for if he went a few yards away in the direction the wind was blowing, he would soon discover that the building no longer afforded any protection from the blast, but that there was some certain point to leeward where the currents again converged, while beyond this the storm raged with the same violence as at any other point. (Every boatman knows what it is to get under the lee of a very high island; the sea may be smoother, but the sudden gusts of wind are often more dangerous than when exposed to the full force of the gale.) Immediately in rear of the wall itself he would find eddies of air whirling about in all directions. Within the space



A B C D E there would be a partial protection from the storm, and instead of the wind being in the direction shown by the arrow, there would be whirling eddies within this space, which could not exist were the air to pass off in straight lines as represented by the dotted lines B B', C C', D D', E E'; neither could the several currents of air converge at the point A, which it is well known is always the case.

In the same manner any obstruction placed in a stream of water, causes eddies in rear of it; that is to say, the water does not pass on in straight lines, but within this space it goes revolving about in all directions, the distance of A probably depending on the velocity: showing that there is neither a sliding motion nor a parallelism in the direction of the lines of current.*

T. LOGIN

* Possibly by the introduction of an elastic medium, such as air, between the ship's bottom and the water, the skin friction may be reduced, as it may, in a measure, reduce this rotatory action.

* By an experimental study of this subject, it may be discovered how far these eddies extend with different velocities, which may throw light on the proper length of the after portion of ships intended for different speeds.

THE CLIMATE OF IRELAND

IN the science of nature there is no chapter more interesting than that which treats of Physical Geography, which, properly understood, means the account of physical phenomena as they are modified by geographical position; and at the present moment the physical geography of Green Erin, or it speculiarities of soil and climate, presents a theme of no slight importance. It has been stated in the House of Commons as a proof of the retrograde condition of Ireland, that its production of cereals has of late years diminished, while its pasture lands have increased. To this it ought to have been answered that the decreased cultivation of cereals, and of wheat in particular, was a proof of improved knowledge. Years ago, at the meeting of the British Association in Cork, a communication was read, pointing out that agriculturists in general are governed wholly by example, their scanty science not allowing them to quit the beaten path. Hence Irish farmers, when they aim at improvement, endeavour to imitate the farming of Norfolk or the Lothians, and in so doing fail miserably, owing to the wide difference between the climates of the western isle and of the eastern side of Great Britain. It is commonly stated that Ireland has a very wet climate. It has undoubtedly a humid atmosphere, owing, perhaps, in some measure, to a great extent of undrained surface. But the total quantity of rain that falls in Ireland, little, if at all, exceeds the rainfall of England. In its distribution through the year, however, it differs much from the latter. The vicinity of the Atlantic gives Ireland in the highest degree an oceanic and, to some extent, an equatorial climate. Winter in the Green Isle is extremely mild. The southern and western coasts, though seldom free from wind and drizzling rain, never experience severe cold. Vegetation remains in mid-winter brilliantly green and undepressed. As spring advances, everything seems to flourish; crops of all kinds promise abundance, and already, in May, harvest seems to be close at hand. But now the scene changes. There is little or no dry summer. When the sun is highest in the meridian, there is a constantly clouded sky and no sunshine. Rain begins to fall in June. The rainfall of July is the heaviest in the year. In August the rain begins to abate; but clear skies and bright sunshine cannot be reckoned on till September, when the shortened days and the sun's declination have much reduced the solar heat. The crops in the meantime, arrested in their progress, are not the better for two months' slumbering under the clouds They have summer rain in excess, and too little sunshine. From this it will be seen that the character of the Irish climate is, that under it everything grows well, but that the process of ripening is painfully slow and uncertain. Now, to cultivators of the cereals the success of this process is of the utmost importance. The corn harvest in Ireland falls late in the year, in September and October, when the days are short and nocturnal frosts not unfrequent. The plains of Southern Russia, or of the Red River in Canada, with a comparatively rigorous climate, far excel Ireland as wheat-producing countries, because their short summer is one of uninterrupted fierce sunshine; their vegetation suffers no check; the grain is ripened all at once, and the harvest gathered without delay or difficulty. The deficiency of ripening power in the Irish climate produces a secondary defect, which meets with less attention than it deserves. The grain which lingers on the stem two or three months before it hardens is sure to be unequally ripened; some of it is immature, while more is tending to decay. Consequently, it is bad seed, and the Irish farmer habitually sows perhaps six or eight times as much as Mr. Mechi would deem requisite. Under these circumstances, it is evident that the Irish farmer ought to cultivate cereals no further than is requisite for the economy of his farm, and to look to other productions for his profit. Fortunately, there is a husbandry for the pursuit of which he enjoys peculiar advantages. In green crops no country can compete with Ireland, where, nevertheless, they are still little known or esteemed by the multitude. From this it may be inferred that sheep and cattle ought to be the chief objects of Irish husbandry. In truth, the Green Isle, under proper management, could easily supply England with beef, mutton, poultry, milk, and butter, and grow rich by giving abundance at a cheap rate to her neighbours. But then this could be effected only under a system of large farms. The grazier and cattle dealer, to make their business profitable, must do it on a large scale. Butter of the best quality cannot come from a small dairy. The improvement of Ireland, therefore, as dictated by climate and natural capability, can be effected only under a system of large farms. The popular wish, however, is for small holdings. It is thought that the country, when divided into potato gardens and all covered with cottages, will be a paradise. But this poor man's paradise, beginning with a few years of felicity, will assuredly lead to the pauperism of ages. The Legislature cannot countenance schemes opposed to the wholesome development of society, and which would make poverty an institution; neither can it prevent their diffusion; but it may counteract them by spreading enlightenment and by presenting plain truths to the common sense of the community. This might be done by the publication of some statistics, showing the relative amount of cost and production of wheat and of green crops in England and Ireland, with some illustrations of the gain derivable from large farms and the use of machinery. W. D. C.

THE STONE AGE IN EGYPT

At a recent meeting of the French Academy, two communications were read relatve to the discovery of relics presumably belonging to the Stone Age in Egypt. The one of these was merely a claim on the part of M. Arcelin to priority in the discovery of various localities abounding in such remains. The other, by Messrs. Hamy and Lenormant, while according priority in the discovery to M. Arcelin, gives a list of the various spots at present known in Egypt on which the manufacture of flint implements was carried on in early times—or where *ateliers de fabrication* have been discovered. For the benefit of our countrymen travelling in Egypt, we here reproduce the list, arranged in the order in which the places occur in travelling southwards.

1. SAQQARAH, where have been found "scrapers" and other worked flints.

2. NEG-SALMANI, a small *atelier* in the desert, at some distance from the Libyan chain, and to the north of the ruins of Abydos. Flakes of whitish flint have been observed here.

3. HARABAT-EL-MADFOUNEH, another small *atelier* to the west of the great temple of Seti I., at the foot of the mountain. The worked flints, principally flakes, are of a fine texture, and pink in colour.

4. BAB-EL-MOLOUK, at the entry of the Valley of the Tombs. M. Arcelin here found flakes, "scrapers," &c.

5. GEBEL-QOURNAH. Here are traces of the manufacture on a large scale of worked flints of various types. Among these are said to be "lance-heads" of a curious character, like some of those from the Valley of the Somme, and the Cave of Le Moustier, arrowheads, knives with or without a shoulder, "scrapers," hammer-stones, and nuclei, not unlike those of Pressigny. The flint is brown or blackish, and fine in texture.

6. DEIR-EL-BAHARI, and 7, DEIR-EL-MEDINEH, at the foot of the mountain of Thebes. Nuclei and flakes, like those of Gebel-Qournah, are found here occasionally, and it is suggested may have come from some unexplored locality on the summit.

8. EL-KAB, where, at the foot of the cliff, flakes, arrowheads, and other forms have been found.

Besides these localities, where worked flints occur on the surface of the soil, there is ABOU-MANGA, where the containing bed is not superficial, and some spots in the plain of Thebes, where MM. Hamy and Lenormant have found implements comparable in type with those of St. Acheul, and in connection with the old alluvia of the Nile, the relative date of which has, however, not been fixed.

It is stated that the instruments are not all of flint, but in some cases of porphyry, amphibolic rock, or other hard kinds of stone. J. EVANS

THE PROJECTED CHANNEL RAILWAYS

III.

WE have already considered two modes of crossing the English Channel by a railway, viz. one above the water by a bridge, and another below the water by a tunnel through the chalk. The two shores might be also connected by a submerged roadway passing direct through the water. It might be constructed either on the bottom of the channel or at a certain distance below the level of the sea. Submerged roadways have been proposed, some of iron, others of concrete; of the former of these we shall only consider such schemes as appear to have received sufficient attention from their originators.

These structures may be simply called tubes, because of their circular shape, which is, we all know, the most favourable form to resist pressure against collapse. The various propositions for the construction of iron tubes may be divided in two classes, viz.: 1st, schemes in which the parts of the proposed submerged tube are to be constructed on shore in certain lengths, afterwards to be united under water to form the permanent structure. 2nd, Schemes in which the whole tube is to be at once built in deep water.

Among the designs which belong to the first class, the best and most elaborate is that of the late Mr. Chalmers. His design is well known from his publication on the Channel Railway, which we consider a meritorious and ingenious production. He proposes a line of tube between the South Foreland and Blanc-Nez on the French coast, with a gigantic tower—or ventilator, as he terms it—midway in the channel in thirty fathoms of water. Having made this tower, he proposes to construct wrought-iron tubes on shore, each about 400 feet long, closed at both ends by watertight bulkheads. These tubes are to be floated, one by one, to the tower, and to be there submerged, "being drawn down by means of endless chains passing round pulleys or drums attached to massive anchor boxes on the bottom of the Channel." The separate parts to be submerged at one operation are to have each a floating-power equal to about 100 tons. A short description is also given how the ends of the tube about to be submerged should be drawn and attached to that part already permanently secured to the tower and the bottom of the Channel.

The deep sea tower or ventilator is probably not practicable, but we consider it does not form an essential part of the scheme. The whole tube might be formed of 240 separate pieces, each 400 feet long, and submerged without the tower by working from one shore end. The submerging and joining together of these parts in deep water would, however, be a perilous operation. No doubt this is the main difficulty of every plan of this class of scheme. In the present case it must be overcome and the operation 240 times successfully repeated, in order to complete the structure, and we may accordingly appreciate the chance in favour of the completion of this kind of submerged roadway.

Of the second class of works, viz. building the whole tube in deep water, we have but one scheme. It is the more satisfactory to observe that, of all the schemes which have been proposed with a view to establish a permanent railway communication between England and France, it is the most elaborate and complete, offering a solution on all material points in connection with this subject. The authors of this project—Messrs. Bateman and Révy—have published a full account of their scheme, and we cannot do better than refer to their work for a short description of the plan they adopt.

Our object has been to devise a scheme by which all difficulties of operating in water should be avoided. We propose to lay a tube of cast iron on the bottom of the sea, between coast and coast, to be commenced on one side of the Channel, and to be built up within the inside of a horizontal cylinder, or bell, or chamber, which shall be constantly pushed forward as the building up of the tube proceeds. The bell or chamber within which the tube is to be constructed will be about 80 ft. in length, 18 ft. internal diameter, and composed of cast-iron rings 8 inches thick, securely bolted together. The interior of the bell will be bored out to a true cylindrical surface, like the inside of a steam cylinder. The tube to be constructed within it will consist of cast-iron plates in segments 4 in. in thickness, connected by flanges, bolted together inside the tube, leaving a clear diameter of 13ft. when finished. Surrounding this tube and forming part of it, will be constructed annular discs or diaphragms, the outside circumference of which will accurately fit the interior of the bell. These diaphragms will be furnished with arrangements for making perfectly water-tight joints for the purpose of excluding sea water and securing a dry chamber, within which the various operations for building up the tube, and for pressing forward the bell as each ring of the tube is added, will be performed. Within this chamber, powerful hydraulic presses, using the built and completed portion of the tube as a fulcrum, will, as each ring is completed, push forward the bell to a sufficient distance to admit the addition of another ring to the tube. The bell will slide over the water-tight joints described, one of which will be left behind as the bell is projected forward, leaving three always in operation against the sea. The weight of the bell and of the machinery within it will be a little in excess of the weight of water displaced, and therefore the only resistance to be overcome by the hydraulic presses when pushing forward the bell, is the friction due to the slight difference in weight and the head or column of water pressing upon the sectional area of the bell against its forward motion. In like manner, the specific gravity of the tube will be a little in excess of the weight of water which it displaces; and in order to obtain a firm footing upon the bottom of the sea, the tube will be weighted by a lining of brick in cement, and for its further protection will be tied to the ground by screw piles, which will pass through stuffing boxes in the bottom of the tube. These piles will, during the construction of the tube within the bell chamber, be introduced in the annular space between the outside of the tube and the inside of the bell, and will be screwed into the ground as they are left behind by the progression of the bell. The hydraulic presses and the other hydraulic machinery, which will be employed for lifting and fixing the various segments of the tube, will be supplied with the power required for working them from accumulators on shore, on Sir William Armstrong's system, and the supply of fresh air required for the sustenance of the workmen employed within the bell and within the tube will be insured also by steam power on shore. As the tube is completed, the rails will be laid within it for the trains of waggons to be employed in bringing up segments of the rings as they may be required for the constructions of the tube, and for taking back the waste water from the hydraulic presses, or any water from leakage during the construction.

The tube will be formed of rings of 10 feet in length, each ring consisting of six segments, all precisely alike, turned and faced at the flanges or joints, and fitted together on shore previous to being taken into the bell, so that on their arrival the segments may, with perfect certainty and precision, be attached to each other. The building of the tube will be commenced on dry land above the level of the sea, and will be gradually submerged as the tube lengthens. The operations on dry land will be attended with more difficulty than those under water, but all these circumstances have been carefully considered and provided for.

The precise line to be taken betwixt the English and French coasts can hardly be determined without a more minute survey of the bottom of the Channel than at present exists. It will probably be between a point in close proximity to Dover on the English coast, and a point in close proximity to Cape Grisnez on the French coast. On the line suggested the water increases in depth on both sides of the Channel more rapidly than elsewhere, although in no instance will the gradient be more than about 1 in 100. The tube at each end would gradually emerge from the water, and on arriving above the level of the sea would be connected with the existing railway systems, so that the same carriage may travel all the way from London to Paris, or, if Captain Tyler's anticipations be realised, all the way from John O'Groat's to Bombay.

The distance across the Channel on the line chosen is about 22 miles. The tube as proposed is large enough for the passage of carriages of the present ordinary construction, and to avoid the objections to the use of locomotives in a tube of so great a length, and the nuisance which would be thereby created, and taking advantage of the perfect circular form which the mechanical operation of turning, facing, &c., will insure, it is proposed to work the traffic by pneumatic pressure. The air will be exhausted on one side of the train and forced in on the other, and so the required difference of pressure will be given for carrying the train through at any determined speed. Powerful steam-engines, with the necessary apparatus for exhausting and forcing the air into the tube, will be erected on shore at each end; and supposing one tube only to exist, the traffic will be worked alternately in each direction.

It has been found by calculation, that, for moving a large amount of tonnage and a great number of passengers, the most economical arrangement will be to send combined goods and passenger trains through the tube at 20 miles an hour, with occasional express trains at 30 miles an hour. Thus, an ordinary or slow train would occupy about 66 minutes in the transit, and a quick or express train about 45 minutes. In this way the tube, if fully worked, would permit the passage of 16 ordinary slow trains (8 each way), and 6 express trains (3 each way), each conveying both goods and passengers. About 10,000 tons of goods per day, or upwards of 3,000,000 per annum, and 5,000 passengers, or nearly 2,000,000 per annum, might be taken through, or a less amount of goods and a larger number of passengers, or *vice versâ*, if circumstances rendered other proportions necessary or desirable.

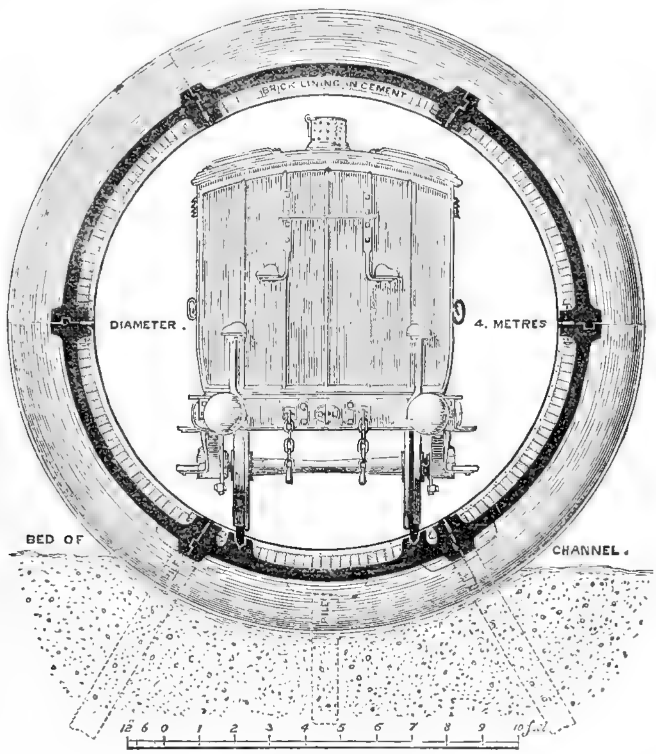
The horse power required for working the traffic with the above number of ordinary and express trains will be, on the average, 1,750 indicated, or about 400 nominal horse power at each end.

We should gladly have referred to many other interesting and important statements contained in this work, but our limited space does not admit of our doing so. A general idea of the proposition may be gathered from the above description of the authors, taken from the popular part of their work. The Appendix, which really contains the substance of the scheme, is too elaborate and technical for the general reader, without devoting special study and attention to it. Suffice it to state, that the amount of information conveyed in those 40 pages of close print is very great, being an account of a succession of results of elaborate investigations of physical, mathematical, and even of a chemical nature. One gains confidence from the mere fact, that in treating the subject the authors are evidently "at home," and do not evade a difficulty.

The general principle of the scheme, as invented and elaborated by Messrs. Bateman and Révy, may be easily understood by the ordinary reader. He can, however, have little idea how the practical difficulties attending the execution of such immense works have been overcome by these engineers. Take, for example, the first sentence or two we have quoted above. The general proposition is this: "A tube of cast iron to be built up inside a horizontal cylinder or chamber."—No doubt this may appear simple enough, but when we come to consider what the operation of *building* means,—when we come to consider that no part of the tube to be so built up weighs in one piece less than *ten tons*,—that those solid pieces of iron could not even be stirred by the power of scores of men, much less lifted or deposited in the right place—that this "building up" is to take place in a comparatively small space, not exceeding 13 feet in diameter, the larger part of which is already occupied by the very plate weighing 10 tons;—we may in a measure realise what the word "building" under these circumstances signifies.

But we have further to bear in mind, that it is not enough that we should be able somehow to "build up" the tube inside that chamber, but that it must be done quickly, without delay or a hitch, and that unless it could be so done the operation of "building up" would take generations in crossing the Channel, and make the whole proposition, though practicable in every detail, yet a forlorn hope, because of the length of time. If thus we come to consider, that the authors have not contented themselves with saying that "their tube is to be built up in that chamber," but have given us the precise designs and the exact mode of proceeding to be adopted; that the designs and arrangements are so complete that they might be forthwith placed in the hands of a contractor; that these mechanical arrangements would enable a boy of ordinary intelligence to take hold, lift, and place, and finally deposit these monster plates with the same ease, quickness, and certainty as a bricklayer would lay his brick in the construction of an arch, we venture to say the authors have made out their case.

We believe it is the first time that any of the projectors or designers of Channel railways have paid serious attention to the important question, how such a submerged railway or tunnel could be used and worked to advantage for the enormous traffic between England and France. Most of them seem to assume, as a matter of course, that such a tunnel of iron or brick would be worked as ordinary railways. It appears, however, from the investigations of Messrs. Bateman and Révy that there is but one way of working such a tunnel to advantage, and unless the arrangements and the construction of the works be kept in accordance with that mode of working the traffic, the tunnel, when completed, would be of no use for practical purposes. The authors find that the power for the propulsion of trains must be pneumatic pressure; not as applied in the old-fashioned style above ground, and known by the name of atmospheric railways, but a pressure of air applied by powerful pumps directly upon the train, which would form a kind of loose piston inside the tube. On the old plan, the train was outside a little tube; on the new plan, the train is inside a large tube; and with this simple alteration all the difficulties which led to the abandonment of the former, disappear on the latter plan. The difficulties of the old atmospheric railways were: (1) mechanical difficulty of connecting the piston of the little tube with the train outside it; (2) The high pressure required on the small area of the piston for the propulsion of the train, and consequent development of an excessive amount of heat within the pumps, leading to their rapid destruction and great loss of power by subsequent cooling of the air. By the new mode of atmospheric propulsion all these difficulties are done away with, for there is no connection



SECTION OF THE TUBE.

between a piston and the train wanted, and the pressure of the air over the large sectional area of the tube required for propulsion is but a small fraction of that formerly employed; there is, consequently, no heating, no inordinate wear and tear, and no loss of power. Equally ingenious is the construction of the proposed air pumps. Very large volumes of air are wanted to accompany and press forward the train—several hundred thousand cubic feet per minute. And what is the nature of the pumps to supply these? Are they to be blast engines? No; they are to be air pumps, in the shape of gasometers. We are all familiar enough with the sight of gasometers, but their application for such a purpose is certainly new.

We find throughout the work the same invincible spirit which seems to seek a difficulty for its immediate destruction. That a permanent railway across the English Channel will be built, we doubt not; we are equally confident that Messrs. Bateman and Révy's scheme is a practicable solution of the problem. No less an authority than the Emperor Napoleon III., after mature consideration of the scheme, wrote to say:—"*C'est le seul realisable*," and as the design is one that belongs essentially to England, His Majesty's opinion acquires enhanced value and importance. Let us, then, hope that the engineering and enterprising powers of this eminently engineering country will heartily support, advance, and improve the plan, which seems to ensure inestimable advantages to England and France.

NOTES

THE Secretaries of the Royal Astronomical Society have circulated the following notification. "We are instructed to communicate to you the following Resolution, which was passed at a Committee of the Council held yesterday, April 8th:—Resolved—'That the Fellows be informed that there is a possibility of the Government providing means of transit to and from stations on the Mediterranean for about sixty observers, who may be willing to take part in the Observation of the Total Eclipse of December 22, 1870; and that persons willing to undertake a portion of the Observations on a plan to be arranged by the Council, be invited to send their names to the Secretaries, and also to state the branch of observation which they would be prepared, or prefer, to undertake, and the instruments they would be willing to contribute.' It is desirable that the names of those who are willing to take part in the observation of the Eclipse should be sent in, if possible, before the next meeting of Council, May 13."

WE are informed that M. Fahnehjelm, the Swedish Commissioner for the forthcoming series of Annual International Exhibitions, has applied for permission to exhibit a full-sized model of a school-room, just as it exists in the country parishes in Sweden, with all the books, maps, apparatus, forms, desks, &c., in order to give a complete idea of the Swedish system of elementary instruction. Her Majesty's Commissioners will, there can be no doubt, gladly place a sufficient space at the disposal of the Swedish Commissioner for so interesting an exhibit. It is to be hoped that encouragement will be given to other countries to follow this excellent example. An easy comparison of international appliances for educational purposes would be most useful to visitors to the Exhibition, and would be beneficial and stimulating to the countries exhibiting.

YET another contribution to Mr. De Morgan's "Budget of Paradoxes." A pamphlet reaches us under the title of "The New System of Astronomy" by "Incognito" (Spon, Charing Cross), reviving, as "more in accordance with ascertained observations, and more capable of exact proof than any yet propounded," the old idea that the earth is the centre of our system, the sun revolving round it in an orbit intermediate between those of the Moon and Mars, with Mercury and Venus as his satellites.

PROFESSOR H. J. CLARK, of Lexington University, Kentucky, sends us a paper entitled "Polarity and Polycephalism, an essay on Individuality." He applies the term "polarity" to the tendency of the vertebrate individual to arrange its organs in two opposing sets, cephalic and caudal, and again dorsal and ventral. An individual is generally understood to be a monocephalic being. In the case of so-called "alternation of generation" among the Acalephic, since the sexual and sexless are necessary to make up a distinct organism, *i.e.*, vegetative and reproductive, the one a completement of the other, neither alone can represent the individual unit or whole cycle of life; and cephalism is therefore, Professor Clark contends, a better term to indicate the potentiality of these subdivisions to live apart.

MR. T. PAYNTER ALLEN reprints from the "Journal of the Society of Arts" an Inquiry into the existing state of education in Richmond, Twickenham, and Mortlake. He finds that of the whole number of children in the district, one-third are absolutely uninstructed, scarcely one half are in average attendance at school, one-fifth alternate attendance at school with fluctuating labour injuriously to themselves and to the school; one-sixth are of the maximum school age without having reached the maximum of proficiency, and above one-half are children of eight years, and therefore in training in infant or mixed schools, the classification, methods, and teaching power of which are very imperfect and inferior.

PROFESSOR PIAZZI SMYTH publishes "A Poor Man's Photography at the Great Pyramid in the year 1865." The "poor man" is Professor Smyth himself, who details the difficulties encountered in pursuit of his undertaking in the face of a "coalition of rich ones against him." Whatever may be thought of Professor Smyth's theory of the object for which the Great Pyramid was built, there can be no question that he has brought to the subject an immense amount of patient self-denying research which demands acknowledgment, and some of his meteorological observations may yet lead to important results.

MESSRS. LONGMAN's latest list of forthcoming works includes the following, in different departments of science:—The Origin of Civilisation, and the Primitive Condition of Man, by Sir John Lubbock; Other Worlds than Ours, by R. A. Proctor; The Historical Geography of Europe, by E. A. Freeman; Le Maout and Decaisne's General System of Descriptive and Analytical Botany, translated by Mrs. J. D. Hooker; Researches on Diamagnetism and Magnecrystallic Action, by Professor Tyndall; Lectures on Surgical Pathology, by James Paget; A Course of Elementary Problems in Practical Plane Geometry, by John Lowres; Principles of Mechanism, by Professor Willis; Smoking Fires—their Cause and Cure, by Rev. A. C. Ainslie; On the Manufacture of Beet-root Sugar in England, by W. Crookes; and A Handbook of Dyeing and Calico-printing, by the same author.

THE continental subscription list on behalf of the late Professor Sars now exceeds 10,000fr. A young naturalist, Mr. C. Jobert, called a public meeting at Havre in its support, which was a great success, the mayor granting free use of a room in the Hotel de Ville, and the printer refusing to be paid for printing the circulars: a worthy example for imitation.

Apropos of Professor Tyndall's "Dust and Disease," we extract the following from the *Scientific American*:—"The dust obtained from the places of amusement in New York has recently been analysed by the scientific officers of the Metropolitan Board of Health. Over one hundred specimens of the particles floating in the air, and falling as dust, were collected on plates of glass, and were examined under the microscope. The proportions of the different ingredients varied, but the same substances were found in all the specimens. The composition of the matter subjected to the microscope was as follows:—'The dust of the streets in its finer or coarser particles, according to the height at which it had been collected, with a large proportion of organic elements; particles of sand, quartz, and feldspar; of carbon, from coal-dust and lampblack; fibres of wool and cotton of various tints; epidermic scales; granules of starch of wheat, mainly the tissues of plants; the epidermic tissue, recognised by the stomata or breathing pores; vegetable ducts and fibres, with spiral markings; vegetable hairs or down, either single or in tufts of four or eight, and of great variety, and three distinct kinds of pollens. Fungi were abundant, from mere micrococcus granules to filaments of mould. When water was added to a portion of dust from whatever source, and exposed in a test tube to sunlight or heat for a few hours, vibriones and bacteria made their appearance, and the fungous elements sprouted and multiplied, showing that they maintained their vitality, and proving that the germs of fermentation and putrefaction are very widely diffused.'"

IT is said that Professor Nordenskiold is organising another Polar Expedition for 1871-2, and that he intends, amongst other things, to attempt to reach the North Pole by starting from Spitzbergen, or its neighbourhood, in the spring, and travelling by sledge over the frozen sea. It is reported that he intends to visit Greenland this year to procure dogs for his enterprise. We fear that if he relies upon dogs, he will not succeed better than his predecessors, and he may even experience great difficulty at the outset in obtaining the requisite number for his purpose; for, by the latest accounts from Greenland, the disease among the dogs in that country (which proved such a hindrance to Mr. Whymper in his attempt to penetrate to the interior in 1867) has spread, in spite of all efforts to check it, from one district to another, and is still continuing its fatal ravages.

THE new number of the *Proceedings of the Royal Institution*, commencing the sixth volume, includes Professor Tyndall's lecture "On Dust and Disease," Professor Odling's "History of the Scientific Work of the late Professor Graham," and Dr. Carpenter's lecture on the "Temperature and Animal Life of the Deep Sea," with briefer notices of the other Friday evening discourses before Easter.

AT the meeting of the French Academy on the 11th inst., Marshal Vaillant communicated the curious fact that Cuvier's name was not *George*, but *Jean Leopold Nicolas Frederic*. According to M. Dumas, this circumstance was well known to persons familiarly acquainted with Cuvier, but no reason is given by him for such a singular change of name.

THE second of Sir Edward Sabine's conversaziones as President of the Royal Society will be held on Saturday evening next.

THE *Engineer* states that a new method of warming first-class carriages in express trains has been adopted in Bavaria: a special van is attached to the train and contains a powerful "calorifere," and the heated air is conveyed to all the carriages of the train by means of india-rubber tubes. The experiment with first-class carriages is reported upon so favourably that the authorities have determined to apply it to all the carriages on the Bavarian lines, and it is expected that it will soon be adopted on all the German railways.

THE herbarium of the late Von Martins, which was offered to and refused by the Bavarian Government, has been purchased for 30,000 fr. by the Belgian Government to form the basis of a national collection, to be located at Brussels. It consists, 1st, of the general herbarium, containing 60,000 species, represented by 300,000 specimens, nearly half of which are Brazilian; 2nd, of the great collection of palms; 3rd, a collection of fruits and seeds; 4th, a series of woods; 5th, a collection of drugs and economic specimens, in great part formed by his brother Theodore Martins, Professor of Pharmacy at Erlangen.

ACCORDING to the *Photographic News*, the oft-reiterated statement that the eye of a dead animal has impressed upon it an image of the last object seen in life has been the subject of serious investigation in Germany. Americans have gone so far as to state that the eye of a murdered man had been found in which a portrait of the murderer was distinctly traceable. In the investigation in question the eyes of thirty different animals, all of which had been killed with a view to subsequent examination, were carefully inspected; but in no case was there any evidence discovered to warrant the statement referred to.

A COMPACT and valuable little "Route-map and Index to the more interesting objects in the Royal Gardens, Kew," is about to be issued under official sanction by Messrs. Macmillan and Co It contains an excellent map of the gardens, and index to some o the more interesting plants: and as it is to be sold for the low price of *2d.* it will doubtless have a very large circulation.

DR. E. SYMES THOMPSON, Gresham Professor of Physic, will deliver his two courses of three lectures each at the Gresham College, Basinghall-street, after Easter. The first course on April 22nd, 23rd, and 24th, will be on Cough, on Tonics, and on Climate and Health Resorts. The second course, on June 2nd, 3rd, and 4th, on the Epidemics of the Middle Ages, on Sedatives, and on Narcotics. The Lectures are illustrated with diagrams, and chemical experiments, and are free to the public. They commence at 7 o'clock.

DR. CLARK, assistant to the late Dr. Penny, who continued the winter course of lectures on Chemistry after that gentleman's death, will deliver the summer courses. Further arrangements are dependent upon the proposal of Mr. Young, the President, to endow a chair of Technical Chemistry.

THE statistics of the American Pennsylvania crude oil industry for the past year are now published. The total production of the year was the enormous amount of 4,215,142 barrels, being a daily average of 11,548 barrels. The production of 1868 was 3,715,741 barrels, the increase during 1869 over the previous year thus being 499,401 barrels, or about 1,460 barrels per day.

PROF. H. WURTZ has presented to the New York Lyceum of Natural History a report of an extraordinary outburst of gas in the township of West Bloomfield, co. of Ontario, State of New York. It issues from a bore-hole in the solid rock, about five inches in diameter, and when burning, gives in a still atmosphere a flame some thirty feet in height, the flow amounting to 400,000 cubic feet per day, which has now been going on for more than four years, without any perceptible diminution of rapidity. The density is 0·693, and the result of several analyses shows the following composition:—

Marsh gas	82·41	per cent.
Carbonic acid	10·11	,,
Nitrogen	4·31	,,
Oxygen	0·23	,,
Illuminating hydrocarbons . .	2·94	,,
	100·00	

The most remarkable feature of the discharge is the lack of diminution of the flow for so long a time in connection with the low pressure indicated, corresponding to that of but a few inches of water. Dr. Stevens has examined the geological formation of the rock from which the oil proceeds, and finds it to belong to the Hamilton Group, the gas proceeding doubtless from the "Marcellus Shale," which is highly charged with bitumen and carbonaceous matter, and flames on ignition. The four great gas-producing strata of New York, Pennsylvania, and Ohio thus all belong to the Palæozoic formation.

THE quinquennial prize of 5000fr. of the physical and mathematical sciences of the Belgian Academy has been awarded to Prof. Plateau for his researches on the figures of equilibrium of a liquid mass without weight; a fitting sequel to 26 years' unremitting work, the professor being now blind. The Argenteuil prize of 12,000fr. has been bestowed on M. Champonnois, inventer of the method of distilling beet-root.

THE Council of the Entomological Society offers two prizes, of the value of five guineas each, for essays, of sufficient merit, drawn up from personal observation in the anatomy or economy of any insect or insects; the essays to be sent in before the end of November next.

NOTWITHSTANDING the numerous investigations that have been made upon the process of gastric digestion, the ulterior changes that the food undergoes in the alimentary canal exclusive of the action of the pancreatic and biliary fluids, in other words, the action of the fluid secreted by the walls of the alimentary canal itself on the various constituents of our food, admitted on all hands to be considerable, has received but little attention. In the "Untersuchungen aus dem Institut für Physiologie" in Graz, edited by Prof. Rollett, an essay appears written by Dr. Alexis Dobroslawin of St. Petersburg on this subject. In order to obtain the intestinal juice, he made a fistulous opening into an isolated portion of the intestine and inserted a canular into the orifice, which was properly secured. The dog was fed with a pound of horse-flesh and a single supply of water daily. Investigations were in the first instance made with a view of ascertaining the quantity of intestinal secreted juice. The material obtained consisted of a thin fluid and of a mucous portion, the relative proportion of which varied to a considerable extent under different circumstances, but from an isolated portion of intestine (having a length of 13 centim.) in one dog he obtained 34 grains, and in another, where the isolated portion of intestine had a length of 17 centim. 28 grains per hour. The results of electrical excitation by means of induction currents were very similar to those previously obtained by Thiry, and showed a considerable increase in the amount of the secretion during the passage of the current, and further researches showed that the secretion thus obtained did not differ materially from that produced in the healthy and uninjured animal by the application of electricity to the freshly-exposed intestinal tract. The most interesting part of his researches, however, bears upon the action of the intestinal juice on starch, albumen, and fat respectively. In regard to the former, he was able to convince himself, in opposition to the statements of Thiry, that the intestinal juice possesses a distinct power of converting starch into sugar, and this occurred in whatever state the juice might be, whether clear, or troubled, or filtered, or mingled with flocculent masses of mucus. The time required was in all instances nearly the same, or about two hours. In one instance, evidence of the presence of sugar was obtained in a quarter of an hour. In regard to albumen, his experiments were made with portions of raw fibrin of blood. These were kept at a temperature of about 100° Fahr., in contact with some of the recently-obtained intestinal juice, and it was found that a solvent action did occur, but with great slowness, from twenty to forty, or even forty-eight hours being required. The dissolved fibrin underwent conversion without the development of any putrefactive odour into peptones, as was demonstrated by the action of a series of tests. The researches made with a view of ascertaining the action of the juice on fats, as olive oil and butter, had a negative result; he was never able to discover any of the fatty acids.

IN the last part of Schultze's "Archiv. für Mikroskopische-Anatomie," M. Schwalbe describes the lymphatic spaces of the eye. In this paper he shows that there is a large space comparable to a lymphatic sac lined by nucleated epithelium, as shown by the action of nitrate of silver situated between the choroid and sclerotic coats. When injected with a coloured fluid the injection escapes from the globe by channels surrounding the venæ vorticosæ, and then distends the space known as the capsule of Tenon. From thence the fluid passes backwards through a sheath surrounding the optic nerve, and so penetrates into the arachnoid space of the brain.

THE Rev. W. P. Clarke, vice-president of the Royal Society of New South Wales, sends us an interesting paper on the Causes and Phenomena of Earthquakes, especially in relation to shocks felt in New South Wales and in other provinces of Australasia.

IN a letter to *Hardwicke's Science Gossip*, Mr. W. W. Spicer states that the colour of insects is greatly influenced by the length of time during which they have remained in the chrysalis condition, well-marked varieties being produced by preserving the chrysalis in a state of abnormal torpidity through the autumn and winter, which can be done by keeping it in ice.

THOSE of our readers who are interested in the theory of vision will find an instructive paper by Mr. G. Joseph Towne, in the last issued volume of the "Guy's Hospital Reports" (1870). It deals chiefly with the subject of binocular vision, with a criticism on the views recently promulgated by Professors Hering and Helmholtz, and at the conclusion of his essay he makes the following statements :— "That the images of all objects placed within the transverse visual plane are referred to the opposite side of the field; that is, to the side of the field opposite to that occupied by the object viewed, and we remark that this phenomenon is special to the transverse visual plane. That in selecting the transverse visual plane as the region for his experiments, and in having applied to the field generally the exceptional phenomena special to this region, Hering has committed an error, which is fatal alike to the consistency of his experiments and to the soundness of his conclusions. That the phenomena on which Hering has based his theory are inseparably connected with a near convergence of the eyes, and it may be asserted that similar phenomena cannot occur, the field being viewed with the optic-axes parallel." Mr. Towne's statements are supported by much ingenious reasoning, and references to numerous experiments, some of which are illustrated.

LARGE beds of rock-salt have been discovered by borings, in the neighbourhood of Middlesborough-on-Tees, and shafts are now being sunk with a view to work the valuable deposits. In this we have another example of the mineral character of that north-east corner of Yorkshire. Iron ore and smelting furnaces abound. Mineral waters well-up in sundry places. Alum used to be made at Guisborough, near the foot of Rosebury Topping; and now the rock-salt offers a new resource to a large and busy port, which, forty years ago, was a wild waste with two or three houses only.

IT is perhaps a sign of a wider awakening interest in geology among the Italians, that a new journal—*Bolletino R. Comitato Geologico d'Italia*—was brought out at Florence, at the beginning of the present year. The second number has just appeared. It contains papers and notices on geological and mineralogical subjects, illustrated by engravings, and so far fulfils its purpose of making "better known than hitherto the geology and topography of Italy." We are glad to welcome this new periodical; for the more the Italians become acquainted with the natural resources of their country, the better will it be for all concerned.

BOTANY

Variegation of Leaves

M. EDOUARD MORREN attributes the variegation of leaves to a disease which is contagious and which may also be communicated from one species to another by inoculation, as by the grafting of a variegated plant on to a healthy stock, or even from the stock to a healthy graft. The discoloured or variegated portions of a leaf have lost their power of reducing carbonic acid, the plants are generally weaker and smaller, their flowers and fruit inferior, and they are more liable to be injured by cold. It is the sign of an organic disease produced by various causes, as the deterioration of the seeds, dampness of the ground, want of light, &c. None of the higher classes of plants can exist if entirely deprived of chlorophyll, except such as are parasitic. Some of our common variegated cultivated plants, such as *Pelargonium zonale* and *Hydrangea*, sometimes put out branches which are entirely colourless, but these only live a parasitic life on the rest of the plant. That the disease is an individual one is shown by the fact that it can be propagated by buds, layers, or grafts, even by the insertion of the petiole of an infected leaf beneath the bark; while the seeds of variegated individuals will generally produce healthy and fully-coloured plants. A. W. B.

Dimorphic Leaves of Water-plants

FOLLOWING out his observations on the leaves of *Marsilia* (see NATURE, No. 11 p. 293) Prof. Hildebrand finds that some other water plants exhibit a similar peculiarity, as, for instance, *Polygonum amphibium*, and the common arrow-head, *Sagittaria saggitifolia*, frequently producing, when growing in very deep water, floating leaves of a different form from the ordinary leaves, and exhibiting also differences in structure and in the arrangement of the stomata. In the latter species the floating-leaves are round and heart-shaped, similar to those of a water-lily, instead of arrow-shaped. A. W. B.

THE MARQUIS DE POMPIGNAN asserts that a remarkably fine quality of truffle is cultivated in the vicinity of the Garonne, on a district almost solely arenaceous.

PHYSICS

Phosphorescence of Gases

IT is a well-known fact, the discovery of which appears due to Geissler, of Bonn, that certain highly attenuated gases have the power of remaining luminous for a short time after the interruption of an electric current by which they have been traversed. M. Becquerel attributed this phenomena to the presence of oxygen, either free or combined; M. Morren has since denied that pure oxygen itself can exhibit the electric phosphorescence, but that it does so when mixed with other gases, more particularly nitrogen. Such being the state of the question, M. de la Rive requested M. Edouard Sarasin to execute a series of critical experiments, an account of which appears in the Archives des Sciences physiques et naturelles [135, p. 243] and is summarised in the following paragraphs.

The experiments were made in a large glass jar, 20 centimetres in diameter and 30 centimetres high, which was placed on the platinum plate of a Babinet's air-pump, capable of giving a vacuum of half a millimetre. The electrodes consisted of two brass stems, to the extremities of which were screwed two thin disks of either brass, platinum, or silver. One of them was fixed on the brass screw-plate in the centre of the platinum, the other occupied the middle of the flat glass cover of the jar. They were also connected with the two poles of a Ruhmkorff's coil of medium size, traversed by the current from four Grove's cells. The interior of the jar communicated with (1) a desiccating apparatus, through which the gases were introduced; (2) a manometer reading to 0·04 millimetre, and (3) a brass tube in which were placed chemically pure gases, contained in bulbs which could be broken in a vacuum.

A number of experiments were made with oxygen, both as prepared from potassium chlorate and as yielded by electrolysis. Closing his eyes during the intense and blinding glow of the continuous discharge, and suddenly opening them on the interruption of the current, the observer witnessed, in every case, a pale, whitish glimmer, directed, though but momentarily, over the path of the preceding display. At and below a pressure of three millimetres, but especially at two millimetres, this light fills the whole jar. Simultaneously with this occurrence, ozone is produced, as proved by testing with finely divided silver; whence, as might be expected, the phosphorescence is considerably diminished by employing electrodes of silver. No gas, other than oxygen, exhibits this property. Hydrogen, nitrogen, chlorine, iodine-vapour, ammonia, coal-gas, hydrogen chloride, and even atmospheric air, alike failed to produce it.

When highly concentrated hydrogen sulphate was placed in a capsule on the platinum plate, and nitrogen, air, nitrous oxide, carbon moxide or dioxide was admitted under the usual conditions, a phosphorescence was obtained of greater intensity and larger duration than in any of the other experiments. Here, also, ozone was formed. The presence of silver diminished, the presence of hydrogen entirely obliterated the phenomenon.

Sulphur dioxide gave a feeble but decided phosphorescence. Hydrogen nitrate and nitrogen peroxide showed a weak effect. Carbon monoxide and dioxide were very perceptibly phosphorescent, and still more on the introduction of hydroge sulphate. It was noticed that the addition of this sulphate invariably diminished the conductibility of the gas.

The most curious results were observed with nitrous oxide. During the passage of the spark, at ten millimetres (and even higher) pressure, a narrow jet appears, of a bright rose colour, and exhibiting fine clear striæ. Surrounding the jet is a sheath of the most brilliant yellow mist of eight to ten millimetres in thickness, and perfectly defined. As the jet grows with diminishing pressure, this sheath loses its brilliancy, advances farther in the jar, and, at two millimetres, fills it entirely. At half a millimetre, there is a large rosy jet, with enormous striæ extending to the walls of the jar, all the interstices being filled with yellowish mist. Nitrous oxide shows a phosphorescence at all pressures below ten millimetres. At first this is very bright but only instantaneous, occupying exactly the place previously assumed by the yellow sheath. As the vacuum improves, the phosphorescence becomes more permanent; and ultimately, at one millimetre, and after the interruption of the spark, a yellow mist is visible for three seconds, and is bright enough at first to illuminate surrounding objects very evidently.

The preceding experiments lead the author to infer that oxygen is the sole cause of the phosphorescence in question, which is also and necessarily produced by most oxygenated gases.

SCIENTIFIC SERIALS

Berg-und huttenmannische Zeitung. The last number of this journal contains the following account of a new locality for the mineral Knebelite, by L. J. Igelström, of Filipstadt. For some time Knebelite was only known as occurring at Ilmenau and then it was afterwards discovered at Danemora. During a journey in the year 1866 he discovered it at the Hilläng iron mine in the parish of Ludovika, province of Dalarne, Sweden. It is found there in great quantities, sometimes in masses twelve feet thick. It occurs in the hälleflinta, the ore-bearing rock, in connection with magnetic iron limestone and traces of magnetic pyrites, with all of which it is impregnated. The mineral from Ilmessau and Danemora has a pretty constant composition, containing 30—32 silica, 32—34 protoxide of iron, and 34—35 protoxide of manganese (*vide* Dana, 1868). The composition of the Knebelite from Hilläng, which is somewhat different, is as follows:—

Silica	33·14	with		16·74	Oxygen
Protoxide of iron .	40·96	,,	9·09	15·38	,,
Protoxide of manganese	19·35	,,	4·42		,,
Lime	6·55	,,	1·87		,,
	100·00				

This difference may, perhaps, have been caused by the mineral not being entirely free from intermixed magnetic iron. There is, nevertheless, no doubt whatever, if one compares the external characters, that the Hillängs mineral is the same as that of Danemora, and, indeed, it was this identity of external appearance which occasioned its discovery at Hillängs. Both varieties of the mineral have the characteristic of gelatinising with hydrochloric acid.

IN *The Journal of the Quekett Microscopical Club* for April, is the commencement of an article by Mr. M. C. Cooke, on Microscopic Moulds, restricting the term "moulds" to the *Hyphomycetes*, and including all those filamentous fungi which bear naked spores (sporiferous, in contradistinction to sporidiiferous) at the apex of simple or branched threads. It promises to contain much valuable information. Other interesting papers are by Dr. Braithwaite, on the Geographical Distribution of Mosses; M. de Brebisson, on French Diatomaceæ; and Mr. B. T. Lowne, on the Cornea of the Bee.

THE *Journal of the Ethnological Society* for April contains a valuable report by Lieut. Oliver, R.A., illustrated by several very beautiful lithographs, on the present state and condition of Pre-historic Remains in the Channel Islands. Notwithstanding the wholesale and wanton destruction of these monuments in the Channel Islands within the last half-century, there are nevertheless few localities, Brittany excepted, in which the sepulchral stone structures of the neolithic period can be studied with greater advantage. Lieut. Oliver describes in detail the monuments still remaining in Guernsey, Herm, Serk, Jersey, and Alderney; and notes the remarkable resemblance borne by them to the monoliths and stone tombs of Madagascar, erected by the hill-tribes of Hovas even at this very day. Mr. C. T. Gardner contributes an essay on the Chinese Race, their Language, Government, Social Institutions, and Religion; Mr. G. Busk, a description of, and remarks upon, an ancient *Calvaria* from China, which had been supposed to be that of Confucius; and Mr. H. H. Howorth, a continuation of his article on the Westerly Drifting of Nomades, from the fifth to the nineteenth century.

Geological Magazine, vol. vii. No. 4, April 1870.—This number opens with the first of a series of notices of eminent living geologists, and the editor's choice has worthily fallen upon the veteran Professor Sedgwick. Professor Huxley has a paper, illustrated with a plate, on the milk-dentition of *Palæotherium magnum*. From Professor Rupert Jones we have a series of notes on the Tertiary Entomostraca, containing supplementary remarks and corrections to his monograph of those minute fossils published by the Palæontographical Society in 1856, and including a revised list of the species. The other papers are, an article on the superficial deposits of Belgium, illustrated with a map prepared by Mr. H. M. Jenkins for his paper on Belgian agriculture, published by the Agricultural Society; a notice of the Basaltic Rocks of the Midland Coal-fields, by Mr. S. Allport; a note on the Middle Drift-beds in Cheshire, by Mr. J. E. Taylor; and an extract from a letter of Mr. F. B. Meek to Dr. Bigsby, giving an account of the fossils found in some silver-bearing rocks near Central Nevada, which appear to be of Devonian age. The number contains the usual notices, reviews, reports, and miscellaneous matter.

THE *Revue des Cours Scientifiques* for April 9th is occupied by a sketch of the biological labours of the late Prof. Sars, by Emile Blanchard; a translation of Mr. Andrews' paper, read before the Royal Society, on the continuity of the liquid and gaseous states of matter. The number for April 16th contains a translation of the Anniversary Address before the Hunterian Society by H. J. Fotherby; and a report of a lecture by Claude Bernard on Blood and its General Properties.

IN the *Monthly Microscopical Journal* for April we find a description (with illustrations) by Dr. Carpenter of some peculiar fish's ova, the peculiarities having reference to the shape of the ova, the mode of their attachment to the surface of the shell, and the position and remarkable distinctness of the micropyle; and a description (with plate), by Mr. C. A. Barrett, of a new tube-dwelling stentor, found on a piece of weed taken from the Thames at Moulsford; an article on the polymorphic character of the products of development of Monas lens, by M. Johnson, with others of less importance.

THE *Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, vol. 5, section 1, contains several very interesting papers of travel. An Ascent of the Peak of Teneriffe, by E. Häckel, Sketches of a Journey from Chartum to the Gazelle River, by G. Schweinfurth, both these articles being abundantly full of valuable natural-historical details; a report of the Western-Australian Expedition, by Mr. Forrest, in search of traces of Leichardt; an account of Dr. Nachtigall's Journey to Tibesti, and other shorter articles.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, April 7.—"On supraannual cycles of temperature in the earth's surface-crust." By Prof. C. Piazzi Smyth, F.R.S. The author presents and discusses here the completely reduced observations, from 1837 to 1869 inclusive, of the four great earth-thermometers sunk into the rock of the Calton Hill, at the Royal Observatory, Edinburgh, by the late Principal Forbes, pursuant to a vote by the British Association for the Advancement of Science. Leaving on one side the several Natural-Philosophy data which have been investigated from smaller portions of the same series of observations both by Principal Forbes and Sir William Thomson, the author applies himself solely to trace the existence of other cycles than the ordinary annual one, in the rise and fall of the different thermometers. Of such cycles, and of more than one year's duration, he considers that he has discovered three; and of these the most marked has a period of 11·1 years, or practically the same as Schwabe's numbers for new groups of solar spots. Several numerical circumstances, however, which the author details, show that the sun-spots cannot be the actual cause of the observed waves of terrestrial temperature, and he suggests what may be; concluding with two examples of the practical use to which a knowledge of the temperature cycles, as observed, may at once be turned, no matter to what cosmical origin their existence may be owing.

"On the Constituent Minerals of the Granites of Scotland, as compared with those of Donegal." By the Rev. Samuel Haughton, M.D., Dubl., D.C.L. Oxon., Fellow of Trinity College, Dublin. This paper contains analysis of Orthoclase from the following localities:—

No. 1. Stirling Hill, Peterhead. Occurs in an eruptive Granite, in veins, in well-developed reddish pink opaque crystals, encrusted with crystals of Albite.—No. 2. Rubislaw, Aberdeen. Large beautiful reddish pink opaque crystals, in veins, associated with white Mica. The Granite of Rubislaw is of metamorphic origin, and different in character from the eruptive Granite of Peterhead. No Albite has been found in it.—No. 3. Peterculter, Aberdeen. In Metamorphic Granite; white, translucent, large crystals.—No. 4. Callernish, extreme west of Lewis. In Metamorphic Granite; in large grey crystals, with a slight shade of pink, translucent.—The Granites of central and western Scotland are metamorphic rocks, like those of Donegal and Norway, with which they are geologically identical; and truly eruptive Granite occurs at only a few localities, as, for example, near Peterhead. The second felspar, associated with Orthoclase in the Metamorphic Granites, is Oligoclase, as in Donegal; while the second felspar associated with Orthoclase in the eruptive Granites, is Albite, as in Mourne, Leinster, and Cornwall. The fact thus indicated by the Scotch Granites is completely in accordance with the mode of occurrence of Oligoclase and Albite in the Irish Granites. (Then follow analyses of two Oligoclases.)—No. 1. This Oligoclase occurs in the Granite of Craigie Buckler, near Aberdeen; it is white and opaque, and so much resembles Cleavelandite in appearance as to have been mistaken for that variety of Albite; its analysis proves it to be Oligoclase. The crystals do not exhibit striation.—No. 2. From the Granite of Rhiconich, in the west of Sutherlandshire; it is greyish white, semitranslucent, in large striated crystals, and resembles the Oligoclase of Ytterby, in Sweden.—Analysis of an Albite which occurs at Stirling Hill, near Peterhead, in eruptive Granite, and is found associated with red Orthoclase in veins. It encrusts the large crystals of Orthoclase, and is semitranslucent; and is generally stained on the surface by peroxide of iron. This mineral is evidently a typical albite. There are two kinds of mica found in the Scotch granites, and both micas resemble very closely the corresponding minerals of the Donegal granites. The specimen of mica analysed came from veins in the granite quarry of Rubislaw, near Aberdeen, and occurs in large plates, associated with red orthoclase. It was carefully examined for lithia, but no trace of this alkali could be found in it. The angles of the rhombic plates were 60° and 120° exactly, and the angle between its optic axes was found to be 70° 30′. The black mica, in large crystals, is very rare, but it seems abundantly disseminated, in minute scales, through most of the Scotch granites. An analysis was made on specimens found near Aberdeen by Professor Nicol, and kindly forwarded to me by him, for the purposes of this paper. This mica was carefully examined for fluorine, and found not to contain any.

Researches on Vanadium. Part III.—Preliminary Notice. By Henry E. Roscoe, B.A., F.R.S.—I.—Metallic Vanadium.—II.—Vanadium and Bromine.—1.—Vanadium Tribromide, VBr_3, molec. wt. = 291.3.—2—Vanadium Oxytribromide, or Vanadyl Tribromide, $VOBr_3$, molec. wt. = 307·3.—The specific gravity of the oxytribromide at 0° is 2·967.—3.—Vanadium Oxydibromide, or Vanadyl Dibromide, $VOBr_2$, molec. wt. = 227·3.—III.—Vanadium and Iodine.—Iodine-vapour does not attack either the trioxide or the nitride at a red heat, both these substances remain unchanged, and no trace of vanadium can be detected in the iodine which has passed over them.—IV.—The Metallic Vanadates.—Sodium Vanadates.—1.—Ortho- or Tri-Sodium Vanadate, $Na_3\ VO_4 + 16H_2\ O_2$.—2.—Tetrasodium Vanadate, $Na_4\ V_2O_7\ 18H_2\ O$.—Lead Vanadates.—1.—Tribasic or Ortho-Lead Vanadate, $Pb_3\ 2(VO_4)$.—2.—Vanadinite, the Double Orthovanadate and Chloride of Lead, $3Pb_3\ VO_4 + Pb\ C_1l_2$.—3.—Basic Dilead Vanadate, $2(Pb_2\ V_2O_7) + Pb\ O$.—Silver Vanadates.—1.—The Ortho-silver Vanadate, $Ag_3\ Vo_4$.—2.—The Tetrabasic Silver Vanadat, $Ag_4\ P_2\ O_7$.

Anthropological Society, April 5.—Captain Bedford Pim, R.N., V.P., in the chair. A paper, by Mr. Hodder M. Westropp, was read, on Phallic Worship. The author, after asserting the spontaneity and independence of certain beliefs and superstitions in the human mind, at all times and in all climates, proceeded to trace out the rise and development of phallic worship as one of the most ancient of those religions that have extensively prevailed among various sections of the human race. In the earlier ages the operations of nature made stronger impressions on the mind of man than in the later periods of his history. There were two causes which must have engaged the attention of the savage observer of nature, the generative and the productive, the active and passive. The author then described what he conceived to have been the process of thought, founded on analogies from the observation of the great forces of nature by the Egyptians, Assyrians, Hindus, Chinese, Phœnicians, Greeks, Romans, the aborigines of America, Australasia, and Polynesia, and on the unquestioned evidence of phallic worship in its various phases belonging to those peoples. That worship was always, among the ancients, of a purely reverential kind, and partook of nothing obscene, either in its teaching or its observance; it was a homage paid to the most potent and most mysterious of the powers of nature.—Mr. C. Staniland Wake then read a paper on the Influence of the Phallic idea in the Religions of Antiquity.

Chemical Society, April 7.—Prof. Williamson, president, in the chair. The following gentlemen were elected Fellows:—F. Andrews, jun., W. Martindale, and A. H. Palmer.—Dr. Divers concluded a paper, commenced in a previous meeting, "On the combination of carbonic acid with ammonia and water." The elaborate and very extensive memoir does not permit of any convenient abbreviation.—Dr. Gladstone communicated a paper "On the refraction equivalents of the aromatic hydrocarbons, and their derivatives." In a previous paper it was shown that the refraction values of organic compounds may easily be calculated when the refraction equivalents of the constituent bodies are known. The present paper enumerates a large number of substances which do not conform to the rule. The so-called aromatic hydrocarbons give, by experiment, higher figures than required by calculation. Dr. Gladstone accounts for this anomaly by regarding the nucleus phenyl, $C_6\ H_5$, as an entity having, like some elements (for instance, iron and phosphorus), the peculiarity of changing its refraction value.—Mr. Hunter, of Belfast, communicated a paper "On Deep-Sea waters," a sequel to a note read before the society in December last.—Messrs. Bolas and Gloves read a note "On Bromopicrin" and announced also the discovery of tetrabromide of carbon.—Prof. How, of Nova Scotia, reports of a feed water occurring at Stellarton, N.S., which contains traces of free oil of vitriol.—For the meeting on April 21st a lecture "On Vanadium," by Prof. Roscoe, is announced.

Ethnological Society, April 12.—Professor Huxley F.R.S., president, in the chair. It was announced that Dr. Bonavia had been elected a member of the Society; Dr. Carl Semper, of Würzburg, an honorary foreign member; and Lieutenant S. P. Oliver, R.A., a corresponding member.—An interesting paper by Hodder M. Westropp, Esq., described very fully the ancient tribal system and land tenure in Ireland under the Brehon laws, and gave rise to a spirited discussion which was sustained by Mr. G. Campbell, Colonel Lane Fox, the president, Dr. Hyde Clarke, and Mr. McLennan.—A communication was then read "On the Danish Element in the population of Cleveland in Yorkshire." The author pointed out that not only many words in the Cleveland dialect and a very large proportion of personal and local names in the district are of Scandinavian origin, but also that many of the idioms in use are markedly Scandinavian. He also sought to trace an old Anglian element in the population. Mr. Jón. Hjaltalin (an Icelander,) Dr. Hyde Clarke, the Rev. Dr. Nicholas, and Col. Lane Fox, took part in the discussion which followed the reading of this valuable communication.

Entomological Society, April 4.—Mr. Alfred R. Wallace, F.Z.S., &c., president, in the chair. Exhibitions were made of *Coleoptera* by Mr. Jenner Weir and Mr. Janson; of *Lepidoptera* by Mr. Jenner Weir and Mr. Howard Vaughan; of *Hymenoptera* by Mr. F. Smith; and *Orthoptera* by the secretary.—The ravages committed in granaries by *Calandra granaria* and *C. oryzæ*, and the means of preventing the same, were the subject of a lengthy discussion, in which Messrs. Jenner Weir, Vogan, Janson, Westwood, McLachlan, F. Smith, and the president took part.—Mr. Albert Müller read a note on the odour of certain *Cynipidæ*, and Mr. G. R. Crotch communicated some observations on British species of *Dasytidæ*.

BIRMINGHAM

Natural History Society.—Geological Section.—A paper on the Igneous Rocks of the Midland Coalfields was read by Mr. S. Allport, F.G.S. The author had examined carefully the mineral constitution of the igneous rocks of the Shropshire, Staffordshire, and Warwickshire coalfields, and also the so-called loadstone of Derbyshire, and was of opinion that they all belonged to the carboniferous age, and in the case of the traps of the coalfields he had no doubt the said traps were contemporaneous and not intrusive. These rocks, now found in patches over the several coalfields of the Midlands were probably all derived from one source, just as the coalfields themselves were probably only remnants of a coalfield of great extent. In conclusion the author made some reference to the nomenclature of igneous rocks, which he said at present was in a very unsatisfactory state.

CAMBRIDGE

Philosophical Society, March 21.—Communications made to the society: 1. By Mr. Röhrs (Jesus College) "On carmine and the colouring principles of cochineal." The author described the process which he had followed in some experiments in making carmine. He found that the presence of carbonate of lime in the water used was essential to success. The hard and shelly (Mexican) cochineal, of a colour inclining to foxy red, made the best carmine. Whitening was a most important ingredient in the process. He then discussed the theory of this, and inferred that two colouring principles existed in cochineal—purpureo-carminic and coccineo-carminic acid, whereof the latter was unstable.—2. By Mr. Lewis (Corpus Christi College), "On a Roman Lanx and other antiques found at Welney." The lanx was found about four feet below the surface. It was a specimen of the flat dish bearing this name, which often was of great size. Pliny mentions one weighing 500lbs. The metal of that exhibited (according to an analysis made by Prof. Liveing) was 80 per cent. tin, 18·5 per cent. lead. In the centre was an elaborate pattern in a circle, with letters at equal distances in angles of the pattern. This had been read "VTERE FELIX." The reading, however, was doubtful. The author then commented upon other antiques of bronze, stone, and horn, from the same neighbourhood.

DERRY

Natural History and Philosophical Society, March 4.—William Harte, C.E., F.R.G.S.I., president, in the chair. Mr. Harte communicated some observations on a remarkable meteor which passed over Donegal on the night of the 27th of December last; also a notice of a beautiful Aurora Borealis.—Mr. C. W. Dugan, M.A., read a paper on the "Gold Antiquities of Ireland," illustrated by drawings. In this paper he endeavoured to controvert some views adverse to the very early civilisation of Ireland; also some opinions advanced as to the source of gold from which the massive and gorgeous ornaments brought under notice had been fashioned. In connection with this paper there were exhibited some specimens of Irish ring money, &c., as also some splendid amber beads found on the property of Dr. Forsythe, and now in his possession.—Mr. Harte exhibited and made a few observations upon some beautiful cinerary urns found at Grange, near Strabane, and at Malins, Donegal. It is remarkable that a large urn and a small one were found together. These specimens are in good preservation. The black burnt ashes were adhering quite fresh to the sides of one of them.

EDINBURGH

Scottish Meteorological Society, March 30.—Admiral Sir William Ramsay in the chair. Dr. Keith Johnston read a paper "On the temperature of the Gulf Stream in the North Atlantic Ocean." He began by saying that he had read a paper on the Gulf Stream at the half-yearly meeting of the society in January 1862, which embodied the results of observations made in the Iceland seas by Captain Irminger, of Denmark. That paper attracted the attention of meteorologists, and the result was that new stations had been established by the society in Iceland and the Faroe Islands, each of them supplied with the best instruments, placed at the disposal of the council by the Board of Trade. The Meteorological Institute of Norway has, during the past three years, made observations of the temperature of the sea at the lighthouses round the coast as far north as 71°·6′ lat. N., and on board ships engaged in the Arctic fisheries. From these observations, together with those made at different stations off the Scottish coast, in Faroe, and in Iceland, Professor Mohn of Christiania, has just published a memoir on the temperature of this part of the Atlantic, illustrated by five charts for the four seasons of the year. The five charts exhibited were based on Professor Mohn's. The singular distribution of the temperature of the sea between Iceland, Scotland, and Norway must, as M. Mohn observes, be regarded as the best representation of the course and the extent of the Gulf Stream in these parts. The line designated as the thermal axis indicates the direction of the principal axis of the current. It is along this axis that the warm waters of the Gulf Stream are pushed forward by the current to the latitude of the North Cape and Spitzbergen. At the same time, the water is cooled as it advances, either from the effect of latitude or from the loss of heat experienced on both sides in beating the coast of Norway and in melting the ice of the sea between Greenland and Spitzbergen. The distribution of temperature during the summer months, being dominated by the solar heat, the isotherms of the sea have a greater tendency to follow the parallels of latitude. The thermal axis is, as it were, thrown on the shores of Norway, where it may be followed to the west coast of Spitzbergen and Nova Zembla. The distance of the thermal axis of the Gulf Stream from the west coast of Norway being not more than 125 miles, its effect on the climate of that country must be very remarkable. Thus we find that the west coast during winter has a temperature of the air which surpasses by from 40° to 50° that due to corresponding latitudes, if there were no current of warm water. On the shores of Norway round to the frontiers of Russia, the current of the sea is directed generally towards the north and east; and, carried by the current to this far northern region, products of the vegetable kingdom are often found which had their origin in the West Indies—a fact which proves beyond all question the existence of a north-eastern branch of the Gulf Stream thus far into the Arctic Ocean. Mr. Buchan said that, to illustrate the effect of winds upon the currents, he had looked into the question of the temperature of the air at various stations as compared with that of the sea. Over the whole of Scotland and as far west at least as Faroe, the winds were south-west in winter, there being very few easterly or north-easterly winds. In Iceland a different state of things prevailed, the mean direction of the wind being east-north-east. On the west coast of Norway, the prevailing direction was uniformly south-east, or south-south-east, that is to say the winds blow to a considerable extent off the land, where at that season the temperature is exceedingly low. In summer the winds in Iceland continue easterly, with some northing in them; but in the north of Scotland they prevail more from the west. On the coast of Norway, the summer winds take the opposite direction to those prevailing in winter. The same holds good in the south and north of Norway, where the difference was 4° in favour of the sea.—Mr. Buchan read a paper on the cold weather of May 1869. Mr. Buchan said the temperature of Scotland during May 1869, was 45·1°, which was 4·7° below the average of May in the past thirteen years, and 2½° lower than any previous May recorded.

Royal Society, March 21.—Prof. Kelland in the chair. Dr. Keith Johnston communicated a paper by Mr. Keith Johnston, jun., on the "Lake Region of Eastern Africa." See abstract of this paper in NATURE, No. 24, p. 607.

Royal Physical Society, March 23.—Professor Duns, D.D., president, in the chair. The following communications were read:—On *Crocodilus biporcatus* (Cuvier), the Muggar. By Professor Duns, New College, Note on the Capture of the Grey Seal (*Halichœrus grypus*) in the Firth of Tay. By Professor Turner. Note on the Preservation of Minute Animals in Acetic Acid. By T. Strethill Wright, M.D. Notice of an instance of Double or Vertical Hermaphrodism in a Cod Fish (*Gadus morrhua*). By John Alex. Smith, M.D.

Botanical Society, March 10.—Sir Walter Elliot, president, in the chair. On the Formation of a Museum of Vegetable Materia Medica. By William Craig, M.B. and C.M. On the Fructification of *Griffithsia corallina*, with a notice of the other *Algæ* found in Shetland, not mentioned in Edmonston's Flora. By C. W. Peach, A.L.S. On Two New British Hepaticæ. By Dr. B. Carrington. On the occurrence of *Luzula arcuata* and *Buxbaumia indusiata*, in Inverness-shire. By Dr. Buchanan White. On some recent Additions made to the Flora of Canada. By Mr. Sadler. Report on the Open-air Vegetation at the Royal Botanic Gardens. By Mr. M'Nab.

GLASGOW

Natural History Society, April 5.—Prof. J. Young, M.D., president, in the chair. The following papers were read:—1. "On shell mounds at the Machar Grogary, South Uist," by James A. Mahony. This paper was illustrated by a large collection of objects, chiefly shells of various kinds, bones of a number of animals, some of them drilled with holes, others split longitudinally, stone knives or scrapers, pieces of rude pottery, and other articles of a like nature, usually found in these refuse heaps. At the close of the paper, Prof. Young dwelt at some length in comparing these Hebridean mounds with what had been examined in the Eastern counties, especially in Caithness. 2. "On the sea anemones of the shores of the Cumbraes," by David Robertson, F.G.S. The author gave a complete list of the species taken by himself in that most interesting locality, and exhibited several living anemones in illustration of his paper.

MANCHESTER

Literary and Philosophical Society, April 5.—Dr. J. P. Joule, F.R.S., president, in the chair.—"Description of a New Anemometer," by Mr. Peter Hart. It consists first of a base board furnished with levels and levelling screws; to this is hinged the board carrying the U tube, which may be called the sloping base; on this sloping base is secured the U tube furnished with a scale and vernier capable of being read to the $\frac{1}{100}$ inch. By means of a screw passing through the sloping base, and resting on the lower base board, the former can be made to assume any angle with the latter, the angle being determined by a quadrant fixed to the lowest base board.

Mr. W. Boyd Dawkins, F.R.S., described the results of the preliminary investigation undertaken by the Settle Cave Exploration Committee. Mr. W. L. Dickinson read a paper "On the Eclipse of the Sun, Dec. 21—22." A paper was also read "On the Influence of Changes in the character of the Seasons upon the Rate of Mortality," by Joseph Baxendell, F.R.A.S.

PARIS

Academy of Sciences, April 11.—A memoir, by M. C. Antoine on screw propellers, was presented by M. Laugier. The author examined the two main questions relating to the employment of the screw-propeller, viz., the number of turns obtained by means of a given motive power, and the advance made by the vessel for each turn of the screw.—M. Cahours presented a note by M. L. Daniel, on the action of magnetism upon two currents passing simultaneously through rarefied gases. The author found that when the currents are passing in opposite directions magnetism separates them even in capillary parts of the tubes; when they are in the same direction, they are attracted or repelled like a single current. The magnetic properties of the gases have nothing to do with the condensation of the light by the magnet, which acts upon the current itself.—Notices of the Aurora Borealis of the 5th April were communicated:—From Angers by M. C. Dechanne, from Paris by M. Tremeschini, from Le Mans by M. Charault, from Louvain by M. Terby, from Auvers by M. Geslin, from Vendôme by M. Guerreau, from Betz by M. Fortier-Garnier, from Rohrbach by M. Gramant, from St. Lo by M. Lepingard, and from Loget-sur-Seine by M. Lagoret.—A memoir by M. C. Flammarion on the law of the movement of rotation of the planets, was communicated by M. Delaunay. From his calculations the author deduced the following as the law of the diurnal rotation of the planets:—*The time of rotation of the planets is a function of their densities.*

The rotatory movement of the planets upon their axis is an application of gravitation to their respective densities, and is equal to the time of revolution of a satellite placed at a distance 1, multiplied by a co-efficient of resistance representing the density of the planetary body, which is at the same time the square root of the relation of its weight to the centrifugal force. The squares of these co-efficients are equal to the cubes of the distances at which satellites would gravitate in the period of rotation of each planet, and the distance at which a synchronous satellite would gravitate round each planet is the cube root of the centrifugal force, and marks the theoretical limit of any atmosphere. By applying his law to the planets Uranus and Neptune, the author deduced a diurnal rotation of $10^h\,40^m$ for the former, and of $10^h\,58^m$ for the latter.—Facts towards the history of nitric acid by M. E. Bourgoin, were commnnicated by M. Bussey. The author described the decomposition of nitric acid at different degrees of dilution by the galvanic current. He regarded the formula of nitric acid as NO^5, $2\,H^2O^2$. With the acid in a very diluted state, only hydrogen was evolved from the negative pole; as the strength of the solution was increased the hydrogen evolved reacted upon the nitric acid, and caused the production of ammonia, free nitrogen, deutoxide of nitrogen, and nitrous acid, according to circumstances. With 15 equivs. of water nitrous acid remains in solution.—M. H. Sainte Claire Deville presented a note by M. Deschamps, on the metallic tartrates, in which the author described the preparation and characters of a double tartrate of sesquioxide of manganese and potash, having the formula: $Mn\,^2O^3\,KO$, $C^8H^4O^{10}$, $4\,HO$.—M. P. Duchartre read some observations on the turning of certain fungi. The author described a case in which numerous examples of an agaric (probably *Coprinus radians*, Desmaz.) grew in perfect darkness from the bottom of a water tank, and consequently in a reversed position. They were all upon the southern portion of the tank, but their stems sloped towards the north, and in the mature examples were bent upwards at an angle towards their summits, so as to bring the head into its natural position with the hymeneal lamellæ downwards. The author cited also some experiments made with *Claviceps purpurea*, specimens of which placed in a reversed position curved upwards towards maturity, and thus brought their heads into the natural position. He considered these observations, especially the former, to be strongly opposed to the mechanical theories of the direction of growth in plants.—A note was read by M. H. Baillon, on the dissemination of the stones of *Dorstenia contrayerva*. The author noticed the structure of the fruit in *Dorstenia* and the allied plants, which he stated to consist of a number of small drupes. He stated that the parenchyma of each drupe is much more developed towards the base, and that the cells composing it acquire a great amount of elasticity, which, acting upon the stone when this is set free by the lesion of their upper part, projects it to a considerable distance.—M. Dumas in presenting M. Pasteur's great work on the diseases of silkworms, gave an excellent summary of its contents; and M. Guyon accompanied the presentation of his natural history of the chigoe (*Rhynchoprion penetrans*, Oken), with an elaborate analysis of the work.—M. Roulin communicated a note containing observations on the chigoe, supplementary to M. Guyon's remarks.—M. A. Duméril presented an account of the production of a white race of axolotls at the menagerie of the Museum, with some remarks on the transformations of those batrachians. The white race of axolotls has been established by breeding from ordinary females with an albino male, and again breeding from pale-coloured females thus produced with the same male. Some of the white individuals have undergone their complete transformation. The author stated that hitherto the transformed axolots (*Amblystoma*) have never propagated, and that an examination of their sexual organs showed ova and spermatozoids in plenty, but not in the perfect condition. The generative products seemed to have undergone an arrest of development at the metamorphosis.—A note by M. E. Duchemin was read, describing a singular cause of the death of carp in a piece of water at Montigny. The fish thrive in this water, but every spring a considerable number are found dead, and all these are blind. This blindness is ascribed by the author to the attacks of toads, which fix themselves upon the heads of the fish, and do not quit their hold even when taken out of the water. As remarked by the Secretary of the Academy, this habit of the toad has been long known.—M. C. Robin presented a note by M. Legros on the real origin of the secretory canals of the bile.—M. Guyon presented statistics of the cases of hydrophobia observed among Europeans in Algeria from 1830 to August 1851.—A note on the operation of artificial pupil, by M. Liebreich, with figures of an instrument employed in the operation, was communicated.—Of several other papers no particulars are given.

Brussels

Royal Academy of Belgium, March 5.—The following papers were read:—1. On the Aurora Borealis in the months of January and Febuary 1870, by M. A. Quetelet.—2. On commensalism in the animal kingdom, by M. P. J. Van Beneden. The author distinguishes under the name of commensalism those cases in which one animal lives upon another, but not at its expense. In the present paper he described some new examples of this phenomenon. On the authority of M. Alex. Agassiz, he noticed a *Lepidonotus* which lives near the mouth of *Asteracanthion ochraceus*, Brandt, a small *Clupea* which resides among the fringes of a Pelagian Medusa (*Dactylometa quinquecina*, A. Agass.), a species of Hirudinea which lives in a Beroid (*Mnemiopsis Leydii*), a *Philomedusa*, (named *Biccidium* by L. Agassiz) which haunts the buccal fringes of the great *Gauea arctica*, a *Hyperina* which infests the disc of the American *Aurelia*, and a *Planaria* (*P. angulata* Müll,) which attaches itself to the lower surface of the King Crab, near the base of the tail. M. Agassiz also states that the young *Comatulæ* like to affix themselves to the basal cirri of the adults. M. Van Beneden also noticed, on the authority of Risso, that the Fishing Frog (*Lophius*) lodges a species of Murænid (*Apterichthys oculata*) in its great branchial sac. He referred to the polype, which so generally coats specimens of *Hyalonema*, as furnishing an example of commensalism, and in connexion with *Hyalonema* as a Sponge reaffirmed his opinion that Sponges represent the polype type reduced to its simplest expression; a notion very like that which has lately been put forward by Häckel.—3. Remarks on the equation $x^m - 1 = 0$, by M. E. Catalan.—4. Note on the nature of the sun, by M. G. Bernaerts, in which the author maintained that the sun consists of a gaseous nucleus covered with a thin, incandescent liquid layer and luminous clouds.—5. On the meteoric stone which fell at Saint Denis-Westrem, near Ghent, on the 7th June 1855, by Dr. Stanislas Meunier. The author stated that the material of this meteorite, of which a portion, weighing 723 grammes, was picked up, is identical with that of many others, including the meteorite of Lucé (1768), whence he proposes to call it *lucéite*. He gave the analysis of another stone, which fell in the Lower Pyrenees in 1868, and remarked upon the occurrence of *lucéite* in various brecciiform meteorites, associated in some with an oolitic mass which he denominated *montrejite*, from the stone of Montrejeau (1859), and which, in other meteorites occurs alone. The author maintained that the formation of meteorites is due to the natural breaking up of larger celestial bodies at the close of their development, and that the moon is now approaching this stage of its existence.—6. On Bryonicine, a new nitrogenous substance extracted from the roots of *Bryonia dioica*, by MM. L. de Koninck and P. Murgart.—This was described as of a very pale, yellow colour, crystallising from dilute alcohol in slightly flattened and irregularly intermixed needles, neutral, insoluble in cold water, potash, ammonia and dilute mineral acids, soluble in alcohol, ether, &c., and in glacial acetic acid, and concentrated sulphuric acid, with the last giving a blood-red solution. The formula was stated to be $C^{19}H^{16}N^2O^9$.—7. Investigations on the embryogeny of the Crustacea, by Dr. E. Van Beneden.—In this paper the author described in detail the development of the genera *Anchorella, Lerneopoda Brachiella and Hessia*, the last-named a new genus.—8. Discovery of a deposit of phosphate of lime beneath the town of Louvain, by Prof. G. Lambert. This bed was discovered in 1869, in boring an artesian well; it commenced at a depth of 105-50 mm., and was 5 mm. in thickness, containing nodules of phosphate of lime like those worked for manure in this country.

Vienna

Imperial Academy of Sciences, Feb. 17 (continued from p. 618).—11. Prof. Brücke communicated the results of his investigations of the digestive products of the albuminous bodies.—12. Experimental investigation on the diffusion of the gases without porous septa by Prof. Loschmidt. The author had investigated the rapidity of diffusion of two gases superimposed in layers and in contact upon a horizontal plane. His experiments related to air and carbonic acid, carbonic acid and hydrogen, and hydrogen and oxygen. Their chief result is the law of the proportionality of the constants of diffusion with the squares of the respective absolute temperatures.—13. Project for preliminary operations in connection with the transit of Venus in 1874, by Dr. G. Neumayer, in which the author discussed at considerable length the measures to be taken in the observation of that important phenomenon.—14. Prof. E. Ludwig noticed an investigation made by himself and Dr. C. Graebe upon some derivatives of napthaline allied to the chinones.—In presenting the fourth part of Dr. Manzoni's "Bryozoi fossili Italiani," Prof. Reuss noticed its contents, which include the descriptions of twenty-four species of fossil *Chilostomatous Bryozoa*, partly from the pliocene of Calabria and Castellarquato and partly from the miocene of Turin, &c. Nine species are described as new. This part also contains a critical examination of all the Italian fossils of this class. The report of the observations made during February at the Central Institution for Meteorology and Terrestrial Magnetism was communicated.

Imperial Geological Institution, March 16.—M. C. Griesbach, in a letter dated Port Natal, January 3, 1870, relates that he found fossils in the sandstone of the Table mountain. On a journey into the Griqua-land, he discovered also a large series of very well-preserved fossils, which he thinks belong to the Tithonic series.—Baron O. Petrino, On the origin of the Löss. Researches in the territories of the Dniester, the Pruth, and the Sereth rivers have led the author to the following conclusions:—(1) The Löss is the product of slowly running rivers, deposited from the upper part of the mass of water which during inundations overflows the surrounding country; (2) the time of its formation begins with the end of the glacial period, and has continued up to the present day; (3) within the löss-deposits layers of different periods are, locally, easily to be distinguished. The old river terraces and banks of pebblestone and sand are the product of quicker running rivers, which excavate their bed more rapidly. They are contemporaneous with the löss-deposits.—Dr. Bunzel exhibited a series of fossil bones from the upper chalk formation of Grünbach, near Neunkirchen in Austria. They form one of the most interesting palæontological discoveries which we have met with in the last few years. Dr. Bunzel recognised among them remains from animals of the families of the *Crocodilians*, *Lacertilians*, *Dinosaurians*, and *Chelonians*. The *Lacertilians* are especially represented by a new genus very nearly allied to the gigantic *Mosasaurus* from Mästricht, which genus has received the name *Danubiosaurus*. To the *Dinosaurians* belongs a new species of *Iguanodon*, *I. Suessi* Bunz. A very peculiar type is indicated by a skull of a saurian, in many respects resembling that of a bird, which he has called *Struthiosaurus*.—Charles von Hauer, On the deposit of Potassium-salts at Kalusz (Galicia). They form a layer seventy feet thick. The whole mass contains on an average 15·5 per cent. potassium, and consists of a mixture of the mineral species, kainit, sylvin, and salt. The presence of sulphuric acid renders it more suitable for all industrial purposes than the well-known layer of Stassfurth, Prussia.—D. Stur has shown by an accurate examination of a large series of fossil plants, that the red sandstones of the Banat belong to the Permian (Dyas) formation, and that the coal-measures below it belong to the fifth or fern-zone (Geinitz) of the carboniferous formation.

Anthropological Society, March 22.—Prof. Rokitansky in the chair. Prof. Müller on the origin of the writing of the Malayan peoples. The author argued against the views defended especially by the English ethnologist, Crawfurd, the famous Malayan scholar, that the Malayan alphabets (the writing of the Battak, the Redschang, Lampong, Bugi, Makassar, and Tagulo peoples) are an independent invention. By the form of the single letters, as well as by the manner used to indicate the vowels, he proved that these alphabets originate from the old Indian writing which is to be found in the Buddhistic inscriptions. In connection with this question he spoke also of the origin of the Indian writing generally, and by a comparison of the old Indian with the Malayan alphabets, he comes to the conclusion that the Indian writing originated from an old Semitic alphabet. He remarked especially on the close relation between the language and the writing, and pointed out the progress which the people made by developing the writing with syllables (Silbenschrift) to a pure sound-writing (Lautschrift).—Franz v. Hauer offered to the society a large series of pre-historic archæological objects found in different parts of the Austro-Hungarian monarchy. Of very high interest among them are stone (Obsidian) implements, recently discovered by H. Wolf in the environs of Tokaj (Hungary). They have been found in many different spots, partly actually on the surface, partly in a particular stratum, covered with a bed eight feet thick of quicksand. The implements are not polished, they are accompanied by fragments of very rude vessels, by bones, and rarely by metal objects. The analysis of one of the latter, made by A. Patera, gave in 100 parts 63·75 silver, 32·5 copper, 2·0 tin, 0·125, gold, and traces of iron. The collection contains further perfectly well preserved rude vessels from Morovan near Pistyan in Hungary, fragments of similar vessels from Waitzen on the Danube, many objects from Olmütz, &c., Von Hauer remarked besides that all the remainder belong to the alluvial period, and that we have hitherto possessed very few indications of the existence of man in the diluvial (postpliocene) period in Austria. Count T. Wilczek dedicated to the society a sum of 2,000 flor. (200 l. sterl.) for excavations in the celebrated sepulchral field of Hallstatt, and for an exploration of the lakes of Upper Austria for pile-buildings.

DIARY

THURSDAY, April 21.

Linnean Society, at 8.—On the Vertebrate Skeleton: Mr. St. George J. Mivart.
Chemical Society, at 8.
Numismatic Society, at 7.

FRIDAY, April 22.

Quekett Microscopical Society, at 8.

MONDAY, April 25.

Royal Geographical Society, at 8.30.
London Institution, at 4.

TUESDAY, April 26.

Royal Institution, at 3.—On Moral Philosophy: Prof. Blackie.
Ethnological Society, at 8.—On the Philosophy of Religion among the Lower Races of Mankind: Mr. E. B. Tylor.—On the Brain in the Study of Ethnology: Dr. Donavon.
Society of Antiquaries, at 2.—Anniversary Meeting.

WEDNESDAY, April 27.

Society of Arts, at 8.
Geological Society, at 8.

THURSDAY, April 28.

Royal Institution, at 3.—Electricity; Prof. Tyndall.
Royal Society, at 8.30.
Zoological Society, at 8.30.

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Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & Co. at the Office, 63, Bleecker Street, New York.—THURSDAY, April 21, 1870

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH

No. 26] THURSDAY, APRIL 28, 1870

THURSDAY, APRIL 28, 1870.

WHAT IS ENERGY?

It is only of late years that the laws of motion have been fully comprehended. No doubt it has been known since the time of Newton that there can be no action without reaction; or, in other words, if we define momentum to be the product of the mass of a moving body into its velocity of motion, then whenever this is generated in one direction an equal amount is simultaneously generated in the opposite direction, and whenever it is destroyed in one direction an equal amount is simultaneously destroyed in the opposite direction. Thus the recoil of a gun is the appropriate reaction to the forward motion of the bullet, and the ascent of a rocket to the downrush of heated gas from its orifice; and in other cases where the action of the principle is not so apparent, its truth has notwithstanding been universally admitted.

It has, for instance, been perfectly well understood for the last 200 years that if a rock be detached from the top of a precipice 144 feet high it will reach the earth with the velocity of 96 feet in a second, while the earth will in return move up to meet it, if not with the same velocity yet with the same momentum. But inasmuch as the mass of the earth is very great compared with that of the rock, so the velocity of the former must be very small compared with that of the latter, in order that the momentum or product of mass into velocity may be the same for both. In fact, in this case, the velocity of the earth is quite insensible and may be disregarded.

The old conception of the laws of motion was thus sufficient to represent what takes place when the rock is in the act of traversing the air to meet the earth; but, on the other hand, the true physical concomitants of the crash which takes place when the two bodies have come together were entirely ignored. They met, their momentum was cancelled—that was enough for the old hypothesis.

So, when a hammer descends upon an anvil, it was considered enough to believe that the blow was stopped by the anvil; or when a break was applied to a carriage-wheel it was enough to imagine that the momentum of the carriage was stopped by friction. We shall presently allude to the names of those distinguished men who have come prominently forward as the champions of a juster conception of things, but in the meantime let us consider some of those influences which served to prepare men's minds for the reception of a truer hypothesis.

We live in a world of work, of work from which we cannot possibly escape; and those of us who do not require to work in order to eat, must yet in some sense perform work in order to live. Gradually, and by very slow steps, the true nature of work came to be understood. It was seen, for instance, that it involved a much less expenditure of energy for a man to carry a pound weight along a level road than to carry it an equal distance up to the top of a mountain.

It is not improbable that considerations of this kind may have led the way to a numerical estimate of work.

Thus, if we raise a pound weight one foot high against the force of gravity we may call it one unit of work, in which case two pounds raised one foot high or one pound raised two feet high would represent two units, and so on. We have therefore only to multiply the number of pounds by the vertical height in feet to which they are raised, and the product will represent the work done against gravity. The force of gravity being very nearly constant at the earth's surface, and always in action, is a very convenient force for this purpose; but any other force, such as that of a spring, would do equally well to measure work by. Generalising, we may say, *the space moved over against a force multiplied into the intensity of that force will represent the quantity of work done.* So much for the definition of work, and it is necessary to know what *work* is before proceeding to define *Energy*.

Now what does the word Energy really mean? In the first place it does not mean force.

Two substances may have an intense mutual attraction, in virtue of which they form a very intimate union with one another; but when once this union has been consummated, although the force still continues to exist, the combination is singularly deficient in Energy. Nor does Energy mean motion, for although we cannot have motion without Energy, yet we may have Energy without motion.

By the word Energy is meant the power of doing work; and the energy which a labouring man possesses means, in the strictly physical sense, the number of units of work which he is capable of accomplishing.

This is a subject which at this stage we may attempt to illustrate by reference to a very different department of knowledge.*

The analogy which we shall venture to institute is between the social and the physical world, in the hope that those who are more familiar with the former than with the latter may be led to perceive clearly what is meant by the word Energy in a strictly physical sense. Energy in the social world is well understood. When a man pursues his course, undaunted by opposition and unappalled by obstacles, he is said to be a very energetic man.

By his energy is meant the power which he possesses of overcoming obstacles; and the amount of this energy is measured (in the loose way in which we measure such things) by the amount of obstacles which he can overcome—the amount of work which he can do. Such a man may in truth be regarded as a social cannon-ball. By means of his energy of character he will scatter the ranks of his opponents and demolish their ramparts. Nevertheless, a man of this kind will sometimes be defeated by an opponent who does not possess a tithe of his personal energy. Now, why is this? A reply to this question will, if we do not mistake, exhibit in a striking manner the likeness that exists between the social and the physical world. The reason is that, although his opponent may be deficient in personal energy, yet he may possess more than an equivalent in the high position which he occupies, and it is simply this position that enables him to combat successfully with a man of much greater personal energy than himself. If two men throw stones at one another, one of whom stands at the top of a house and the other at the bottom, the man at the top of the house has evidently the advantage.

So, in like manner, if two men of equal personal energy contend together, the one who has the highest social

* The subject has previously been discussed from this point of view by Messrs. Stewart and Lockyer in an article in *Macmillan's Magazine*, August 1868.

position has the best chance of succeeding. For this high position means energy under another form. It means that at some remote period a vast amount of personal energy was expended in raising the family into this high position. The founder of the family had, doubtless, greater energy than most of his fellows, and spent it in raising himself and his family into a position of advantage. The personal element may have long since disappeared from the family, but not before it had been transmuted into something else, in virtue of which the present representative is able to accomplish a great deal, owing solely to the high position which he has acquired through the efforts of another. We thus see that in the social world we have what may justly be termed two kinds of energy, namely :—

1. Actual or personal energy.
2. Energy derived from position.

Let us now again turn to the physical world. In this, as in the social world, it is difficult to ascend. The force of gravity may be compared to that force which keeps a man down in the world. If a stone be shot upwards with great velocity, it may be said to have in it a great deal of actual energy, because it has the power of doing useful work or of overcoming up to a great height the obstacle interposed by gravity to its ascent, just as a man of great energy has the power of overcoming obstacles. But this stone as it continues to mount upwards will do so with a gradually decreasing velocity, until at the summit of its flight all the actual energy with which it started will have been spent in raising it against the force of gravity to this elevated position. It is now moving with no velocity—just, in fact, beginning to turn—and we may suppose it to be caught and lodged upon the top of a house. Here, then, it remains at rest, without the slightest tendency to motion of any kind, and we are led to ask what has become of the energy with which it began its flight? Has this energy disappeared from the universe without leaving behind it any equivalent? Is it lost for ever, and utterly wasted? But the answer to this question must be reserved for another article.

BALFOUR STEWART

LEGISLATION AND NATURE

THE effect of Legislation upon Nature is one of those far-reaching subjects which men are only just beginning to investigate in a practical spirit. It is, of course, only a minor branch of the larger question of man's influence upon all external life and forms, but it has its special attractions, nevertheless, and may be pursued to advantage as an independent study. Incidentally, it illustrates many other problems. The diminutiveness of the Hindu cow, for example, may be due as much to the legislation which has made the domesticated animal sacred as to the nature of the climate of Hindustan. It is quite possible the oxen of this country would not have exhibited such a variety of forms and sizes had we selected one species and made it sacred some two or three thousand years ago. Take, again, the subject of maritime canals, which is now in its infancy. The Suez Canal has not existed long enough to have had any appreciable effect, either in modifying the coast-lines of the Mediterranean, or in creating any interchange of marine species; but it is likely enough to be one of a series, and we cannot predict what may be their effects. The diversion of the Nile may prove a serious matter, and now the Darien scheme has revived, a great impetus has been given to speculation, so that an ingenious projector has actually sketched a canal which should unite the Bristol Channel with the English Channel. Two more illustrations may suffice to make my meaning clear. There seems little apparent connection between woods and national greatness, but, nevertheless, the relation is a real one. When Spain lost the empire of the seas, she lost it from two causes—impoverished finances, due to a speculative trade in precious metals, and want of woods to build her ships. Her people had a foolish prejudice against trees, and an arid climate and reduced shipbuilding were the results. From Danzig to Pillau once stretched a thick pine forest. When King Frederic William I. was in want of money, one Herr Von Korff recommended its destruction. The experiment was a financial success, but the State was injured by it. As Willibald Alexis states, "the sea-winds rushed over the bared hills; the Frische Haff is half choked with sand; the channel between Elbing, the sea, and Königsberg is endangered; and the fisheries in the Haff injured. The operation of Herr Von Korff brought the King 200,000 thalers. The State would now willingly expend millions to restore the forests again."

Neither directly nor indirectly, in fact, can we touch nature by our laws, without beginning a new chain of causes, the end of which we cannot foresee. The consequences of human volition are always a little wonderful. When the treasures of Thorwaldsen were packed up in Rome, it was not dreamed that new plants would be conveyed to Copenhagen in the grasses of the Campagna, any more than Clusius, the first European writer who mentions the potato, could possibly foresee that half the miseries of Ireland would spring from its exclusive cultivation. What we owe to our game-laws, again, is a boundless subject which might be investigated by a naturalist with profit.

My immediate purpose, however, is—strange as it may seem—with Mr. Lowe and his Budget. He deserves to be styled a real friend to the farmer, though apparently he has only given him a restricted use of germinating barley. Readers of Darwin will remember how he traces the connection between the number of cats in a given locality, and the number of humble bees, and the abundance of red clover and heartsease. Well, Mr. Lowe's Budget starts a similar House-that-Jack-built. The freedom of firearms from taxation affects their number in any district, the number of guns determines the number of our small birds, and the number of our small birds affects the immunity of our fields from grasshoppers, cricket-moles, beetles, locusts, slugs, &c. Mr. Lowe was concerned for the security of life, for the prevention of early quasi-poaching habits, but his 1*l.* tax may effect a revolution all the same. It is no longer a secret, that wherever a persistent warfare is carried on against small birds—against martins, blackbirds, sparrows, larks, &c.—vegetable life is sure to suffer. In the Isle of Bourbon, as M. Michelet tells us, the martin was exterminated, and a plague of grasshoppers followed; in Hungary, the sparrow was proscribed, until this valiant militia of the fields had to be recalled; in the neighbourhood of Rouen, the blackbird was shot down without mercy, and many a meadow's turf could be rolled up like a carpet; and in this country we had, until lately, our sparrow clubs, which paid for little victims at so many a dozen, just as two or three hundred years ago some of our pious churchwardens used to purchase hedgehogs of truant schoolboys in the rural districts, a lamentable increase of pestiferous insects being the consequence. The Rev. Charles Kingsley gives us a more recent example. In Trinidad, the free negro has been banging away at the small birds, partly for his own pleasure, and partly to supply the London markets and our ladies' hats. What has been the consequence? "Already the turf of the savannah, or public park, close by, is being destroyed by hordes of mole-crickets, almost exactly like (strange to say) those of our old English meadows; and unless something is done to save the birds, the canes and other crops will surely suffer in their turn. A gun-licence would be, it seems, both unpopular and easily evaded in a wild forest country. A heavy export tax on bird-skins has been preferred" (*Good Words*, April). A single pair of swallows, says M. Michelet, carry every week to the nest 4,300 caterpillars or *coleoptera*. The blackbird is a notorious insect-eater, and consumes hundreds of imperfect insects every day, to say nothing of worms and slugs. The common sparrow is a vivacious feeder, and somewhat dainty withal, but it makes great havoc with young worms and soft insects. All our field birds, in short, troublesome and non-melodious as many of them are, rid us of millions of fast breeding insects which would otherwise do incalculable injury to our vegetation, and could not well be destroyed by artificial means. Indeed, we disturb a natural arrangement when we step in and decimate a predatory class without also destroying their victims, and therefore it is gratifying to find Mr. Lowe putting a check upon amateur sportsmen, who bang away, reckless of consequences either to themselves or others. A little time ago we agreed to protect our sea-birds, because we found they showed us "schooling" fish, and warned our seamen from dangerous rocks in misty weather. This time our legislation is less direct. We have not had a select committee on the sparrow—there are plenty of chatterers in the House of Commons who might be "sat upon" to advantage; we have not even anticipated a Ministry of Agriculture by investigating the sources of injury to growing crops; but we have been moved by social advantages, and the bright-eyed broods of field and wood will profit by our sense of security and our desire to equalise taxation.

A word on another topic. The rating of woods and plantations is threatened. It is part of the very question I have so hastily touched upon. Wherever farms are very bare of trees, insects always abound. The locust and the grasshopper delight in the plain, whilst the smaller insects thrive in the young woods that give shelter to their enemies. If we do anything to diminish the planting of trees, we shall increase our insects and also dry our already impoverished soils. We are protecting salmon—why should we not protect our woods, and with them our birds and our crops? Dean Stanley notes that Jewish tradition ascribes to Joshua certain useful regulations as to woods—the grazing of cattle therein, the cutting of sticks, and the preserving of thinly-planted trees. There was wisdom in them all. Watch a bare and a wooded hill on a cloudy day, or a well-wooded farm in a dry summer, and you will see a difference which need not be described. Disafforesting threatens to become as common in the nineteenth as enclosuring was in the sixteenth century. Are we wise to hasten it?

E. GOADBY.

DR. JELINECK ON METEOROLOGICAL OBSERVATIONS

Anleitung zur Anstellung meteorologischer Beobachtungen und Sammlung von Hilfstafeln. Dr. Carl Jelineck. Royal 8vo. pp. 193, with 17 figures. (Vienna, 1869. London: Williams and Norgate, price 6*s*.)

A COMPARISON between the instructions of M. Carl Kreil, the late director of the Austrian Central Office for Meteorology and Terrestrial Magnetism, and those now issued by his successor, demonstrates steady and sound progress in practical meteorology. M. Kreil had to sow his seed on uncultivated soil, and was only partially supplied with the more modern implements of cultivation; Dr. Jelineck, on the contrary, has had before him the successive results of nearly a quarter of a century, and has profited by the vast experience gained from the correspondence carried on during that time between the central office and the numerous stations, distributed over the wide geographical area of the Austrian empire with its striking physical contrasts. No wonder then, that Dr. Jelineck's work, which the author modestly calls "a guide to meteorological observations, with particular reference to the stations in Austria and Hungary," has developed, under his hands, into an excellent manual of practical meteorology, which will prove, in many respects, most valuable to the observers of every country. In the instructions of his predecessor such important subjects as the employment of the aneroid and marine barometers, and of the maximum and minimum thermometers, are not discussed at all, and little attention is paid to a rigid reduction of the observations.

The introductory part of the present work treats on the following subjects: general organisation of the system of meteorological observations in Austria and Hungary; conditions for establishing new stations; regulations for the official correspondence through the post and telegraph offices; local requirements and instrumental equipment of stations, with a precise statement of the necessary expenditure; a list of the most recent and important works on meteorology published in Germany, England, and France; hours of observation and means for determining the true local mean time.

Then follows a concise and clear description illustrated by excellent figures, of the different kinds of barometers and aneroids, a discussion of their relative advantages and defects, and an exposition of the principal formulæ used in the reductions of the observations, with well-selected examples fully worked out, for those observers whose mathematical knowledge is deficient. It appears that the form of barometer mostly in use at the Austrian stations, is that in which there is no provision for adjusting the zero of the scale to the fluctuating surface of the mercury in the cistern. Hence, only one displacement of the index is made for every observation, viz. that at the upper surface of the mercurial column. This is undoubtedly an advantage, for the lower adjustment requires always great nicety in the observer, and is, in some kinds of light, really difficult; but the advantage is, in our opinion, more than counterbalanced by the complexity of the reductions necessary for the instruments, which obviously require an additional correction for the change of level in the cistern.

The thermometers, maximum and minimum, dry and wet bulb, are described in the same exhaustive manner, and the best methods are discussed for obtaining trustworthy observations on the temperature of air, springs, rivers, and soils; the tension of the vapour of the atmosphere, and hence the relative humidity of the latter. Dr. Jelineck erroneously states on page 41 (foot-note No. 4), that the mean temperatures in England and Scotland are solely derived from the readings of the maximum and minimum thermometers. It is quite possible that in former years such observations, for want of better ones, were made the basis for deducing the mean temperature of some localities; but, as far as we are aware, these are exceptional cases, and the daily and annual mean temperatures are everywhere in this country derived from daily observations at fixed hours.

The remainder of the work comprises chapters on raingauges, the direction and force of wind, anemometers, the amount and form of clouds, the direction of upper currents, thunderstorms, optical phenomena of the atmosphere, ozone observations, and finally, the best methods for deducing from the observations the most probable annual mean results. Although the author shows himself, on the whole, well acquainted with what has been done in this branch of physical science beyond Germany, some of the chapters alluded to appear defective. A great deal of scientific knowledge and mechanical ingenuity have been brought to bear in this country on many of the subjects just mentioned, and our observatories, both public and private, are now supplied with instruments for different purposes, with which those described by Dr. Jelineck will bear no comparison; indeed, his instructions with reference to them, show that very little advance has been made in this respect from an almost primitive state: and if we consider what use is being made in this country of photography for obtaining continuous records of the principal atmospheric phenomena, and how well founded our hopes are thus, at last, to obtain an insight into the great laws which must regulate these phenomena,—we cannot but regret that the wide experience and profound knowledge of continental meteorologists should remain unsupported by the invaluable assistance of our modern appliances in their scientific investigations. The attentive reader will nevertheless find treasures even in those parts which fall short of our expectations, for every page is replete with most valuable hints, instructions, and suggestions, derived from long and extended experience.

The second part consists of very numerous and highly-valuable auxiliary tables, some of which, especially those referring to hypsometrical observations, we do not recollect to have met before in such a compact form.

No allusion whatever is made to solar radiation and atmospheric electricity, two meteorological elements the importance of which is rising more and more in the estimation of all thoughtful meteorologists.

We learn with satisfaction that the metrical system will shortly be introduced in Austria and Hungary, and that in future the Centigrade scale will be made use of in the meteorological observations. B. L.

OUR BOOK-SHELF

The Home Life of Sir David Brewster. By his Daughter, Mrs. Gordon.

WE like this book. It is notoriously difficult for a near relation to write a truthful biography, but Mrs. Gordon has done her work with great ability, taste and judgment. To most readers, the family details at the beginning will be of little interest, but as the life advances the interest grows. The book is essentially what its title imports, it pictures Sir David as a man rather than as a philosopher; yet his daughter tells us much of when and how his literary and scientific work was accomplished, and gives us lively anecdotes both of himself and of many of his contemporaries. In one chapter she analyzes his mental characteristics, and while acknowledging his imperfections, she shows that much which appeared inconsistent in his actions arose from an uusually dual nature, the continuation of a peculiarly impulsive temperament, with a scientific habit of thought. In another, she traces his religious history, and we see his advance from a somewhat cold and rigid orthodoxy to a living and happy faith, when without materially changing his own opinions he was ready to sympathise with good men who differed from him. Those who are well acquainted with the multitudinous optical researches of Brewster, will enjoy a glimpse of him at work among apparatus, often extemporised from corks and bits of metal, and glass, meanwhile indulging in a low purring whistle of satisfaction, and those who remember him only as a Nestor in science with furrowed features and snowy hair, describing his discoveries, or declaring his convictions in clear vehement language, will like to know him also as the head of a family, and the principal of a university, a politician, and a writer of reviews, gaining high distinctions, and promoting valuable institutions. But we can only just indicate these things, and must refer to his daughter's book for details about the dawn full of promise, the brillant noonday, and the beautiful sunset of his life.

J. H. GLADSTONE

On the Rotation of the Embryoes of the Frog within the Egg. By Dr. S. L. Schenk. Pflüger's Archiv. 1870, iii. Jahr., Heft 2 and 3.

IT is well known that the embryo of the frog exhibits remarkable movements of rotation, the direction being in opposition to that of the movements of the hands of a watch, supposing the observer to be looking vertically down upon the instrument, and that the head of the animal is directed away from him. These movements continue without interruption, and may be watched for hours together. They vary considerably in rapidity, but a series of observations made by Dr. Schenk showed that the rotation was effected in from five minutes and thirteen seconds to twelve minutes and two seconds. It has not been accurately ascertained when these movements commence, since in the earliest stages of development the surface of the egg is in close contact with the capsule, and it is only after some water has been imbibed that the two are separated, but Dr. Schenk shows that they result from the presence of ciliated cells on the surface; first, because these can be demonstrated with the microscope; secondly, because they can be accelerated by the application of moderate heat, which is well known to render the movements of cilia more rapid, and thirdly, because they can be arrested almost instantaneously by the action of weak acids, which are known to operate in the same way on ciliary movements.

Des Races Humaines ou Eléments D'Ethnographie. Par J. J. D'Omalius D'Halloy. Pp. 157. 1869. (Williams and Norgate.)

THE author of this treatise divides mankind into five races, distinguished by the colour of the skin—the white, yellow, black, brown, and red races—which he holds to be more reliable than either craniological character or linguistic affinities; adducing against the former, or Retzius' classification, the observation of Brandt that in examining the crania of a large number of beavers he found great variations to exist; whilst in regard to the classification founded on language, admitting that the consideration of language may prove of great service to ethnology, there is yet no identity between the two sciences. He estimates the members belonging to the several great religions of the world as follows: Christianity 380,000,000, Mahommedanism 100,000,000, Buddhism 500,000,000, Brahmanism 100,000,000, other religions 120,000,000, making a total population for the world of 1,200,000,000. M. D'Halloy is unusually orthodox in his opinions, and defends Scriptural authority with more energy than of late years has been customary with anthropological *savants*.

Studien aus dem Institute für experimentelle Pathologie in Wien aus dem Jahre 1869. Herausgegeben von S. Stricker. (Wien: Braunmüller.)

THIS is another of those German local periodical publications which disturb the minds and pockets of English readers. The time is evidently not far distant when a sumptuary law of publications will become a necessity in Germany. This, the first number of an intended series, is devoted to the histology and physiology of inflammation, and contains papers entitled, "Experiments on Corneal Inflammation," "On Cell Division in Inflamed Tissues," "On Endogenous Formation of Pus Corpuscles in the Conjunctiva of the Rabbit," and others, in all nine in number, contributed by Stricker and his pupils, with a prologue "On the Present State of the Inflammation Controversy," and an epilogue "On the Effect on that Controversy of the Preceding Memoirs," both by Stricker. One paper by Oellacher, "On the Cleavage and Stratification of the Hen's Egg," has only a general and indirect reference to inflammation.

Sketches of Life and Sport in South-Eastern Africa. By Charles Hamilton, F.A.S.L. (London: Chapman and Hall. 1870.)

WE do not understand with what object this book has been published. Of sketches of sport there are few, and none that can compare in interest with the many exciting records of South African adventure in earlier books with which we are familiar. The author's ideas on all subjects connected with natural history are of the vaguest, as where he says, "The Struthionidæ may comprise, *for what I know*, other species besides those of the ostrich; a geologist would give the reader information on the possibility of these birds existing in some analogous form centuries before the present formation of the globe!" Of sketches of life there are some, but with not much greater claim to novelty. That Mr. Hamilton succeeded in so far divesting himself of European prejudices as to submit to be carried to his bath by twenty buxom Kaffir girls, and after having been ducked by them in the water (an operation which he found "rather agreeable than otherwise"), to be painted over with red earth, may be interesting to himself and his friends, but hardly to the general public. What becomes of the old crinolines appears from the fact that the ordinary costume of a Kaffir schoolgirl is a necklace and an outrageously large skeleton crinoline without any covering over it. The woodcuts are on a par with the letter-press, and would be a hideous disfigurement to any work of higher literary pretensions.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Analogy of Colour and Music*

I HAVE read with interest the letters in NATURE of 31st March, on the relation between the harmonies of sound and colour, and I wish to point out that the most important principle of harmonising in colour is one which has no parallel or analogue in sound, except only that, like the harmony of sound, it has a mathematical basis. I mean the law that complementary colours harmonise with each other. The definition of complementary colours is, that any two colours which are complementary and of equal intensity, produce white when combined. In sound, on the contrary, there is nothing analogous to white, and consequently no relation analogous to that of complementaries.

All possible colours except white are colours of the spectrum. Black is only the negation of light, and grey is a subdued or lowered white. Brown tints, which to the eye appear unlike any of the colours of the spectrum, are "merely red, orange, or yellow, of feeble intensity, more or less diluted with white." (Clerk Maxwell, *Philosophical Transactions*, 1860.) "One circumstance, however, must not be left unnoticed here: namely, the difficulty of obtaining [that homogeneous red light which forms the transition between the violet and red of the ordinary spectrum, and which can only be produced by the prism under remarkably favourable circumstances (on a bright summer's noon). This outermost colour of the spectrum, which may be equally well regarded as extreme red or extreme violet, I will call purple . . . . In point of fact, the transition from violet to red is just as continuous to the eye as that between any two other colours, though the limit has not yet been fixed by observation at which the same impression of colour is produced by a different duration of vibration." (Prof. Grassmann, *Philosophical Magazine*, April 1864.)

The duration of vibration at the extreme of the violet end of the visible spectrum is about twice what it is at the extreme of the red end. According to Sir John Herschel (*Good Words*, August 1865), the vibrations at the extreme ends of the spectrum, number respectively 399,401,000,000,000 and 831,479,000,000,000 to the second; so that those of the extreme violet are a little more than twice as numerous as those of the extreme red, and the power of vision extends through a little more than a large octave.

With these facts before us it is scarcely possible to doubt that the principle of the octave is as true of light as of sound. Any two notes, whereof the vibrations producing the one are exactly twice as numerous in the same time as those producing the other, are in a manner recognised as the same note, the one being the octave of the other. It is in the highest degree probable that the same is true of light, and that "the limit at which the same impression of colour is produced by a different duration of vibration" is at the point where the vibrations of the one are exactly twice as numerous in the same time as those of the other.

Independently of this speculation (which is not a new one), it is a fact of observation, and is indeed only a statement in other words of the fact quoted above from Prof. Grassmann, that the order of the tints in the spectrum is recurrent. According to Prof. Grassmann, the order of the tints is the following:—

1. Red.
2. Orange.
3. Yellow.
4. Yellowish green.
5. Green.
6. Bluish green.
7. Azure.
8. Indigo.
9. Violet.
10. Purple.

Red again.

And he maintains, reviving Newton's theory, that every colour has its complementary in the spectrum;—the series of complementaries being this:—

1. Red + bluish green = white.
2. Orange + Azure = white.
3. Yellow + indigo = white.
4. Yellowish green + violet = white.
5. Green + purple = white.

*The importance of the accompanying letter from Mr. Murphy induces us to reopen a subject which we had considered closed; we append also two others previously received.—ED.

If the order of the tints is recurrent, it is only using another word for the same fact to say that it is circular; and it is possible so to arrange the colours of the spectrum in a circle that any two tints which are opposite to each other shall be complementaries.

Grassmann's results are purely theoretical, but they coincide in a great degree with the experimental determinations of Helmholtz, and of Clerk Maxwell. In such experiments the method is to mix two or more coloured lights by letting them fall on the same spot of white paper. Mixture of colouring stuffs will not give the same result.

I now come to some remarks of my own on the theory of complementaries.

If colours are so arranged on the circumference of a circle that every tint has its complementary opposite to it, as has been done by Newton and by Grassmann after him, any two tints which are 180° apart are complementaries, and any two tints which are 360° apart coincide. If then the theory of the octave is true, of two tints which are 360° apart, the number of vibrations in a second (or the frequency of vibrations) of one is twice that of the other. It might be expected that the ratio of the frequency of vibrations between any two tints which are 180° apart, would be the square root of this; or, in other words, that when the frequency of the vibrations of any colour is known, that of its complementary might be found by multiplying or dividing, as the case may be, by the square root of two.

To put this in another form: If we so arrange the tints, from red to its octave, where purple turns red again, round the 360° of a circle, that any two tints separated by equal areas shall have their frequencies of vibration in equal ratios; then, as the frequencies of vibration of the two reds which are separated by 360° stand to each other in the ratio of 2 to 1, the frequencies of vibration of any two tints which are separated by 180° will be to each other in the ratio of the square root of 2 to 1. Now if the theory of a chromatic octave be true, the pair of tints which are 360° apart are exactly alike, and we might expect those which are 180° apart to be complementary to each other.

But this is not the case.

The ratios of the wave-lengths and of the frequencies of vibration (which, of course, are in the ratios of the reciprocals of the wave-lengths), corresponding to various tints, have been determined with great accuracy by Prof. Clerk Maxwell (*Philosophical Transactions*, 1860), by means of an interference-spectrum. The numbers in the following table, which are given on his authority, are the numbers of wave-lengths in the retardations; each colour is written in the same line with its complementary. In the case of bluish-green, blue, and indigo, I take the middle one of three places in the same colour.

Red	36·40	Bluish green	48·30
Orange	39·80	Blue	51·80
Yellow	41·40	Indigo	54·70

If the frequency of vibration of the colours in the second column were to that of their complementaries in the first, in the ratio of the square root of 2 to 1, the numbers would be—

Bluish green	51·47
Blue	56·28
Indigo	58·54

Thus the frequencies as observed were considerably less than as calculated from the hypothesis. The differences are all on the one side, and are much too great to be the result of any accidental error. The complementary tints in the foregoing table are not precisely opposite, but approach each other by the green side of the circle; and if from the portions of the circle from red to yellow, and from bluish green to indigo, any two tints are taken which stand exactly opposite, so that their frequencies of vibration are in the ratio of 1 and the square root of 2, their unison will not give pure white, but white with a blue tinge.

But does this disprove the hypothesis that the true complementaries are those tints whereof the frequencies of vibration are in the ratio of 1 and the square root of 2? I think not.

Complementaries are usually understood to be tints, which by combination form a colour sensibly identical with that of sunshine. But is this correct? The solar spectrum is not pure, in consequence of the great number of absorption lines towards the violet end. That of the electric light, on the contrary, is free from absorption lines, and, in consequence of their absence, the electric light is sensibly bluer than that of the sun. If now the colour of the electric light, instead of that of sunshine, were taken as the true white, it appears probable that experiment would show the frequencies of vibration in any colour and its complementary to be in the ratio of 1 and the square root of 2.

There are some remarks on this subject in the 2nd vol. of my work on "Habit and Intelligence," of which book you inserted a notice by Mr. Wallace on 15th Nov. and 2nd Dec., 1869, but it is more thoroughly thought out in this letter.

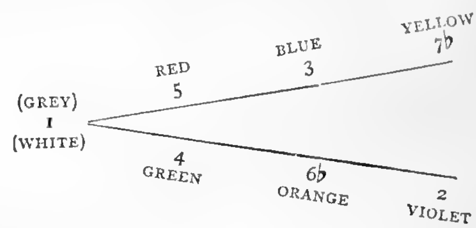
JOSEPH JOHN MURPHY

Old Forge, Dunmurry, Co. Antrim, April 16

M. RADAU, in his "Acoustique," says:—"The disdain with which most musicians repel the invasion of their domain by the exact sciences is to a certain extent justified." I venture to think it is very much justified, since little has been accomplished in aid of a technical theory of music by scientific men from Pythagoras down to Helmholtz. The highest service the mathematicians have rendered was to assist in destroying the application of their own theories by establishing the universally received system of "equal temperament." Now that the "effects" of colours are falling under the manipulation of mathematicians, could not the learned who are occupying your columns with the old discussion on "ratios" condescend to receive some warning from the history of "speculative music"?

One of your correspondents asks for a "white sound"! Seeing that a complementary colour completes the numerical value of the white rays more or less as the inversion of any musical interval completes the octave, is it unscientific to assume that the white ray must be the analogue of the monochord? Allow me to assume that it is so, and that white and black are complementaries, as M. Chevreul admits. Let me also assume that they are the two extremes of *light and shade*, including many gradations —*many octaves*—of intermediate shades of grey.

Taking any normal gradation of light and shade, and calling it grey or white, as the generator, the primary colours and their complementaries correspond to the harmonics, thus:—



The following series of figures

1	2	3♭	3	4	4♭	5	6♭	6	7♭	7	1
1	7♭	6	6♭	5	5♭	4	3	3♭	2	2♭	1

represent what musicians call a table of inversions in the octave. It must be understood that in the system of inversions of numbers I employ, what is meant by a number and its inversion are the distinct notes in the scale the two numbers represent. For instance, 1 to 5 is C to G in ascending, and the inversion is 1 to 4, C to F—always in ascending, and counting from the generator No. 1.

Hence the following table of abstract intervals and their inversions, produced in regular order from the generator:—

Unison 1 White or Grey.	5th Red.	Minor 3rd Indigo.	Major 3rd Blue.	Minor 7th Yellow.	Major 7th Lemon.	5th Red+Green (brown). (tritone).
1 White Octave	4th Green.	Major 6th Chrome.	Minor 6th Orange.	Major 2nd Violet.	Minor 2nd Lavender.	Sharp 4th Green+Red (brown

Musically speaking, the generator No. 1, as the root of a natural dissonant chord 1, 5, 3, 7♭, becomes No. 5 of the scale, or dominant of the key, the tonic of which is four degrees higher.

Consequently, if there be any analogy at all between sound and light, or between musical intervals and colours, the key-note of the spectrum would be *green*—the ray of medium refrangibility—and four degrees higher than the dominant or generator *white*. In modern views of harmony, I may remark it is not the concord or triad, but the dissonance, which is the basis of the technical theory.

Collecting, then, the abstract intervals given above, and considering them as representing separate notes, and arranging them in regular order, counting the original generator as No. 5, we get the following scale—major, minor, and chromatic—of F♮, or *green*:—

					(Tonic)						
5	6♭	6	7♭	7	1	2	3♭	3	4	4♯	5
C	D♭	D	E♭	E	F	G	A♭	A	B♭	B	C
Grey.	Laven-der.	Violet.	Indigo.*	Blue.	Green.	Red.	Orange.	Chrome.	Yel-low.	Lemon.	White.

* Indigo is, I think, a misnomer: it should be purple between blue and violet.

On the same system it is easy to construct an enharmonic scale on the principle employed by M. Chevreul. The double flats and sharps sometimes give ternary compounds. For example, 4♯♯ equals green + red + red, and its inversion 5♭♭ would give red + green + green. Some of the neutral greys, olives, slates, browns, &c., which would not appear in a table so constructed and calculated at a normal pitch, are produced by lowering the diapason.

From the above very brief explanation of the system of inversions, the following results may be suggested:—

1. That a table of colours of all gradations, with their complementaries, may be musically expressed in numerical notation with the greatest exactitude.

2. That, contrary to scientific opinion, it does not follow that because the red ray has the lowest degree of refrangibility, &c. &c., or perhaps because it happens to be at the bottom of the series of prismatic colours, it should necessarily be the initial note on the tonic of a scale.

3. Even if the red ray be the tonic, it does not follow that the scale of the spectrum should be *major*, as is too frequently given in elementary works on optics. By the system of inversions of numbers here presented, the scale of the spectrum appears, by disjoining the conjunct tetrachords, to consist of one tetrachord major and one minor, corresponding to the descending minor scale in use, of F♮ minor, supposing C♮ to represent the normal pitch of the dominant No. 5 corresponding to any given intensity of white light. Moreover, one conjunct tetrachord of the spectrum appears in *ascending* and one in *descending*, both tetrachords *converging* on the tonic.

4. If the analogy be true so far, there is only one colorific key. Modulation through a series of colorific keys, as in *modern* music, is impracticable. The reasons I have not space to explain.

J. G.

Mr. Sedley Taylor has, it seems to me, written his criticism on my letter published in Nature, Feb. 10th, far too hastily. I do *not* compare the diameter of the rings with one another, but *their cubes*, otherwise we should be led in establishing the musical analogy to the absurd equation $\frac{1}{\sqrt[3]{2}} = \frac{1}{2}$. It would perhaps have been better to have said, that the ratios of the spheres described on the diameters of the rings, taken successively from red to violet, two and two together, the 1st to the 2nd and the 2nd to the 3rd, &c., give a series of fractions identical with those expressing the relative lengths of the musical chords from D to C, ascending and taken in like manner. As Mr. Taylor doubts Prof. Zannotti's accuracy, I will quote the following passage from Biot's "Precis Elémentaire de Physique," 3rd Ed., Vol. ii. Paris, 1824, p. 400, *et seq.* Speaking of Newton, "Il mesura les diamètres des anneaux simples *de même ordre*, dans la partie intérieure et dans la partie extérieure de leur périmètre, et en les considérant successivement aux limites des diverses couleurs du spectre a commencé par le violet extrême. Suivant sa méthode constante, il prit soin de lier ces resultats par une loi mathématique qui les représentât avec une suffisante exactitude. Il trouva ainsi que les diamêtres, soit intérieurs, soit extérieurs, étaient sensiblement entre eux comme les racines cubiques des nombres $\frac{1}{2}$, $\frac{9}{16}$, $\frac{3}{5}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{5}{6}$, $\frac{8}{9}$, 1, lesquels représentent les longueurs que doit avoir une corde de musique pour produire toutes les notes d'une gamme mineure; c'est-à-dire, que si l'on représente par 1 le diamètre intérieur d'un certain anneau, lors qu'il est formé par les rayons rouges qui composent la partie la plus extrême du spectre, $\sqrt[3]{\frac{8}{9}}$ exprimera le diamètre intérieur du même anneau, quand il sera formé par les rayons qui sont la limite du rouge et de l'orange, et ainsi de suite jusqu' à $\sqrt[3]{\frac{1}{2}}$ qui représentera le diamètre intérieur du même anneau quand il sera formé par les derniers rayons violets pris à l'autre extrémité du spectre."

I can only add, that if Mr. Taylor doubts also the accuracy of M. Biot, he can easily refer to Newton's own treatise on colour.

Rome, March 16 W. S. Okely

The Barlow Lens

I have found the addition of a double concave lens to my telescope and microscope of so much service that I am anxious to call the attention of your readers to this simple application for increasing and improving the working power both of telescopes and microscopes. The application consists in the introduction of a biconcave lens in the adapter, which holds the eye-piece of the telescope, at a distance of two or three inches from the field-lens; as the focal length of the instrument is thereby increased, it is necessary to adjust the distance of the lens from the eye-piece according to the length of the adapter, so that the latter still admits of being drawn out sufficiently for focussing. A friend procured me several lenses of different powers at the ridiculous price of a shilling a-piece from an optician and spectacle-maker at Brighton, which answer admirably.

The chief advantage obtained by the use of this lens is the great increase of magnifying power without a corresponding loss of light. This is a great desideratum in looking at a planet, but it is equally important in separating double stars. With a low eye-piece of 60, my refractor (one of Cook's with a 3½in. object glass, and the addition of the Barlow lens) shows the Companion of Rigel beautifully.

I first became aware of this useful application many years ago, in reading Admiral W. H. Smyth's "Cycle of Celestial Objects." In page 343, vol. i., he states: "On receiving it, I directed the telescope upon a watch-plate fixed on a distant chimney, which quickly proved the power of the lens in enlargement, with scarcely any obscuration of light. While the image expanded under each progressive eye-piece, I was surprised at the additional advantage of its simultaneously flattening the whole field of view; and though the magnifying power became double on distant objects, the apparent magnitude of the spider-lines diminished in an equal ratio: a property which, with all powers above three hundred, is of considerable benefit to operations upon close double stars, and the finer micrometric desiderata. I afterwards raised the discs of the Satellites of Jupiter, and examined several double stars, with equal facility and advantage, the definition being quite distinct, and the stray light rather subdued than increased. After a little practice, I came to the conclusion that the achromatic concave lens will render the instrument to which it shall be applied equal to two telescopes for particular cases; for if a set of observations be made *with* it and another set *without* it, the errors of vision will be in some degree neutralised, or even done away with."

In spite of this strong recommendation I never gave it a trial until a few weeks ago, when a paper in the Polish language by Prof. Piotrowsky passed through my hands. It remains to this

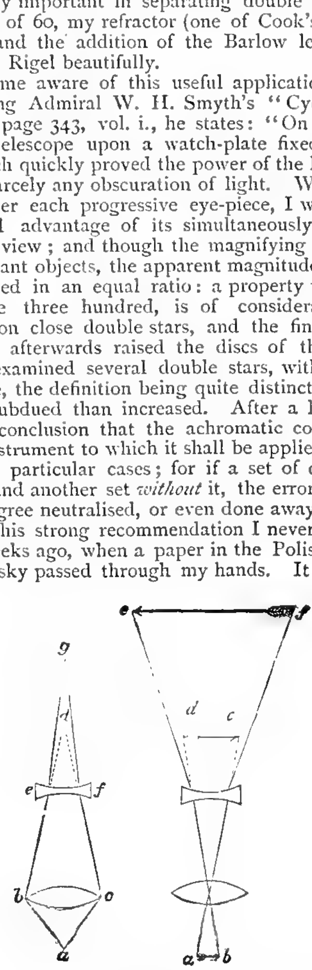


Fig. 1. *b c*, object glass; *ef*, Barlow lens; *d g*, foci of *b c*, with and without Barlow lens.
Fig. 2. *a b*, object; *c d*, image, with convex lens alone: *ef*, image, with Barlow lens.

day a sealed book to me, but the two annexed figures taken from it leave no doubt in my mind that the paper treats on the same subject of which Admiral Smyth speaks so favourably. The result of my own trial made me regret having foregone for many years an advantage which I have every reason to congratulate myself on now possessing; but this circumstance it is also which induced me to ask for a small corner in Nature for these remarks, when other more interesting subjects are less pressing than usual.

Walham Grove F. d'A.

A Word in Defence of Physicists.

Two passages in NATURE of April 14th show that the supposed opposition between geologists and physicists is not forgotten. This feud can only impede the advancement of truth.

Prof. Duncan, in his instructive paper on Dr. Carpenter's Report, writes thus :—" Physicists have propounded theories which have been accepted by some geologists, but they are looked upon as doubtful hypotheses by others. Palæontologists and such theories have been constantly at issue. The theories involving pressure, and the hardness of deep-sea deposits, will suffer from the researches ; but many difficulties in the way of palæontologists will be removed."

I cannot think that either of the "theories," to which allusion appears to be made, can ever have been accepted by any one who understood the nature of fluid pressure. The tissues of a living being inhabiting the depths must necessarily be permeated by liquids at the same pressure as that of the water without. Hence no crushing effect can be produced. So, too, the particles of mud or sand at the bottom of the ocean are buoyed up by water at the same pressure as that by which they are forced down, and they sink only by the difference of weight between themselves and the dense water ; so that the ooze at a profound depth ought actually to lie lighter than beneath shallower water. These considerations have always occurred to me when reading about the misconceptions to which Prof. Duncan alludes. But what I wish to point out is, that it is not the deductions of physicists which are overthrown, but the fancies of those who are not physicists, which were always opposed to physical principles.

Mr. Wilson's letter about "geological time" may possibly elicit a reply from Professor Pritchard. But why is Sir W. Thomson's name introduced into the heading? And does Mr. Wilson intend to tell us that Mr. Darwin considers natural selection incompetent to produce the human eye? For unless Mr. Darwin admits direct *design* in the arrangement of the human eye, it does not appear how Mr. Pritchard's *lapsus* in seeming to include man among the *Articulata*, can vitiate his argument as against Darwin. O. FISHER

Heat Units

IN No. 24 of NATURE (April 14) Mr. Thomas Muir calls atention to the inconvenience arising from the want of some uniform and generally recognised mode of expressing qualities of heat. As there can be no question that the inconvenience is a real one, I venture to suggest as one remedy for it, the employment of the following terms, namely—

grain-degree,
pound-degree,
gramme-degree
kilogramme-degree,

to denote respectively the quantities of heat required to raise the temperature of one grain, pound, gramme, or kilogramme of water from 0° to 1° Centigrade. These expressions are used in the article HEAT, in Watts's "Dictionary of Chemistry"; and having been for several years in the habit of using them in my lectures, I am able to say from experience that the employment of them greatly facilitates statements relating to quantities of heat.

It appears to me to be in favour of these terms, as compared with Mr. Muir's "therm," "kilotherm," &c., that they enable us to do without the formation of any new word, that they are self-interpreting, and that by means of them quantities of heat can be expressed with reference to the British or to the metrical standards of mass, with equal facility.

University College, London, April 25. G. C. FOSTER

The Sun's Chromosphere

Is there any way, by means of an ordinary telescope with coloured glasses, of seeing the red prominences on the sun's edge —that is, without a spectroscope? If so, what coloured glasses ought to be used? In one of the former numbers of NATURE, an observer saw, with only a telescope, what he believed to be these prominences ; the sun was near the horizon, a series of rose-coloured undulations became visible, unconnected, as supposed, with atmospheric disturbance, and which it was suggested might be due to the red flames of the chromosphere.

A.

Lefthandedness

IN a letter on this subject by J. S., in this week's number of NATURE, the hypothesis is mentioned that left-handed persons may owe their peculiarity to a transposition of the viscera, or at least of the great arteries of the upper limbs. This supposition, which has been more than once advanced, is certainly not true. Several cases of transposition of viscera are on record in which the persons affected were right-handed. One was recorded by M. Géry (quoted in Cruveillier's *Anatomie*, tome 1, p. 65, note), another by M. Gachet (*Gazette des Hopitaux*, Aug. 31, 1861), and a third in the *Pathological Transactions*, vol. xix., p. 447.

Your correspondent's opinion seems probable that righthandedness is the result partly of hereditary, partly of individual education, and is intimately associated with the more complex functions of the hand. P. S.

April 18, 1870

THE ABRADING AND TRANSPORTING POWER OF WATER

II.—FRICTION OF WATER

ON a former occasion the abrading and transporting power of water (which is supposed to increase as the velocity increases, but to decrease as the depth increases) was considered from a mechanical point of view, and arguments were brought forward to show that water rolls rather than slides. The question then arises—

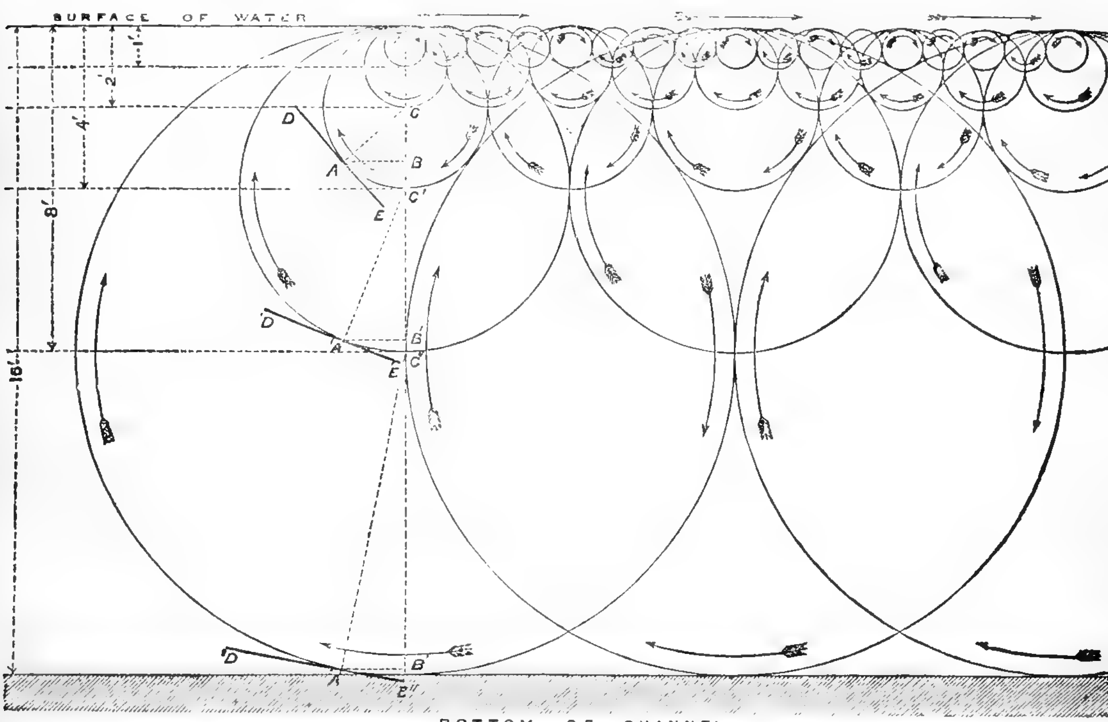
III. How does flowing water obtain this rolling motion? The reply to this is, By *friction*.

Take, for example, the rifling of a gun ; we all know that it is owing to the spiral grooves or prominences in the chamber that the shot gets its spinning motion ; but supposing the shot be a sphere, and fired from a smooth bore, it has not this rotatory motion at right angles to the line of flight, and no great dependence can be placed on its accuracy, but it may rise or fall, pass to the right or left, all depending on which side of the gun's mouth the shot touched when passing out, for so will it revolve. Should it ricochet, it will, when nearly spent, be observed to roll over the ground, and this is all caused by the friction offered by the resistance of the ground with which it came in contact. And what reason can there be assigned against water adopting this most simple of all laws for bodies in motion ; and is it not owing to this that water in a cistern takes a circular motion when escaping through an orifice in its bottom, or presents a cork-screw appearance when poured out of a small vessel? Again, on the large scale, with rapid currents such as in the Pentland Frith, what but this circular motion of the stream can cause that boiling apappearance given to the water, which everyone must have observed who has navigated waters where there is a strong tideway? And cannot this explain why there should be an enormous breaking sea at the point where the heavy swell of the Atlantic meets the ebb tide ; and does not this rolling motion given to the tide, acting in an opposite direction, check the oscillations of the Atlantic swell, causing those huge breakers so well known to the Orcadian boatmen?

Supposing every particle of water to be a sphere in itself that can roll independently, and that a number of them being collected together form a larger sphere, which also rolls, and so on, then the diameter of the spheres increases with the depth, be it ever so great. Consequently, the facility for rolling will also increase, so that the deeper and broader a stream is—that is, the farther the centre of a stream is from the retarding medium (the bed and banks of a river)—the less is this rotatory motion obstructed ; and does not this explain how the velocity increases with the hydraulic mean depth? The air also has a retarding effect even in a perfect calm ; for where the Mississippi was very deep, it has been observed that the greatest velocity was not at the surface, but at some distance below it.

Supposing that water moves in an innumerable number of circles, varying from a single particle in diameter to that of hundreds of feet, and that every obstruction sets these circles revolving at right angles to their surfaces, we can at once begin to understand how, by increasing the areas exposed to friction, an innumerable set of wheels of various sizes are set spinning in all directions, but are retarded in this action by the attraction of the several particles to each other. Thus wheels within wheels will be set in motion, some revolving in opposite directions; and the quicker the revolutions—that is, the smaller the diameter of the wheels, in other words the shallower the stream—the greater will be the power expendend, which power Nature exerts in holding solid matter in suspension; therefore, if the foregoing arguments be correct, it is evident that the transporting and abrading power of water must increase in some ratio inversely as the depth, and that the retarding of a ship's sailing on a flowing river must depend on the increased area of surface exposed, thus explaining why a ship with a foul bottom, a rough, rocky bed to a river, or weeds in a stream, all retard velocity, because they one and all set so many more wheels spinning. This leads us to the important questions where abrasion and the power of flowing water to hold solid matter in suspension have to be investigated, with the view of showing how this rotatory motion acts in nature. To do so the following diagram will perhaps give a slight idea of the complicated nature of this rotation, the circles being supposed to increase in diameter with the depth. This diagram is only intended to show the relative motion of one set of particles with respect to its neighbouring set of particles, each for its own depth of 1, 2, 4, 8, or 16 feet deep. Thus where the depth is 16 feet, there would be a series of circles 16 feet in diameter rolling within each other, where the depth was 8 feet, there would be circles of 8 feet in diameter, and so on. That is, with the same velocity, the rotation would decrease as the diameters became greater.

The various angles with the horizon are represented by the lines D E, D′ E′, and D″ E″, which show the necessary slopes, in order that the centre of gravity of each circle should be equally beyond the point of support A′, and that consequently A B, A′ B′, A″ B″, should be all equal; they indicate that where the slope of the surface of the water remains in each case the same (say, for example, one foot in a mile), the velocity probably increases proportionally to the increased hydraulic mean depth, or that where the velocities are the same, and the depths differ, the slope requires also to vary. Let, for example, the velocity be in each case about 5 miles an hour, or some 7½ ft. a second, while the depths are 5ft., 8ft., 10ft., and 90ft. respectively, the slopes vary from 25 feet in the mile to only some 4 inches, while the load of solid matter held in suspension is about 7 per cent., 5 per cent., 3 per cent., and only $\frac{1}{1100}$ of the weight of water in each of the above cases respectively. With the assistance of the diagram, therefore, it will



at once be seen how the whirling motion given to a stream must increase as the depth decreases, and how, by the increased agitation, the water is able to hold proportionally more solid matter in suspension, while the action on the bed of the channel must at the same time be increased.

To carry this action to extreme cases it appears evident that where the velocities are considerable, and the depths only a foot or two, the slopes must become almost precipitous, while the stream must become semi-fluid mud, or transport a large proportion of boulders, and even rocks; in doing which a certain amount of power must be expended, and in transporting this solid matter this loss of power cannot but retard the flow of the stream. On the other hand, it may be assumed that, even with considerable velocities, which at small depths would tear up and hurl forward rocks, boulders, sand, and mud, with excessive depths the water may flow on in almost a comparatively pure state, and instead of holding in suspension stones and coarse sand, can only transport fine particles of mud.

T. LOGIN.

THE SCIENCE OF EXPLOSIVES AS APPLIED TO WARLIKE PURPOSES

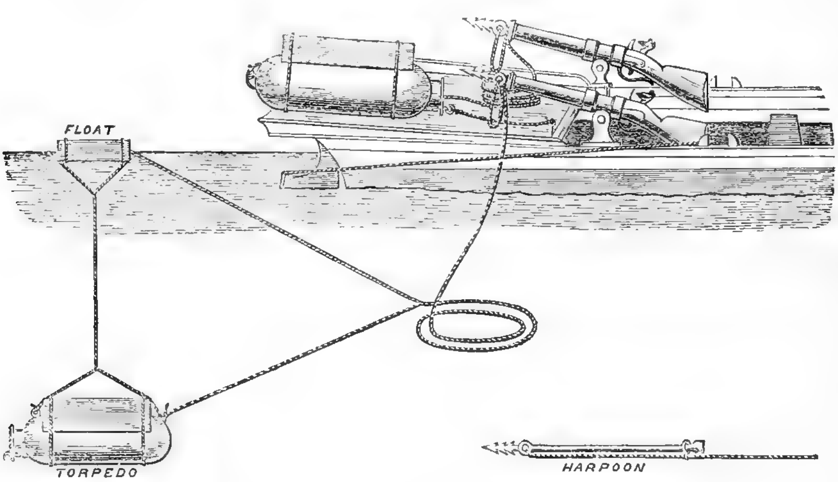
I.—EARLY STUDY AND APPLICATION OF EXPLOSIVES

THE protracted and disastrous war between the Northern and Southern States of America was fruitful in the development of expedients to serve as auxiliaries to the hitherto well-recognised materials of defence and attack. No subject connected with the details of that war has, however, received more general attention on the part of European Powers, great and small, than the extensive and successful applications of a somewhat ancient class of war-engine, the value of which up to that time had received no practical demonstration, but which is now on every hand regarded as destined to play a most important part in future wars.

The idea of employing floating or submerged charges of gunpowder as agents for the destruction of ships and other marine structures, has been occasionally put into practice from a somewhat early date, although with but few instances of success. The earliest form of marine-mine was the so-called *Explosion Ship*, which the Dutch appear to have been the first to employ. When Antwerp was besieged by Alessandro de Farnese, Duke of Parma, in 1585, a boom or boat-bridge was constructed across the Scheldt by the besiegers, and this, an Italian engineer, Jambelli, undertook to destroy for the Dutch. Four large flat-bottomed vessels were each of them loaded with several thousand pounds of powder, over which were placed fireworks and large masses of stone; two of the boats were provided with slow matches, the burning of which had been timed, and the others fitted with clock-work contrivances by whose agency the powder was to be exploded at a pre-determined period. The vessels, thus equipped, together with a number of fire-ships, were allowed to drift towards the boom, and, on its centre being reached, one of them immediately exploded with such violence as to destroy several of the ships composing the structure, and likewise to kill 800 men and wound many more, among whom was the Prince Farnese himself.

Vessels of this kind were repeatedly used by the English in the seventeenth century; thus an attempt was made in 1693 to destroy St. Malo by the explosion of a vessel of 300 tons laden with a large quantity of gunpowder, besides various other combustibles; and similar attacks were likewise directed with little or no success two years later against St. Malo, Dieppe, and Dunkirk. For some time after these operations explosion-vessels seem to have fallen into disuse, there being no instance of their employment on record until 1809, when Lord Cochrane destroyed a boom in the Basque Roads by exploding in contact with it a vessel laden with very closely packed gunpowder. Some unsuccessful attempts at the destruction of English ships by means of explosion-vessels were also made by the Americans during the War of Independence; but this very wasteful and uncertain mode of applying gunpowder in marine operations appears to have been since then altogether abandoned, until the late American War, when Admiral Porter, of the United States Navy, added one more to the list of unsuccessful operations of this kind, by endeavouring to destroy or disable Fort Fisher by the above means.

The earliest form of submerged self-acting mine was the so-called *floating petard* used by the English during the operations in Rochelle, in 1628. These implements of warfare consisted of small cases of sheet-iron filled with powder and fitted with a spring which was released as soon as the drifting machine came into collision with a ship, or other obstruction, and thus determined the explosion of the powder by means of a match-lock. They appear to have been too small to inflict any serious injury upon ordinary vessels, and many of them were captured by the French. Similar contrivances were constructed by an American, Mr. Bushnell, in 1777, who endeavoured to apply them to the destruction of the English fleet anchored near Philadelphia in that year; but the machines were started at too great a distance from the ships, and drifted away in wrong directions, the damage inflicted by them being limited to the destruction of a ship's boat and her crew, who were engaged in capturing one of the dangerous shoal. In 1800 another American, Robert Fulton, submitted to the French Government several projects for the destruction of ships by means of submarine mines, or as they were called at the time, infernal machines. This gentleman appears to have spent three or four years in perfecting his system of warfare, but received such scant assistance and encouragement from his own Government, that in 1805 he determined to offer his invention to the English, who about that time had been creating a considerable panic in the French fleet off Boulogne, by sending among the vessels a number of fire-ships and small drifting mines of a self-acting nature, termed *catamorons*.



THE FIRST SO-CALLED "TORPEDO" PROPOSED BY FULTON IN 1800

The first of Fulton's torpedoes, of which trial was made by the English naval authorities, consisted of a metal vessel holding about 100lb. of gunpowder, and fitted with a clockwork instrument which could be regulated to release a flint-lock at a determined period after it was set in motion. The machine was partly encased in cork, so that when charged with powder it was a little heavier than sea-water, and it was attached by a line to a box float, whereby it could be kept suspended at any particular depth. These torpedoes were carried in harpoon-boats, and connected by long lines with harpoons fired from small guns at the ship to be attacked. If the harpoon was successfully planted in the ship's side, the torpedo was drawn into the water by the line, and this, as it ran out, released a pin from the torpedo, setting the clock-work in motion. The submerged torpedo was then supposed to drift into close proximity with the ship by the time the flint-lock caused ignition. Several French ships were attacked by means of these explosive machines—which, by the way, Fulton was the first to term *torpedoes*—but although they were in some instances successfully exploded, the enemy's vessels sustained no material injury, from the fact that the charges were immersed in too great a depth of water. Fulton's drifting torpedoes were employed in a more simple form in an experiment made in October 1805, in the presence of the principal officers of the fleet commanded by Lord Keith, on which occasion a 200-ton brig, the *Dorothea*, anchored for the experiment off Walmer Castle, was destroyed at one operation. The torpedo employed contained 180lb. of powder, and was suspended at a depth of fifteen feet; it was simply allowed to drift with the tide against the hulk, the clockwork which regulated the explosion being timed to run eighteen minutes before the machine was cast adrift.

The torpedoes made use of by the Russians in the Baltic in 1855, were mechanical self-acting machines, containing charges of from 8lb. to 10lb. of powder; they were constructed with some care and ingenuity, and if they had been but of larger size, their existence would have greatly jeopardised the safety of our ships. The machines were conical in form, and were so arranged as to explode on being struck by a passing vessel, the blow causing the fracture of a glass tube containing sulphuric acid, which, falling upon a tuft of cotton wool saturated with chlorate of potash, sulphur, and sugar, at once ignited the charge.

But it was not, as previously stated, until the subject of torpedoes was seriously taken in hand by the Americans during the recent war, that torpedo-warfare assumed a grave and wide-spread importance. In the hands of the Confederates especially, the applications of submarine mines to warlike purposes were very carefully studied, and with such marked success, that, according even to the official despatches of the Federals themselves, twenty-five ships are admitted to have been destroyed. In the first instance *mechanical* torpedoes only were used, such, viz., as exploded by means of percussion arrangements fitted on the outside, or by a drifting line attached to a trigger, but these were afterwards succeeded to some extent by machines ignited at will from the shore by electricity. The latter were, in the opinion of Admiral Porter, of inferior value, from the fact of their ignition not being effected at the proper time; and the gallant officer reports, that on one occasion he safely ran the gauntlet through a channel bristling with these machines, by simply sending forward as pioneer a sham *Monitor* built of logs, and furnished with an imitation turret, which passed without damage over several torpedoes exploded at her, and was afterwards followed by the fleet unharmed.

Consequent upon the successful employment of torpedoes by the Confederates, the Federals turned their attention more closely to the matter, building a torpedo-boat especially for this kind of warfare, and reconstructing six *Monitors* for the same purpose.

The perfection to which submarine mines have been brought up to the present time, and the various methods adopted for applying electricity to their ignition, will form the subject of the second part of this paper.

THE DEEP-SEA SOUNDINGS AND GEOLOGY

SOME little time ago an eminent geologist, Professor Gümbel of Munich, applied to Sir Roderick Murchison for specimens of the Deep-sea Soundings which have lately been the subject of so much discussion. Sir Roderick mentioned Dr. Gümbel's wish to me, and I immediately sent him a small quantity of North Atlantic mud from 2,350 fathoms, which had been preserved in spirit. The following translation of a letter, dated April 18th, 1870, with which Dr. Gümbel has favoured me, and which embodies the result of his researches hitherto, will, I am sure, be read with the greatest interest by geologists and biologists. I may mention that I long since found coccoliths in the nummulitic limestone of Egypt. T. H. HUXLEY

Many thanks for sending me the specimen of mud obtained by the deep-sea dredge. I have already subjected it to searching investigation, and have obtained results, which have the most important bearing upon my other work. Although my inquiries are, at present, only commenced, it will possibly interest you to receive some information respecting them. I call the new kind of investigations which I have begun to carry out, "Deep-sea investigations on the dry land;" *i.e.*, examinations of the different calcareous rocks, with reference to the share which the smallest organic forms, similar to those at present existing in the deep sea, have had in their formation. When limestone is soft and earthy, traces of the smallest marine animals can be detected by triturating it in water. In chalk, for instance, from Palestine, I have convinced myself, in the most unequivocal manner, of the formation of the calcareous mass, for the greater part from your so-called coccoliths, besides *Foraminifera*, &c., which have long been known. Similar soft calcareous rocks are unfortunately rare in older formations. With these another process must be adopted. I started from the fact that in many of these calcareous rocks, the original calcareous portion of the organic beings is replaced by silica, and that hence in such rocks, by the separation of chert or flint, at least a part of the calcareous portion of the coccoliths and coccospheres might be replaced by silica. It was to be expected that the exterior form might suffer by this replacement, as, in fact, the chalk coccoliths have become materially different in their form from those of the existing deep-sea ooze.

I found, in fact, by treating such a siliceous limestone with very dilute acetic or hydrochloric acid, in the fine mud which is left, an organic residuum corresponding to the coccoliths of the present day. Even in the Trenton limestone, and in a yellow limestone of the Potsdam series, corresponding minute bodies were to be recognised, although sparingly, presenting themselves amongst an incredible multitude of other minute particles of organic origin. The microscope discloses, like the telescope, in the vault of heaven, a new world of the smallest organic beings, respecting which, however, I must say nothing at present, but confine myself to the coccoliths. These casts of coccoliths are found very sparingly. I explain this from the circumstance that the silica is chiefly the result of the decomposition of large masses of organic material, especially of the larger testacea. I obtained, however, important results by subjecting the deep-sea ooze, for which I am indebted to your kindness, to the action of the acids. These with violent development of carbonic acid, dissolve the minute bodies of the coccoliths, of the coccospheres, and perhaps also those of *Bathybius* (although of this I am not quite sure), and there remain only certain peculiarly formed but very much changed portions of the coccoliths as roundish discoidal flakes, the organic portion of the original coccoliths. In single isolated coccoliths this change of form is difficult to follow, but this can easily be done in those which appear to be firmly bound up (enveloped?) with a mass of the granular flakes (*Bathybius*?); and after the operation of the acid, can be again easily recognised in their exact position. Accompanying these coccoliths transformed by the action of acids, are countless little bodies extremely similar to those which can be obtained, in most cases, by dissolving siliceous limestone in acids.

This is the first commencement of researches which I propose following up, with, I hope, important results; since thin sections are of no good in studying these minute forms. I cannot close these notes of the researches with which I am at present engaged, without adding a further contribution, and I hope not an unimportant one, to what is known respecting the nature of the deep-sea mud.

You speak of the chemical behaviour of these masses. The question whether these minute organisms represent animals or plants is still open. I have exposed the ooze to the action successively of a solution of iodine, of iodine and sulphuric acid, and of zinc chloride with potassium iodide, and have each time obtained in a remarkable manner a distinct blue colour, different shades from violet to green, in the substance of the coccoliths. There must therfore exist in the organism of the coccoliths, besides the calcareous skeleton, a kind of cellulose. Their organic nature is thus established beyond all doubt; but the conclusion might after all be drawn that we are dealing with plants, were it not that in the animal kingdom cellulcse has been found in the Ascidians. But it is at all events interesting here on the boundary of organic life, to meet with cellulose. As a confirmatory test, I treated the substance with Millons' test which, as is well known, colours conchiolin red, but leaves the chitin of the *Orthropoda* on the other hand unchanged.

I obtained by this means no red colour in the flakes belonging to the coccoliths after the limestone had been dissolved by the excess of acid. A red colour showed itself, on the other hand, in many other particles, for instance, in the *Polycistinæ* whose siliceous coat was coloured red at the margins; and in irregular patches, which appeared to be derived from broken and crushed mussel-shells. I also noticed much deep brown and yellow colour. Especially by treatment with different chemical reagents, differentiated minute particles make their appearance which can scarcely be recognised by my microscope, and which, before the treatment with the chemical reagents, cannot be by any means detected. I expect that by this method an important extension of our knowledge of the most minute forms of organic life will be effected. I will only mention further that the red of the conchiolin shows itself of a bright red in the smallest particles which are found in such great numbers in the agglomerated flakes (*Bathybius*), and which are smaller than the little elevations on the epidermal structures, which probably belong to *Holothuridæ*, and which frequently occur in the field of the microscope.

I should like to pursue further the chemical side of these investigations; but, unfortunately, the supply sent over to me is almost exhausted. If you consider these researches of sufficient importance to be worth continuing, and could obtain further material for me for this purpose, I should be greatly indebted to you. If you can make any use of this communication, it is at your service.

NOTES

PROBABLY few are aware of the magnitude or special aim of the Cornell University. While our own rulers can scarcely grapple with the Education question because of the unsettled state of Ireland, the Government of the United States laid the foundation, during the height of the most terrible struggle for existence of modern times, of one of the most important educational movements the world has ever seen. On the 2nd of July, 1862, Congress passed an Act granting public lands to the several States and Territories which might provide colleges for the benefit of agriculture and the mechanical arts; the share of the State of New York amounting to 990,000 acres. In 1865, this grant was conferred on a University about to be established, on the condition that the Hon. Ezra Cornell should give to the institution 500,000 dollars, with a few other conditions. This munificient grant was afterwards supplemented by another of 200,000 dollars; and the University was established at the village of Ithaca. It is needless to say that the Act of Inauguration provides that the education shall be given to all comers irrespective of creed, colour, or race; the motto of the founder being, "I would found an institution where any person can find instruction in any study." Besides the original grants, the University has since been enriched by private liberality, with gifts of public buildings, laboratories, libraries, museums, a herbarium, printing-press, &c. A simple, but, as far as it goes, a strict entrance examination in geography, English grammar, and arithmetic and algebra, admits intending pupils as undergraduates, and they can then take their choice of pursuing their studies in either of several departments in which degrees are conferred, in Science, Philosophy, Arts, or in some other special subjects, the full course extending over four years. The special feature of the University, however, is what is called the voluntary labour scheme, by which students are enabled to work out a portion or the whole of the expenses of their education, either by unskilled labour on the farm, or by skilled labour at the printing-press or workshops. The University Register just published states that the scheme has thus far been worked with a degree of success hardly to be expected at so early a stage. We shall look with great interest on the progress of the University.

WE are in a whirl of soirées. Last Saturday the second Royal Society's soirée of the season drew together a brilliant gathering, and we shall next week give an account of the scientific novelties exhibited. On Wednesday the President of the Linnean Society's conversazione came off, and to-morrow Sir R. Murchison, the president of the Geographical Society, receives his friends at Willis's Rooms.

THE question of admitting lady students of medicine to classes in the Edinburgh University on the same footing as other students was discussed at the half-yearly meeting of the University Court on the 19th inst. Professor Masson moved a resolution in favour of so admitting them, and quoted Miss Pechey's case in support of his motion. Mr. Balfour, Professor of Botany, seconded the resolution. Mr. Laycock, Professor of Physic, moved a negative resolution. Professor Christison seconded the amendment, which was carried by 58 votes against 47 in favour of the motion.

A PROPOSITION was some time ago made to telegraphists by Mr. Robert B. Hoover, of Alleghany, Pennsylvania, to present Professor Morse, the "father of the telegraph," with a testimonial upon his eightieth birthday. The response was general, and the nucleus of a fund was immediately raised. It has since been found that this fund will warrant the casting of a bust, or perhaps a full-length figure, of the professor; so the original idea of making Professor Morse a birthday testimonial has been abandoned, and a really national one is to take its place.

THE corner-stone of a new college for Melbourne, which is to be affiliated with the Melbourne University, under the title of Trinity College, was laid on the 10th February, by the Right Rev. the Bishop of Melbourne. The building stands near the south-west corner of the reserve, to the north of the University, and considerable progress in the erection of it has already been made by the builder. Only a small portion of the whole design, namely, the Provost's lodge, &c., has been undertaken, and it is to cost 7,500*l.* The funds in hand amount to 4,000*l.*, and the buildings will be carried out as far as the money will allow.

THE schooner yacht *Norna*, Mr. Marshall Hall, owner and master, is fitting out to dredge off the west coast of Spain and Portugal. Mr. W. S. Kent, of the British Museum, and Mr. Edward Fielding accompany the expedition.

EVENING Technical Schools are to be established in the chief towns of Massachusetts. A museum of mechanical inventions and models of machinery are to be formed in connection with each, and there is to be one instructor for every twenty-five pupils.

WE regret to have to announce the death, in his 82nd year, of Mr. Jonathan Couch, of Polperro, Cornwall, a well-known naturalist. His name is especially associated with ichthyology, the standard works of Bewick and Yarrell owing much to his assistance; his own work on the subject being also a very valuable one. Hs was also a frequent contributor on various branches of Natural History to the scientific journals. A correspondent of the *British Medical Journal* states that he was a good linguist, and devoted a considerable time to antiquities. He was a man in whom simple tastes were combined with persistent industry and very accurate powers of observation, and was one of few in whom these qualities were not spoiled by easy circumstances.

THE photographic journals announce the sudden death, in his 72nd year, of a distinguished photographer, M. Niepce de St. Victor, one of the most skilful and indefatigable of experimentalists, and unquestionably the practical originator of photography on glass plates. His name will, however, be associated chiefly with the process of photo-engraving.

THE conversazione of the Society of Arts is fixed to take place at the South Kensington Museum on Wednesday evening, the 4th of May. Cards of invitation have been issued.

IT will be remembered that on the 13th of July last a deputation from the Council and India Committee of the Society of Arts waited on the Duke of Argyll for the purpose of urging the Government of India to take steps for providing a Department of Agriculture for India. The Council have great pleasure in announcing that a Department of Agriculture and Commerce for India has now been established, and that Mr. Rivett Carnac has been appointed the secretary.

AT the last meeting of the Society of Arts, a valuable paper was read by Mr. Alexander J. Ellis on a practical method of meeting the spelling difficulty in school and in life, which was followed by an interesting discussion.

A SERIES of ladies' classes has been arranged at Blackheath, and a large number will attend lectures by the Rev. Stopford Brooke, and Professors Seeley, Miller, and Duncan.

MR. W. RALSTON will deliver a lecture at St. George's Hall, Langham-place, at 4 p.m. on Wednesday, May 4, on "Russian Folk-lore," which will be illustrated by a number of stories taken from the "Skazki" (or prose tales answering to Dasent's "Tales from the Norse," or Grimm's "Mährchen"), with a few notes on their historical, mythological, and social bearings.

DR. HOOKER'S "Student's Flora of the British Isles" is announced as nearly ready. It will contain fuller descriptions of the orders, genera, and species of British plants than the existing manuals aim at giving, together with the distribution of the species in area and altitude, and their hitherto recognized sub-species and varieties. The method adopted will differ from those of the author's predecessors in many points, and the whole will be contained in a pocket volume suited for the class-room and the field.

A PECULIAR variety of *Chamælio Vulgaris*, found near Bughodeer, on the Grand Trunk Road, was presented by Mr. H. Hexter to the Asiatic Society of Bengal, Calcutta, on January 5. Dr. Stoliczka, the palæontologist of the Indian Survey, said that the specimen was very interesting, and of a kind not often found in India so far north. It was fully 12 inches long, the tail measuring slightly more than half. Dr. Günther remarks in his "Reptiles of India," p. 162, that most of the Indian specimens are of a green colour. The present specimen was a distinct greyish olive, having throughout a slight green tinge, which Mr. Hexter stated appeared to have been more prevalent and variable during the life of the animal; but faded quickly after its death. Each side was marked with eight irregular orange brown cross bands. The head, the greater part of the feet, and part of the tail were bright yellow. The animal is more fully described in the the Society's *Proceedings*, 1870. No. 1.

FROM Thorell's Essays on European Spiders ("Nova Acta regiæ Societatis Scientiarum Upsaliensis," ser. III. vol. vii. fasc. 1, 1869), we extract the following observations, first suggested by M. Westring, a Swedish naturalist, on the best mode of preserving spiders in Natural History collections. The essential feature of the method is that the spider's *abdomen*, and that part only of its body, is *hardened by heat*. The spider is first killed, either by the vapour of ether or by heat, and is impaled by an insect pin, which is passed through the right side of the cephalo-thorax; the abdomen is then cut off close to the cephalo-thorax, and the cut surface dried with blotting-paper. The head of another insect pin is cut off, and the blunt extremity introduced through the incision into the abdomen, up to the spinners. The abdomen thus spitted is inserted into a large test-tube held over the flame of a candle, the preparation being constantly rotated till dry, avoiding the extremes of too much or too little heat—the firmness of the abdomen being tested every now and then with a fine needle, till it is so firm as not to yield to pressure; the front extremity of the pin is now cut off obliquely, and the point thus made inserted into the cephalo-thorax, the two halves of the body being thus again brought into apposition. The animal may then be mounted as usual. This method is stated by Mr. Thorell to preserve the appearance of the animals almost entirely unchanged.

AN attempt is being made to cultivate the Japanese tea-plant in California. 27,000 trees have been imported.

THE third course of Cantor Lectures of the Society of Arts for the present session is being given by Professor A. W. Williamson, The course consists of four lectures, "On Fermentation," on Monday evenings, the 25th of April, and the 2nd, 9th, and 16th of May, at 8 o'clock, and will include an account of important investigations of M. Pasteur. The subjects treated of will be as follows:—Chief varieties of fermentation; chemical processes which take place in the best known processes of fermentation; other chemical processes analogous to them; how these cyclical processes are distinguished from ordinary processes of chemical action; cyclical action analysed; 1. in known cases; 2. in less known cases; theory of "contagiousness" of chemical action; composition of yeast, and changes which it undergoes; assimilation of food by yeast plants during life; decomposition of yeast plants during life; propagation of ferments; prevention of fermentation; germs in air: how removed: how destroyed; processes for arresting fermentation; wine-making and wine-keeping; chemical changes which improve the quality of wine; chemical changes which deteriorate the quality of wine.—These lectures are open to members, each of whom has the privilege of introducing two friends to each lecture.

A TELEGRAPHIC despatch from Marseilles announces the discovery there, by M. Borelly, of a new planet. Its position on the 19th at 10h. 33m., 13s. was—Right ascension, 13h. 2m. 39s. North declination, 6° 50′ 39″.

THE Italian Parliament is engaged in discussing a vast financial plan of the new Ministry, one feature of which is the suppression of a number of the smaller Italian universities. Irrespective of considerations of economy, it is thought that the cause of education will gain by the concentration of the teaching power of the nation in a few towns where a great educational movement exists. A portion of the scheme which meets with less favour is the suppression of the Superior Institute of Florence, an establishment which, the capital having no University, somewhat supplies the place of a national college and musuem, and which numbers among its staff the distinguished names of Donati in Astronomy, Maurice Schiff in Physiology, Ugo Schiff in Chemistry, Targioni-Tozzetti in Zoology, and Parlatore in Botany.

THE South Kensington authorities have printed syllabuses of the courses of lectures already delivered at the Museum, under the title of "Instruction in Science and Art for Women." We have before us "Notes of fifteen lectures on Physics, by Professor Guthrie," and "Notes of ten lectures on Botany, by Professor Oliver." We commend both these programmes to lecturers on natural science, as models of what scientific lectures ought to be—thorough, exact, and yet popularly intelligible.

WE have received a German edition, by Dr. Oppenheim, of Wurtz's History of Chemical Theory, from the time of Lavoisier to our own day.

THE *Paisley and Renfrewshire Standard* prints an unpublished letter of Wilson the ornithologist. It is dated Nashville, Tennessee, May 1st, 1810, and deals more with the manners and customs of the people than with his favourite science of Ornithology.

MR. KEITH JOHNSTON, jun., publishes a map of the Lake Region of Eastern Africa, showing the sources of the Nile, recently discovered by Dr. Livingstone. To it is appended an interesting account of the progress of discovery in the Lake Region, with notes on its physical features, climate, and population.

DR. J. LEON SOUBEIRAN has reprinted from the Annals of the Linnean Society of Maine-et-Loire an article on the herring fishery, which gives an account of the fishery from the earliest times in the different countries of Europe, and of the various modes of curing the fish.

THE *Architect*, for April 9, describes the projected new buildings for Owens College, Manchester. The designs for the first portion being now complete, the works will shortly be commenced on a site about a mile to the south of the centre of Manchester, on the west side of Oxford Road. The style of the building is Gothic, of a collegiate and early type.

C. G. EHRENBERG'S "Gedächtnissrede auf Alexander von Humboldt," presented to the Academy of Sciences at Berlin, is a graceful centenary tribute to the memory of the great *savant.*

THE Commissioners for the Annual International Exhibitions of selected works of fine and industrial art and scientific inventions have issued a code of rules for educational works and appliances produced in the United Kingdom, or produced abroad, but submitted to the British judges. We suspect that exhibitors will find it somewhat difficult to determine under which of the denominations named in the commissioners' list they should range themselves; thus we find "philosophical instrument makers," and "optical instrument makers," with separate headings for "microscope makers," "telescope makers," "stereoscope makers," &c. We should hardly have thought that it would have been necessary to make arrangements for the special exhibition of objects under the heads of "coloured saucer makers," "pink saucer makers," "preparers of botanical specimens," "Ward's case makers," &c. Everything intended for exhibition must be sent in by Wednesday, the 8th of February, 1871.

M. CLOEZ has detected in the leaves of *Eucalyptus globulus*, a tree which has been recently largely introduced into France for purposes of ornamentation, a substance extremely analogous to camphor. Ten kilogrammes of fresh leaves give 275 grammes of this new substance, the formula for which is $C_{24}H_{20}O_2$, and its boiling point 175° C.

A MONTHLY journal has been started in Jena devoted to the interest of Sericiculture. We have before us the first number of the *Seiden-bau-Zeitung für Nord-deutschland;* bearing the names of Dr. E. Hallier, H. Maurer, and J. Zorn, as Editors.

MADREPORARIA OF THE RED SEA

THE following table is required to complete Prof. Duncan's account in NATURE, No. 24, p. 612, of the Madreporaria dredged up in the *Porcupine* Expedition. The specific names given in the table are those finally adopted by Prof. Duncan:—

Name.	No.	Latitude.	Longitude.	Depth.	Temp.	Remarks.
1. Caryophyllia borealis, *Fleming*	2	51° 57 N.	10° 23 W.	fathoms. 30-40	52°·00	Specimens very numerous.
Syn. C. clavus	...	....	....	......	....	The species is found in the coralliferous British seas and Mediterranean. Fossils in Miocene and Pliocene of Sicily. At great depths in Mediterranean (recent).
C. Smithii	88	59 26 N.	8 23 W.	705	42·65	
C. cyathus and many varieties.						
2. Ceratocyathus ornatus, *Seguenza*	88	....	....	705	42.65	One specimen. Not known elsewhere; the genus is, with this exception, extinct. The species is fossil in the Sicilian Miocene.
3. Flabellum laciniatum, *Ed. & H.*	3	51 51 N.	11 50 W.	370	....	Specimens numerous.
Syn. Ulocyathus arcticus, *Sars*	25	56 41 N.	13 39 W.	164	46·5	This is a well-known Norwegian recent form.
4. Lophohelia prolifera, *Pallas*, sp.	5	52 4 N.	12 8 W.	364	48·8	Specimens numerous.
Syn. All the species hitherto published, viz:—						The variability of this species at different depths is so great that all the known species must in consequence be considered varieties of one form. Recent in Norwegian seas, Mediterranean, and off the Shetlands. Fossil in Miocene and Pliocene deposits of Sicily. A variety is found off the American coast. A considerable number of specimens was found in the "cold area" at depths from 500-600 fathoms.
L. anthophyllites, *Ed. & H.*	13	53 42 N.	13 55 W.	208	49·6	
L. subcostata, *Ed. & H.*	14	53 49 N.	13 15 W.	173	49·6	
L. affinis, *Pourtales*	15	54 5 N.	12 7 W.	422	47·0	
L. Defrancei, *Defrance.*	25	56 41 N.	13 39 W.	164	46·5	
L. gracilis, *Seguenza*	54	59 56 N.	6 27 W.	363	31·5	
and several varieties.						
5. Amphihelia profunda, *Pourtales*, sp.	54	59 56 N.	6 27 W.	363	31·5	Many specimens.
6. —— oculata *Linnæus*, sp.	54	....	....	......	....	The necessity for absorbing *Diplohelia* is stated in the following pages.
7. —— miocenica, *Seguenza*	54	....	....	......	....	The species of *Amphihelia* range from the Miocene to the present day; but only *A. oculata* has hitherto been found in recent fauna.
8. —— atlantica, *nobis*	54					
9. —— ornata, *nobis*	54					
10. Allopora oculina, *Ehrenberg*	54	....	....	......	....	A few specimens.
		59 40 N.	7 10 W.	530	47·0	Dredged in *Lightning* Expedition. A recent form.
11. Balanophyllia (Thecopsammia) socialis, *Pourtales*, sp.	54	59 56 N.	6 27 W.	363	31·5	These are West Indian forms, and are included in *Thecopsammia*, a subgenus, by Pourtales.
var costata						
britannica						
Jeffreysia	65	61 10 N.	2 21 W.	345	29.9	
12. Pliobothrus symmetricus, *Pourtales*	...	....	....	500-600	Cold area.	It is a West Indian form.

Total species, 12; species absorbed, 9. Good varieties numerous. Greatest depth from which species were dredged, 705 fathoms.
Lowes temperature of sea at bottom whence corals were dredged, 29°·9.

ON THE CHARACTER AND INFLUENCE OF THE ANGLO-SAXON CONQUEST OF ENGLAND, AS ILLUSTRATED BY ARCHÆOLOGICAL RESEARCH*

THERE are numerous points of general and living interest relating to the Anglo-Saxon conquest of this country which are very largely dependent upon archæological research for their elucidation. Amongst these may be mentioned the question of the extent to which the Romano-British population previously in occupation was extirpated; the question of the relative position, in the scale of civilization, held by victors and vanquished; and the question of the extent of our indebtedness as to language and laws to one or other of the two nationalities. Light is thrown even upon points apparently of the most purely archæological character from such literary sources as histories of the nomenclature of localities; as the records of monasteries; as illustrations in manuscripts; and as laws. But the graves of the Anglo-Saxons and their contents have been for the present investigator the primary; and such literary works as those alluded to, and such as many of those published under the direction of the Master of the Rolls and by the Early English Society, have been only a secondary source of information. They have however, been by no means neglected by him.

It may be well to begin by stating how an Anglo-Saxon is to be distinguished from a Romano British interment. Anglo Saxons, during the period of their heathendom, which may be spoken of roughly as corresponding in England to a period of some 200 or 230 years onwards from their first invasion of the country in force, were interred in the way of cremation, and in urns of the pattern so common in the parts of North Germany and of Denmark whence they are supposed on all hands to have come. A reference to any manual of archæology, or an inspection of any such series as that figured by Mr. Kemble in the *Horæ Ferales* from the Museum in Hanover, will show the unmistakable identity of the pattern, fashion, and moulding of such urns as these, and these which I have had figured after digging them up in Berkshire. The Romans and Romano-Britons had given up the practice of burning the dead long before the time of Hengist and Horsa. When they practised it in England, their urns were of a very different kind, being well burnt and lathe-turned. All the Romano-Britons I have exhumed in the particular cemetery which has furnished me with the tolerably wide basis of something approaching to 200 interments of all kinds, were interred much as we inter our dead now. They were oriented, though by the aid of the sun and not by that of a compass; and, dying in greater numbers in the winter quarters of the years, had the bearings of their graves, as has been observed by the Abbé Cochet, pointing a little south of east. Now a Romano-British interment in this way of burial has to be distinguished from an Anglo-Saxon one in the same way of non-cremation; and this may be done thus. The Romano-Britons never buried arms nor any other implements which could be of use in this, and might be supposed to be of similar use in the next world, together with a corpse. Funeral ware, such as lacrymatories, I have not found in company with coins of the Christian Emperors; but such articles stand in relation to quite a different idea from that which caused the Teuton to inter the dead with spear, shield, and knife; to say nothing of the less common *situla* and sword.

The Anglo-Saxons are supposed by Kemble to have relinquished cremation only when they assumed Christianity; it is a little difficult to be quite sure of this; at any rate, when we find, as we often do, an Anglo-Saxon in a very shallow grave, which may point to any one point of the compass, and in the arms or other insignia which it contains, gives us such clear proof that its tenant thought that whatever he may *not* have brought with him into the world, at all events he could take *something* out, we are tempted to differ even from such authority as Mr. Kemble's. But I am inclined to think that in some cases it is possible to identify the tenant of a properly oriented grave as having been an Anglo-Saxon. In many such graves Anglo-Saxons are to be recognised by virtue of their insignia; and mixed up with their bones may be found the bones of the Romano-Briton who occupied the grave before them. But farther, in some such cases it is possible to be nearly sure that we have to deal with an Anglo-Saxon, even though there be no arms or insignia in the grave. These cases are those in which we have evidence from the presence of stones under the skull that no coffin was employed in the burial; and in which stones are set alongside of the grave as if vicariously. In many such cases the craniological character of the occupant of such a grave lends some colour to this supposition. But upon such identifications as had been come to in the absence of arms and insignia I have based no statistics. The results of the statistics of the cemetery which I have explored, as stated above, when brought to bear upon the large questions alluded to at the beginning of the paper, would lead us to think that the Anglo-Saxons were in a considerably lower grade of civilisation than the people they conquered, firstly and most forcibly on account of the shorter lives they led. An old Anglo-Saxon male skeleton was a rarity, an old Romano-British one a very common "find" in my excavations. Nothing however in this life is from the natural history point of view more characteristic of real civilisation or real savagery than this matter of the duration of life. The Merovingian Franks had, like the followers of Cerdic, been observed to have led short lives, merry, as the Capitularies of Charlemagne teach us of their kinsmen, with those kinds of mirth the end of which is heaviness. The next question which suggests itself upon the mastery of these facts and figures is, were not these men merely soldiers encamped? are not these statistics just such as a cemetery similarly explored now-a-days, say at Peshawur or Samarcand, would yield? Not altogether such; for, however improbable it may seem, it is nevertheless true that the Anglo-Saxons, at all events in Berkshire, appear to have brought their own wives with them, and not to have provided themselves with wives from the families of the conquered previous inhabitants. The figures of the crania of females interred with Anglo-Saxon insignia, when compared with figures of the crania of Romano-British women, show a very great difference, to the disadvantage of the former of the two sets of females. The soldiers of Cerdic, who conquered this part of Berkshire about half-a-century or so after the time of the first invasion, resembled the soldiers of Gustavus Adolphus in very little else, but they appear to have resembled them in being accompanied by their wives. Whether this was the case elsewhere in England, I do not know; I am inclined to think that savagery was no great recommendation, nor heathendom either, to a Christianised female population in those days; and that the reluctance which would on these grounds interpose itself to prevent inter-marriage between Romano-Britons and Saxons, sets up as great an *a priori* improbability against the theory which assumes that such inter-marriages did take place, as the difficulty of bringing wives over in the ships in those days sets up in its favour.

Indeed, on the hypothesis of much inter-marriage the actuality of our Anglo-Saxon language is a very great difficulty. We do speak a language which, though containing much Celtic and a good deal of Norman-French, is nevertheless "English." Now we know, from finding cremation urns of the Anglo-Saxon type all over England nearly, that the whole of the country was overrun by a heathen population; to thus overrun it, this population must have been (relatively at least) numerous: add to the two conditions of heathendom and multitude which may be considered as proved, the third condition of isolation which may be considered as matter for dispute; and then the fourth of this heathendom and isolation lasting from the time of Hengist to that of Augustine; and the present fact of our language being what it is is explained.

For proving anything as to the period of which I have been speaking, a period which is rendered Pre-historic, not so much by conditions of time as by conditions of space, the absence of contemporary historians having been entailed by geographical and political isolation, arguments of two kinds, literary arguments and natural history arguments, must be employed. Neither the one kind nor the other is sufficient by itself. The empires of the natural sciences and of literature touch at many isolated points, and here and there they lie alongside of each other along lengthy boundary lines. But empires need not be hostile though they be conterminous; and that the empires of which we have just spoken may be united happily and in a most efficient alliance for work in common, may be seen from the title-page of that most excellent German periodical, the 'Archiv für Anthropologie,' where we have the name of the Physiologist Ecker coupled in editorship with that of the Antiquarian Lindenschmit. The necessity for a combination of the two lines of evidence and argument is as obvious when we have to controvert, as when we have to establish a conclusion. If you have to attack or resist a force comprising both cavalry and infantry, you must have both

* A paper read at the Royal Institution on Friday evening, March 25, 1870.

cavalry and infantry of your own; otherwise, some day or other, either in a country intersected with woods, or in some open plain furrowed into deep undulations, one of the two arms in which you are deficient will take you in one or both flanks, and you will be surprised, broken, and routed.

GEORGE ROLLESTON

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, April 21.—Prof. Williamson, F.R.S., president, in the chair. T. Patchett was elected a Fellow. Prof. Roscoe, F.R.S., delivered a lecture on "Vanadium." This metal was discovered in 1830 by Sefström, who also ascertained some of the most peculiar characters of the substance, and prepared some of its compounds in the pure state. Sefström not having leisure to prosecute the full examination of the new metal, handed over his preparations to Berzelius; and it is to the investigations of the great Swede that we owe almost all our acquaintance with the chemistry of vanadium. He found the atomic weight of the metal = 68·5, and wrote its oxides:—VO, VO_2, VO_3, and its chloride VCl_3. Some years afterwards Rammelsberg observed that the mineral vanadinite, a double salt of lead vanadate and lead chloride, is isomorphous, with apatite and with mimetesite, the former containing phosphoric, the latter arsenic acid. This crystallographic analogy would have led to the conclusion that the oxide of vanadium in the vanadinite has the formula V_2O_5, agreeing with the corresponding oxides of phosphorus and arsenic, P_2O_5, and As_2O_5. But the unyielding facts Berzelius had obtained in his analysis, and according to which the oxide in question was represented by the formula VO_3, compelled to regard vanadinite as an exception to the law of isomorphism. Prof. Roscoe, having come into the possession of a plentiful source of vanadium, determined to ascertain whether there really was such an exception, or whether Berzelius's formula may not perhaps be erroneous. He soon found the latter to be the case. He proved that the substance supposed by Berzelius to be vanadium, is not the metal, but an oxide, and that the true atomic weight of the metal is 51·3. Thus the VO_3 of Berzelius becomes V_2O_5, corresponding to P_2O_5 and As_2O_5. The lecturer went on to demonstrate that the characters of the vanadates bear out the analogy of V_2O_5, with P_2O_5 and As_2O_5, and vanadium, hitherto standing in no definite relation to other elements, must therefore be regarded as a member of the well-known Triad class of elementary substances, comprising nitrogen, phosphorus, boron, arsenic, antimony, and bismuth. The above-mentioned source of vanadium is a by-product obtained in the preparation of cobalt from the copper-bearing beds of the lower Keuper sandstone of the Trias at Alderley Edge, in Cheshire.

The President, in proposing a vote of thanks to the lecturer, called attention to the great service Prof. Roscoe had rendered chemical science by his successful investigation of vanadium. The President's remarks were fully endorsed by Profs. Frankland and Odling, and the meeting expressed its appreciation of Prof. Roscoe's lecture by prolonged applause. Prof. Hofmann, from Berlin, who was present at the meeting, favoured the Society with some observations on a compound ($C\ H_2\ N_2$), which he had obtained when treating sulpho-urea with silver oxide. The body is distinguished by its great tendency to polimerise. Dr. Hofmann further communicated that a compound isomeric with chloral (the new anæsthetic) had recently been discovered by two Berlin chemists. It differs from the ordinary chloral by possessing a much higher boiling point.

Geological Society, April 13.—Sir P. de Malpas Grey Egerton, Bart., M.P., F.R.S., vice-president, in the chair. Mr. S. W. North, of Castlegate, York, was elected a Fellow of the Society. The following communications were read:—

1. A letter from Dr. Gerard Krefft, dated Sydney, 29th January, 1869, accompanying a model of the left lower incisor of *Thylacoleo carnifex*, Owen, and the original fragment from which the model was made. Dr. Krefft also referred to the fossil remains of herbivorous marsupials in the museum at Sydney, which included, according to him, besides a great number of Wombats (*Phascolomys*), many wombat-like Kangaroos or Wallabies (*Halmaturus*). He proposed to divide the Kangaroos into the following groups:—

1. *Macropus*, dentition as in *Macropus major.*
2. *Halmaturus*, with the premolar permanent, divided into two sub-groups:—
   a. True Wallabies, with the premolars long, narrow, and compressed, and the rami of the lower jaw but slightly anchylosed.
   b. Wombat-like Wallabies, with the premolars compact, rounded, and molar-like, and the rami of the lower jaw firmly anchylosed.

Illustrative sketches and photographs accompanied this paper. Prof. Owen remarked upon the importance of the researches made by Dr. Krefft and Prof. Thompson. No traces of man had been found. The numerous remains of mammals, especially the herbivorous species, had doubtless been carried into the caves by *Thylacoleo.* Prof. Busk inquired on what evidence Prof. Owen decided that the tooth of *Thylacoleo* was that of a Carnivore. Prof. Owen indicated the remarkable compression of the tooth and the absence of the spatulate form proper to the Kangaroos as characteristic of *Thylacoleo* and indicative of carnivorous habits. Mr. W. Boyd Dawkins stated that *Thylacoleo* was most closely allied to *Plagiaulax*, which was probably a true Herbivore. He indicated the importance of the question, as if *Thylacoleo* were a Carnivore, *Plagiaulax* would be one also. Prof. Owen remarked that *Plagiaulax* was also a Carnivore. The premolars resembled the small tubercular molars of the Hyenas, Felidæ, &c. The anterior tooth, associated with the small tubercular tooth, was compressed and sharp pointed. The low condyle forming part of the angle of the jaw, was such as occurs in *Thylacinus.* Dr. Duncan remarked that it was by no means necessary that all carnivorous mammals should be formed upon the same type, and that he did not see why there should not be a carnivorous form of the kangaroo type. The chairman said that the settlement of these questions must now be postponed until we obtain further materials. He mentioned the discovery by Dr. Krefft, in the interior of Australia, of a species of fish resembling *Lepidosiren*, and possessing singular affinities to some of the Devonian fishes.

2. "On the Fossil Remains of Mammals found in China." By Prof. Owen, LL.D., F.R.S., F.G.S. The specimens of teeth described by the author were obtained by Robert Swinhoe, Esq., late H. M. Consul at Formosa, chiefly by purchase in the apothecaries' shops at Shanghai. They included two new species of Stegodon (named *S. sinensis* and *S. orientalis*), a new Hyena (*H. sinensis*), a new Tapir (*Tapirus sinensis*), a new Rhinoceros (*R. sinensis*), and a species of Kaup's genus Chalicotherium (*C. sinense*). The author remarked that the whole of these teeth presented an agreement in colour, chemical condition, and matrix, which led to the conclusion that all belonged to the same period. But for the presence of the Chalicotherium, they would have been referred either to the Upper Pliocene or the Post Pliocene period. The author did not consider that the occurrence of the Anoplotherioid species need affect the determination of the age of the fossils, especially as Chalicotherium departs in some respects from the type genus Anopoltherium, and is not known from deposits older than the Miocene. The Chairman called attention to the remarkable association of forms among the fossils described by Prof. Owen. Prof. Busk remarked that the materials at command seemed to him insufficient for the establishment of new species. He observed that the distinctive characters of *Stegodon sinensis* appeared to be very slight, and that the Hyena was probably *H. spelæa.* The tooth of Rhinoceros might be a milk-molar of *R. sumatranus.* Mr. W. Boyd Dawkins suggested that, as the specimens were obtained from apothecaries, there was no evidence of the contemporaneity of the fossils. Mr. H. Woodward stated that Mr. Swinhoe had himself obtained a series of these fossils from a cave many miles inland, he believed on the course of the Yang-tse-kiang. Mr. Woodward also called attention to Mr. Hanbury's paper on Chinese Materia Medica, in which many fossil teeth of mammalia are noticed. Prof. Owen, in reply, stated that great quantities of the fossils had passed through his hands, and that he had selected for description those which, from their minute agreement in chemical and other characters, might justly be inferred to be derived from caves of the same age.

3. "Further discovery of the Fossil Elephants of Malta." By Dr. A. A. Caruana. Communicated by Dr. A. Leith Adams, F.G.S. The author described a new locality in Malta in which the remains of elephants had been found recently—the Is-Shantin fissure at the entrance of Micabbiba. It was filled with a compact deposit of red earth containing fragments of limestone, many teeth and fragments of bones of elephants, associated with bones of large birds. The author found three small

shark's teeth, and a small tooth which he regarded as belonging to a Hippopotamus. He indicated the nature of the teeth and bones of elephants found by him in the newly-discovered fissure. The whole of the five localities in which ossiferous fissures have been discovered are in the same part of the island; and the author concluded with some remarks upon the geological conditions under which the remains of mammalia must have been accumulated, and upon the probability that a connection then existed between Malta and Africa. In a note appended to the paper, Dr. A. Leith Adams stated that the supposed tooth of Hippopotamus was a germ true molar of one of the pigmy elephants, and that the shark's teeth had probably been derived from the Miocene deposits. Prof. Busk remarked that there was no doubt that three species of elephants had lived in Malta. Capt. Spratt said that it appeared to him that the chief interest of the communication lay in the greater comparative abundance of the larger species of elephant in the new locality.

Royal Geographical Society, April 11.—Sir R. I. Murchison, President, in the Chair. The first paper was on a Pundit's explorations in Western and Central Thibet in 1868, by Major T. G. Montgomerie, R.E. The previous exploration having furnished some information as to the districts between Rudok and the Thok Jalung gold-field, it was decided to send the third Pundit to Rudok, and through Rawung and Tingche, north of the Aling Gangri Peaks. A reported trade route from Thok Jalung to Tengri-noor lake, and thence to Lhasaon, was to be attempted; failing this, the route by Majin and Shellifuk to Tadum Monastery. The result has been to give definite information as to the character of the great elevated plain of Thibet, 15 to 16,000ft. above sea level, extending probably to Sew Choo, nearly to the great wall of China. The Pundit, as one of a party of Bisahiris, went from Spiti to Demchok, on the upper Indus; the river was 270ft. broad, and 5ft. deep in July—velocity of stream $2\frac{3}{10}$ miles per hour; Rudok had not been visited; officers had penetrated to within 12 miles of the Fort, where the Jong-pon or Governor resides. The Pundit determined the position; the Fort is on a hill of 250ft., with 4 monasteries and 150 houses round it. July 22nd.—The party proceeded eastward through Rawung and Tingche to Dak-korkor, a standing camp and annual fair. Large and small salt lakes were passed, and three days' march of a waterless country, the soil of a dazzling white. Five days north he heard of a district called Tung Phaiyu-Pooyu, of the same character, very lofty, named from high snowy-peaks, probably E. Kiun-kuenlun. A large river is said to flow N. and E. to China; the population is numerous, consists of Dokpas under Lhasa: The snow-white plains have been noticed east of Changchenmo Pass; no high peaks were seen to north and east. All accounts and observations confirm the existence of great plains from the Chang Thang of Rudok to China; the Pundit identified "Jiling," with Sining, N. lat. 37, E. long. 102. The party reached Dak-korkor, 20 miles N. of Aling Gangri, during the annual fair. Robbers attacked the camp. The Jong-pon levied a black mail from the traders to avoid pillage, probably sharing the plunder. The Pundit proceeded eastward by the Aling Chu river, which falls into lake Hagongcho. He passed lake Chakchaka, whence Nepal, &c., is supplied with salt. These lakes are nearly connected. A salt field of 20 miles by 10 is nearly on a level with the lakes. The Pundit heard of seven gold-fields besides those visited, Thok Sailung and Thok Jalung, and those of the northern district. South of Thok Jalung the gold bearing rocks were left. The supply in the gold districts is inexhaustible.

From Thok Jalung they passed through Majin—the country drained eastwards, partly undulating and partly level; all about 16,000ft. above the sea. They reached Kinglo on the large river Chu Sangpo, unfordable in summer, flowing east into a large lake Cho Sildu, which receives three large streams but has no exit. Shellifuk Monastery lies south of this lake from Kinglo. They were obliged to turn off the Tengri-noor route, and go south-west to Lake Mansarowae. Crossing the Nagchail and Riego ranges, offshoots of Kailas Peak, numerous borax fields were passed, furnishing a sufficient supply for the potteries of Europe. A tax of 10 annas or 1s. for above 240 lb. only is imposed. Large herds of black wild yaks, wild asses, numbers of Hodgsonian antelope, wild goats and sheep, including Ovis Ammon wolves, reddish hares, marmots, and a kind of fox were observed. The lakes were tenanted by quantities of geese, ducks, and storks; eagles and vultures were seen everywhere. Robbers abounded, but went off at the sight of guns. The Pundit surveyed the Mansarowae Lake; the water was sweet; no exit. He failed to join the Ladak caravan to Lhasa, but proceeded to Shigatse, where he was stopped, and obliged to return. His servant reached the Tadum Monastery, but was sent back. He crossed into Nepal by the Muktinath, pass of only 13,000 feet.

Mr. Shaw described the white plains which he had traversed for 10 or 12 miles as resembling ice covered with snow, one being soda; under it lay crystallised salt. The thieves were encouraged by the authorities, but were so afraid of guns, that a quantity of stolen sheep were voluntarily restored on the approach of European shooting party. Sir Henry Rawlinson considered there were no mountains north of Rudok, but that the plain descended by a gentle slope, affording facilities for a great road to be connected with the road from India. He referred to a Persian work, Tarik-i-Ras-chidi, written by a cousin and general of the great Baber, giving full topography of Thibet and Kashmir. Mr. Saunders exhibited a map of Thibet, he believed Central Asia proper was encircled by mountains with an escarpment descending rapidly on the north as well as the south, and argued against the hypothesis of a gentle slope. He pointed out the remarkable depth of the Himalayan gorges. The Pundit's servant who had penetrated behind Mr. Everest, found the base of the peaks to be only on a level of 6,000ft., the gorges 20,000ft. deep. Dr. Campbell stated that a Chinese army had invaded Nepaul by the Muktinath Pass.

The President remarked that our knowledge of the country had till now been derived from the Jesuits and Thibetan survey. The discussion made him realise our ignorance of it.

A second paper was read by Captain I. Gregory on an attempt made to communicate from Assam with Catholic missionaries now residing at Sakka and on the Mekong and Salween rivers. The envoy was turned back. A letter received from the missionaries was read, mentioning that Europeans were casting cannon for the Mahommedan king. They expressed their desire to aid English travellers, and mentioned that last year they had received "a nice young gentleman from Bathang named Cooper." The bishop is at Ta-Tsien. Col. Yule mentioned that 10 years ago a letter from the Vicar Apostolic at Bonga to Bishop Des Mesures at Rangoon first disclosed the presence of Catholic missionaries in Thibet. Information was sent by them concerning the rivers flowing from the plateau of Thibet, between the Bramapootra and the Upper Yang-tze-kiang. The upper waters of these and the Mekong Salween and Irrawaddy, issue from a higher latitude than supposed and can be traced to 35°. The determination of the disputed questions connected with these rivers is proposed as an object of future exploration. A paper on the Upper Irrawaddy is shortly to be read before the Society.

Royal Astronomical Society, April 8.—William Lassell, F.R.S., president, in the chair. The minutes of the last meeting were read and confirmed, and 37 presents announced. A paper by Mr. Plummer on the Orbit of the Comet of 1683 was read. From the observations of Flamsteed, a parabolic orbit was decided by Halley, but recently Clausen of Dorpat has computed an elliptical orbit. The author, at Mr. Hind's suggestion, re-examined the matter, making all possible corrections, and using the latest star places, and finds as the result that the orbit is parabolic, so that the return of the comet in a few years hence is not to be expected.—Mr. Tebbutt, junr., sent some observations from Australia, of the Lunar Eclipse on January 17, 1870. During the totality, the details of the surface of the moon were distinctly seen through the copper-coloured tint pervading the disc, which was given at the edges. A number of telescopic stars became visible in the path of the moon, and several occultations of these during the eclipse were noted. The times of contact were likewise given. Mr. Bird read a paper on "The Floor of Plato." There are now 35 spots known on this space, 8 of them having been discovered since November 1869. The result of 771 observations was given in a tabular form, showing the degree of visibility in the first 6 lunations of a year, in the last 6 lunations, the increase and decrease of visibility, and the amount of the variation. The observations were made with telescopes of 6 to 9 inches aperture, the greater number coming from Mr. Crossby's Reporter of the latter size. The President announced that there was a possibility of the Government providing the means of transit to and from Mediterranean ports, for observers of the eclipse in December next, and he invited the Fellows willing to take part in an organised scheme to send in their names, as nothing could be done until the probable number was known. The Astronomer Royal opened a discussion on the subject by tracing the course of the eclipse from Portugal to the Black

Sea, and stated that the only points which were especially available would be Xeres near Cadiz, or Gibraltar; Oran in Algeria, and a station in Sicily, near Syracuse or Catania. [This subject has already been fully discussed in our columns.] The remainder of the evening was occupied by Mr. Watson, who brought forward his hypothesis, the result of ten years' study of the moon, that both water and air exist on the side invisible to us. His argument was, that from his telescopic views of the moon he was convinced water and volcanoes had left traces of their action; that chemically and geologically air and water were necessary for such action; that the air and water could not get away from the moon, and that as they were not present on the side visible—which he admitted to the fullest extent—they must be existing on the other side—although he could give no other proof in support of his assertion. Mr. Watson's views were severely criticised in a jocular tone by Capt. Noble, and more seriously by Col. Strange, who said that Mr. Watson having wished to extract an opinion whether he was right from the society, could not have it, as that body as such never gave an opinion on any communication, and that if distinguished astronomers did not rise to confute him he must not take silence for consent. Even assuming all that Mr. Watson said to be correct, which Col. Strange by no means admitted, there was even another explanation than that offered, viz., that the water had been absorbed into the interior of the moon. Mr. Watson's remarks were a striking example of the danger of bringing forward opinions formed without a foundation of facts.—After electing seven new Fellows, the long and interesting meeting came to an end.

Anthropological Society of London, April 19.—Dr. Berthold Seemann, V. P., in the chair. Mr. John Colam, 105, Jermyn Street, St. James's; and Mr. David Mitchell Henderson, 1, Carden Place, Aberdeen, and Old Calabar, West Africa, were elected Fellows. Dr. D. Lubach, of Kampen, Holland, was elected a corresponding Member.

A paper, by Mr. Alfred Sanders, was read "On Mr. Darwin's Hypothesis of Pangenesis as applied to the Faculty of Memory." The first question to be asked was—"Is thought a function of the brain?" The author answered it in the affirmative, and cited facts and appearances in physiology, anatomy, pathology, and physics in support of his opinion. Thought could not be considered as a product of the brain-cells any more than light could be produced by the cells of the retina, yet the brain-cells were necessary for the communication between the mind and the external and internal world, and were exhausted in the process of thinking and willing, in the same manner as the cells of the retina were exhausted and required renewal in the process of seeing. Passing to the consideration of the faculty of memory, the author combated the theory of Mr. John Stuart Mill, that the mind is a series of feelings and nothing more, and that memory is an ultimate fact incapable of explanation. The remainder of the paper was devoted to the application of Mr. Darwin's hypothesis of Pangenesis, which the author maintained was capable of explaining the difficulty raised by Mr. Mill; it being granted that the mental faculties depend upon the brain, and that the brain-cells give off self-propagating gemmules indefinitely, everything becomes plain. After describing in detail the action of external impressions on the brain at different times in the life of an individual, some of the many conditions favourable or the reverse to the retention of such impressions, and the dormant and active states of the brain-cells, the author entered into a consideration of the growth of the supposed gemmules, their action at maturity, and their power of self-propagation. Mr. W. B. Kesteven supplemented the paper by a speech of some length in general support of Mr. Darwin's hypothesis, but not of its treatment by Mr. Sanders, and by the exhibition of a series of microscopic anathomical preparations in illustration of his remarks. The discussion was further sustained by Dr. Langdon Down, Rev. Dunbar Heath, Mr. Dendy, Dr. Ellis, M. Robert Des Ruffières, Mr. George St. Clair, the Chairman, and others.

Mr. George C. Thompson contributed a note on "Consanguineous Marriages," urging upon the Society an investigation into the following questions:—1. When the defects commonly attributed to relationship of the parents are exhibited, are the germs of these defects traceable in the parents or their families? 2. When the medical pedigree of the parents is faultless are the children sound and healthy? 3. When any particular excellence occurs in the parents' family, is it transmitted to the children in increased force? Dr. Langdon Down said that after an examination of some five thousand cases of interbreeding he had arrived at the conclusion that the practice was not only not necessarily injurious, but that a methodical and judicious selection in the marriage of close relations would be of enormous value to the community in the improved race of men that would by that means be obtained. Captain Blair cited in support of that view the case of a people on the Ganges, while other speakers adduced conflicting evidence.

London Mathematical Society, April 14.—Prof. H. J. S. Smith, V.P., in the chair. The Chairman made some remarks on a problem in kinematics; Mr. Cotterill communicated some propositions bearing on residuals and former papers of his own read before the society; Mr. Crofton drew attention to a locus in Cartesian ovals; Mr. Jenkins gave a geometrical construction for showing the spherical excess of a triangle; and the chairman mentioned some focal properties of skew surfaces to which he had been led.

Palæontographical Society, April 8.—Annual general meeting; Dr. J. S. Bowerbank, F.R.S., in the chair.—The Council reported that the Society was in a most prosperous condition; that the volume for the present year was in progress, and would be published in the autumn; that new monographs by Mr. Carruthers, on the Fossil Cycades, by Dr. Lycett on the Fossil Tregoniæ, and by Prof. Owen on the Purbeck Mammalia, were in preparation. It was added that Mr. H. Woodward would continue the Monograph on the Trilobites, left unfinished through the death of Mr. Salter, and that Mr. Wood would issue a supplement to the Crag Mollusca. The ballot for the council and officers was taken, and the following gentlemen were elected. President, Dr. S. J. Bowerbank. Vice-Presidents: Prof. Bell, C. Darwin, T. Davidson, and Prof. Owen. Council: Prof. Ansted, Dr. J. J. Bigsby, W. Boyd Dawkins, Prof. Duncan, Sir P. Egerton, Bart., J. W. Flower, R. Hudson, J. W. Ilott, J. Gwyn Jeffreys, H. Lee, Sir C. Lyell, Bart., J. Pickering, J. Prestwich (Pres. Geol. Soc.), Prof. Tennant, C. Tyler, H. Woodward. Treasurer, Searles Wood; Honorary Secretary, Rev. T. Wiltshire.

EDINBURGH

Royal Society, April 18.—"On Change of Apparent Colour by Obliquity of Vision." By Robert H. Bow, C.E., Edinburgh. Mr. Bow observed the peculiarity of chromatic vision in the month of January, when experimenting upon the perfection of definition at different parts of the retina. Coloured objects seen obliquely undergo two changes: first, they become less obviously coloured,—this is particularly the case with greens, yellows, and oranges; and secondly, the colour becomes altered in character, most strikingly so in the cases of pinks, purples, and scarlets; pinks and purples become blue, and a brilliant scarlet (such as given by biniodide of mercury fixed with gum arabic) becomes successively orange and yellow, according to the degree of obliquity. The phenomena are most satisfactorily produced when the coloured objects are held on the nasal side of the observing eye. The author speculates on the influence this discovery may have upon the theories of colour sensation, and upon our knowledge of the nature of colour-blindness and the anatomy of the retina.

PARIS

Academy of Sciences, April 18.—A memoir by M. Moutard, entitled "Researches upon the Equations with partial derivatives of the second order, with two independent variables," was communicated by M. Bertrand.—M. Boileau presented a memoir on the determination of the latent work in systems, with uniform or uniformly periodical movements.—M. G. A. Hirn communicated a second note on the specific heat of water towards its maximum of density.—A note by M. Croullebois on the variations of the index of refraction of water with temperature, was presented by M. Balard. Upon this subject the author had come to a conclusion directly opposite to those of Arago and M. Jamin, and maintained that the index of refraction attains its maximum at the maximum density of water (4° C = 39° 1 F.) and decreases both above and below that temperature. He described the apparatus employed by him.—M. L. Sonrel communicated a note on the Aurora Borealis of the 5th April, of which he described the appearance and the various phenomena accompanying it. The Aurora only became visible in the evening, but it was then decreasing in intensity; it was visible over the greater part of Europe, and everywhere presented the same characters. It was accompanied by a strong and disagreeable odour, which was noticed both in France and Germany. Magnetic perturbations were observed both on the 4th and 5th of April.—M.

Delaunay presented some remarks upon M. Flammarion's note on the law of the rotatory movement of the planets, by M. G. Quesneville. The author maintained that M. Flammarion's numbers were incorrect.—A note on the spectrum-analysis of a solar spot, by M. G. Rayet, was also communicated by M. Delaunay. The author stated that while observing the spectrum of an immense spot in the south-west region of the solar disc, he saw the line C become luminous in the portion answering to the nucleus.—The greater number of the papers presented to the meeting were on chemical subjects. M. Descloiseaux presented a note on the clinorhombic form of the red oxide of mercury.—M. H. Sainte-Claire Deville indicated some experiments which he is now completing, upon the decomposition of aqueous vapour by iron. The phenomena, according to him, resemble in some important points, the mechanical phenomena of vaporisation and condensation; that is to say, they favour hygrometric laws.—M. J. P. Prat presented some experimental researches upon gold and its compounds. The author described the formation of a spongy gold by the addition of bicarbonate of potash to a solution of sesquichloride or gold, adding oxalic acid to the filtrate, and boiling it for two minutes. The spongy gold, heated with a combination of sulphuric and iodic acids, is entirely oxydised; the product dissolves in forming nitric acid. The solution, when diluted and heated, gives a precipitate of protosulphate of gold. The author noticed further the chlorides, iodides, and oxides of gold, two of the latter being new compounds ($Au^2\ O^2$ and $Au\ O^2$). A current of chlorine passed over a heated chloride of gold may produce a volatile chlorine superior to the sesquichloride.—M. H. Debray communicated a note on the assay of silver containing mercury. After noticing and explaining the process of Levol for effecting this assay in the humid way, the author described the method adopted by him, which consisted in heating a small portion of the silver, known to contain mercury, in a small crucible of gas charcoal for about a quarter of an hour, when the mercury is driven off and the silver remains as a button.—M. Balard presented a note by M. E. Reboul, on the hydriodates and hydrochlorates of monobrominated æthylene and propylene. —In a note on black phosphorus, M. Blondlot stated that after many unsuccessful trials by Thenard's method, he had prepared this substance by distilling phosphorus, or heating it to 212° F. under water in contact with mercury. Its colour is due to a multitude of black points, which disappear when the substance is fused and reappear on its cooling. At first the black phosphorus thus prepared, contained a trace of mercury, but after several distillations this disappeared, although the coloration was retained. The black material is more volatile than ordinary phosphorus, of which the author believed it to be an allotropic form.—M. Boussingault communicated a note by M. Musculus, on a dextrine insoluble in cold water, prepared by treating starch with crystallisable acetic acid. The author considered their insolubility of this dextrine to be due to its retaining the organisation of the starch grains. He described its characters and behaviour under various circumstances.—M. L. Henry presented two important memoirs, one on the chloronitric and bromonitric æthers of glycerine; the other, on the direct combination of allylic compounds with chloride of iodine and hypochlorous acid. In the former paper he described the action of nitric acid upon the halogenated æthers of glycerine, and especially the compounds *dichloromononitrine* (C^3H^5), Cl^2 (NO^3), and *monochlorodinitrine* (C^3H^5), Cl $(NO^3)^2$,.—M. A. Béchamp communicated a note on the formation of urea by the action of hypermanganate of potash upon albuminous matters, in which he maintained the correctness of his assertion that this reaction takes place, and described his mode of expeiimentation and the results of the analysis of his products.—M. P. Guyot communicated the results of his investigations into the toxical properties of some products of the phenic group—azuline and lydine.—M. J. Cloquet presented a note by M. L. Van Backer, containing a list of earthquake shocks and volcanic eruptions recorded as having taken place in the Dutch East Indies since the commencement of the sixteenth century. This list is derived from Junghuhn's "History of volcanoes."—M. H. Baillon made some observations on the crests of ice which have been noticed on the stems of plants, and stated that this phenomenon was a purely physical one, and had nothing to do with the life of the plant.—According to M. Guérin-Méneville, the parasitic insect, called *uji* or *oudji*, which attacks the silkworms in Japan, is a Dipterous fly, like the Chinese one noticed by M. Castellani, and the French fly which has transferred its attentions to the *Cynthia*-silkworm. M. Guérin names the parasite *Tachina oudji*.—M. N. Joly, in a letter to M. Dumas, noticed the occurrence of a distinct rotation of the embryos in the eggs of the axolot.—Dr. Pettigrew, presented some observations on the flight of Insects, with reference to M. Marey's communications on this subject. Dr. Pettigrew claims the priority in determining that the wings of insects in movement describe a figure of 8.—M. Andral, presented a note on the temperature of new-born infants; M. Moyret proposed the employment of perchloride of iron for the purification of the air evacuated from hospitals; and M. Namias forwarded some remarks upon the employment of bromide of potassium as a medicine, in reply to which M. Balard, made some observations, reccommending the use of bromide of sodium. Of the following communications the titles only are given:—A note on cholera by M. Levery; a note on the movement of liquids by M. d'Estoquois; and a note on vapour in a state of saturation, by M. Leloup.

VIENNA

Imperial Academy of Sciences, March 17.—A memoir was communicated by Professor V. Graber "On the resemblance of the structure of the female external sexual organs in the Locustidæ and Acrydii from the point of view of their developmental history." The author stated that in these two families of saltatorial orthopterous insects the external sexual organs of the females are exactly similar in number, form, and position in their original condition when the young animals leave the egg, and that it is only by changes taking place during development that the great differences observable in the mature insects are brought about. These developmental changes were described by the author in detail.

March 24.—Professor J. Stefan presented a preliminary communication "On a new experimental method of analysing the movement of sounding columns of air," by Professors A. Toepler and L. Boltzmann; and also a paper by himself "On the excitation of longitudinal vibrations by transverse ones."—Dr. S. Stern communicated a memoir "On the resonance of air in free space, as a contribution to the theory of sound."—Dr. A. Boué spoke upon the accumulation of erratic blocks in the sedimentary rocks, and in tertiary sandstones or conglomerates. He discussed the various hypotheses which have been put forward to account for these phenomena, which occur in various formations from the older carboniferous sandstones to the most recent beds. For the Eocene and Miocene rocks the author adopted the theory of their having been floated by ice; he also opposed the notions of those geologists who ascribe the excavation of lake-basins to the action of glaciers and assume the existence of glaciers at all geological periods.—A memoir was communicated by Professor Brücke "On the physiological significance of the partial decomposition of fat in the small intestine."

PHILADELPHIA

American Philosophical Society, March 4.—"On the Periods of Certain Meteoric Rings." By Daniel Kirkwood.

I. The Meteors of April 20. In the *Astronomische Nachrichten*, No. 1632, Dr. Weiss called attention to the fact that the orbit of the first comet of 1861 very nearly intersects that of the earth, in longitude 210°; the point passed by the latter at the epoch of the April meteoric shower. A relation between the meteors and the comet, similar to that recently detected between the November meteors and the comet of 1866, was thus suggested as probable. Is this hypothesis in harmony with facts? and if not, are our present data sufficient for determining with any reasonable probability the true period of the April meteors?

Dates of the April Shower.—Prof. Newton selects the following from Quetelet's catalogue as belonging to this period:*

1.	B. C. 687,	4.	A. D.	1093,	'4 '5, and '6
2.	,, 15,	5.	,,	1122,	'3
3.	A. D. 582,	6.	,,	1803,	

Period of the first Comet of 1861.—The elements of this body were computed by Oppolzer, who assigned it a period of 415 y. 4. Now, while it is true that the interval from B. C. 687 to A. D. 1803, is very nearly equal to six periods of 415 years, the slightest examination will show that this period does not harmonise with *any of the intermediate dates*. This fact, then, without further discussion, seems fatal to the hypothesis that the period of the meteors is nearly equal to that of the comet.

* Silliman's Journal for July, 1863.

What is the probable period of the ring?—The showers of 1093-6 and 1122-3 at once suggest a period of from 26 to 30 years. The nodal passage of the densest portion of the ring at the former epoch may be placed anywhere between 1093 and 1096, and that of the latter, in either 1122 or 1123. The entire interval from B. C. 687 to A. D. 1803 is 2490 years, or 88 periods of 28 y. 295 each; and the known dates are all satisfied by the following scheme:—

B.C. 687 to B.C. 15	672.000 yrs.	=24	periods of	28.000	each.
15 to A.D. 582	597.000 ,,	=21	,,	28.429	,,
A.D 582 to 1093.714	511.714 ,,	=18	,,	28.429	,,
1093.714 to 1122.143	28.429 ,,	= 1	,,	28.429	,,
1122.143 to 1803	680.857 ,,	=24	,,	28.369	,,

These coincidences indicate a period of about $28\frac{1}{3}$* years, corresponding to an ellipse whose major axis is 18.59. Hence the distance of the aphelion is very nearly equal to the mean distance of Uranus. It will also be observed that the time of revolution, which seems to have been somewhat lengthened about the Christian era, was previously one-third of the period of Uranus.

II. The Meteors of December 11-13.

In the catalogue of Quetelet we find the four following extraordinary displays which belong undoubtedly to this period. Observations made in England, 1862, indicate also a more than ordinary number of meteors at the December epoch in that year.

1. A.D. 901. "The whole hemisphere was filled with those meteors called falling stars, the ninth of Dhu'lhajja (288th year of the Hegira) from midnight till morning, to the great surprise of the beholders, in Egypt."—*Modern part of the Universal History*, 8vo. vol. 2, p. 81. Lond. 1780. The date of this phenomenon corresponds to the December epoch, A.D. 901.

2. 930. "Averse remarquable d'ètoiles filantes en Chine."

3. 1571. "On vit à Zurich 'du feu tomber du ciel.'"

4. 1830, 1833, and 1836. The maximum seems to have occurred in 1833, when as many as ten meteors were seen simultaneously. "Dans la nuit du 14 au 12 décembre, on vit, à Parme une grande quantité d'étoiles filantes de différentes grandeurs, qui se dirigeaient presque toutes avec une grande vitesse vers le SSE. A 10 heures et ¼, entre les seules constellations du Bélier et du Taureau, on en compta environ une dizaine."

5. (Doubtful.) 1861, 1862, and 1863. Maximum probably in 1862. The meteors at this return were far from being comparable in numbers with the ancient displays. The shower, however, was distinctly observed. R. P. Grey, Esq., of Manchester, England, says the period for December 10-12 was, in 1862, "exceedingly well defined."†

These dates indicate a period of about $29\frac{1}{8}$ years. Thus:—

901 to 930	1	period of 29.000 years.
930 to 1571	22	periods of 29.136 years.
1571 to 1833	9	periods of 29.111 years.
1833 to 1862	1	period of 29.000 years.

III. The Meteors of October 15-21.

The showers of the following years (see Quetelet's Catalogue) belong to this epoch:—

1. 288. "Apparition en Chine."

2. 1436 and 1439. In each year a remarkable apparition was observed in China.

3. 1743. (Quoted from Herrick, in Silliman's Journal for April 1841.) "A clear night, great shooting of stars between 9 and 10 o'clock, all shot from S.W. to N.E. [*Qu.* N.E. to S.W. ?] One like a comet in the meridian very large, and like fire, with a long broad train after it, which lasted several minutes; after that was a train like a row of thick small stars for twenty minutes together, which dipt N."

4. 1798. "Brandès marque, à Goettingue, un grand nombre d'étoiles filantes dans les observations simultanèes qu' il fait avec Benzenberg."

These dates indicate a period of about $27\frac{1}{2}$ years:—

288 to 1439	42 periods of	27.405 years each.
1439 to 1743	11 ,,	27.636 ,,
1743 to 1798	2 ,,	27.500 ,,

If these periods are correct, it is a remarkable coincidence that the aphelion distances of the meteoric rings of April 18th—20th, October 15th—21st, November 14th, and December 11th—13th, as well as those of the comets 1866 I, and 1867 I, are all nearly equal to the mean distance of Uranus.

* Herrick assigned a value of 27 years. See Silliman's Journal for April 1841, p. 365.

† Silliman's Journal for May, 1863, p. 461.

DIARY

THURSDAY, April 28.

Royal Society, at 8.30.—On the organs of Vision in the Common Mole: Dr. R. J. Lee.—On an Aplanatic Searcher applied to Microscopes: Dr. Royston Pigott.—On a cause of error in Electroscopic Experiments: Sir Chas. Wheatstone.

Zoological Society, at 8.30.—Notes on a North-American Batrachian (*Spelerpes rubra*): Mr. St. George Mivart.—Notes on some points in the anatomy of certain Kingfishers: Dr. Cunningham.—On a new gigantic Amphibian, allied to *Lepidosiren* from Queensland:—Mr. G. Krefft.

Royal Institution, at 3.—Electricity: Prof. Tyndall.

FRIDAY, April 29.

Royal Institution, at 8.—Popular Myths: Prof. Blackie.

Zoological Society, at 1.—Anniversary Meeting.

SATURDAY, April 30.

Royal Institution, at 3.—Comets: Prof. Grant.

MONDAY May 2.

Entomological Society, at 7.

Society of Arts, at 8.—Cantor Lecture on Fermentation: Prof. A. W. Williamson.

Royal Asiatic, at 3.

Royal Institution, at 2.—Annual Meeting.

TUESDAY, May 3.

Anthropological Society, at 8.—The Aboriginal Tribes of the Nilgiri Hills: Major Ross-King.—The Armenians of Southern India: Dr. John Shortt.—The Kajahs of Southern India: Dr. John Shortt.

Royal Institution, at 3.—Moral Philosophy:—Prof. Blackie.

THURSDAY, May 5.

Royal Society, at 8.30.

Society of Antiquaries, at 8.30.

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Errata.—In No. 24, page 630, second column, line 10: for "Acalephic" read "Acalephæ."—Page 635, column 1, line 5 from bottom, for "Von Martins," read "Von Martius; and column 2, line 4: for "Martins," read "Martius."

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