KNOWLEDGE.

VOL. II.

KNOWLEDGE
AN ILLUSTRATED MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

CONDUCTED BY RICHARD A. PROCTOR.

"Let Knowledge grow from more to more." *Tennyson.*

VOLUME II.

JUNE TO DECEMBER, 1882.

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LONDON: FRIDAY, JUNE 2, 1882.

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THE ROYAL ACADEMY.

TO the lovers of the old-fashioned style of landscapes, with subdued mahogany as the prevailing tint, few paintings in this year's exhibition will be more charming than Mr. Leader's "Morning: the Banks of the Ivy, O!" No. 550, Gallery VI. The painting is, in fact, very pleasing, but it is not often that these tints are seen in nature. Certain French, Flemish, and Dutch painters affect them, and we presume they must have seen them; we have not been so fortunate ourselves. Facing this picture is one which will grievously offend all those who think that art should set the fashion to nature, Mr. Charles Stuart's "Sunny Autumn," No. 627. We have seldom seen finer and less exaggerated light than there is in this really charming picture. We have not a blaze of light in which all details are lost, as in so many of Turner's landscapes, nor have we staring contrasts, but a gentle light seems to shine through the landscape. The tender autumn glow is rendered perfectly. Certain optical effects are erroneously presented, however. The vertical reflections (very faint, it is true) in the water, do not correspond to any feature in the landscape which in nature would cast such reflections. At an earlier or later time than that shown in the painting, when the shadows were more marked, they may have been seen, but not otherwise. However, this painting is really so beautiful that we feel loth to touch on what is, after all, a very trivial fault. No. 557, "Winter and Rough Weather," by Mr. Moore, seems intended as a parody on Turner at his wildest. In passing, we notice again a picture in the same room to which we have already referred,—"Extremes Meet," by Mr. Alfred Strutt—to explain that when we spoke of incorrect drawing, we referred not to the dogs but to the background. Considered apart from the background, the big fellow is a very fine dog, and the little "toy" beside him only duly small: but, considered with reference to the background, both dogs look smaller than they should be.

We must notice some of the portraits in the galleries of painting and of sculpture. But we are told that there is a great pressure on space this week, so we leave this to another occasion.

We may, in passing, consider some of the water-colour paintings. "The Dying Day," by Walter E. Stocks, is very finely painted, the effects of the dying lights being well caught. Miss Kate Macaulay, in "Scotch Herring Trawlers," No. 894, and "A Sea Cliff," No. 914, represents a very curious substance, on which boats are placed as they might be placed on the sea; but it is not sea—nor have we any idea what it is it is like nothing we have ever seen outside this lady's paintings. Mr. Arthur Croft, in Nos. 902 and 906—the latter a magnificent painting—has admirably dealt with the difficulties involved in the correct delineation of misty air in water-colours; while in the "Port of Algiers, Africa," No. 917, he as skilfully represents the effects of an exceptionally pure atmosphere. In No. 1,056, "Hill-side at Assisi," Mr. Henry Goodwin tries to represent a rainbow! "Coneysthorpe," No. 1,062, by Mr. Walter F. Stocks (it was hardly necessary to add to our last sentence that Mr. Goodwin utterly fails in representing a rainbow), is a painting in the old-fashioned style, but very charming, too. We must ask Mr. Proctor about the moons in Nos. 1,094 and 1,099. The horned moon in the latter, "An August Evening," by Mr. Walter F. Stocks, is certainly unlike the horned moon as we have ever seen it on an evening when the air is so pure,—the horns being fluffy in a clear sky. But can the line joining the horns of the setting moon in autumn be nearly upright? we always thought that they were at right angles to a line from the sun. [So they are. We have seen both this moon and the moon in "Cairo from the Mohattam Hills," by Tristram Ellis (No. 1,094), (gibbous near the place of sunrise at early morning), and both are, in an astronomical sense, utterly wrong. Of the artistic qualities of either painting we would not venture, of course, to express an opinion. But we can see no earthly, or heavenly, reason why the heavenly bodies should not be correctly represented in paintings, even by Royal Academicians. Is there anything inartistic in correctness? On the cover of the two first thousand of our "Easy Star Lessons" there was a sort of parody on Orion, and we were told, when we remarked on its utter inaccuracy, that it was meant to be artistic. Is the real Orion of the skies unfortunately inartistic? We note that in the painting of "The Saving of the Capitol"—we have not our artist by us to tell us the number and painter, and the printers are waiting—there is a sort of attempt to represent certain familiar star-groups; but the painter seems to have been afraid lest there might be something inartistic in putting in the stars as they exist in reality (or, it occurs to us as possible, he may think they have altered since the time of ancient Rome). It would be as artistic, I should say, to represent limbs and muscles incorrectly as the stars which garland the heavens. There is nothing essentially artistic in incorrectness.—Ed.]

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

By Amelia B. Edwards.

I.—THE ARGUMENT OF DE ROUGÉ.

THE busy, practical world does not, as a rule, concern itself very warmly in matters of archæological research, and rarely indeed has any discovery of a purely archæological character taken so powerful a hold upon the attention of the general public as did the recent discovery at Thebes. The first announcement of the decipherment of the Deluge Tablets by the late George Smith can alone be compared with it in this respect; but the enthusiasm with which that announcement was received neither spread so fast nor rose so high as the excitement with which, in the month of July, 1881, we read of the finding of Rameses the Great. For, although the mortal remains and sepulchral relics of between thirty and forty royal personages belonging to various dynasties had, it was reported, been recovered from the depths of a subterraneous tomb at Dayr-el-Baharee, and although some others of those mummied kings were among the mightiest warriors of ancient Egyptian history, it was upon the mummy of Rameses the Great, the reputed oppressor of the Hebrews, that our interest was mainly concentrated.

I say the "reputed" oppressor, because, in the absence of direct contemporary evidence, it is scarcely possible to prove quite positively that Rameses II. was indeed the Pharaoh who afflicted the descendants of Jacob. That is to say, no Egyptian records bearing upon the history of the Hebrew sojourn, or even mentioning the Hebrews by name,* have yet been discovered. Nor is this to be wondered at; for, in the first place, that part of Egypt in which the Hebrew colony dwelt—namely, the land of Goshen—remains to this day almost wholly unexplored; and, in the second place, being themselves politically insignificant, the Hebrews were not likely to be named in monumental inscriptions elsewhere. We have, therefore, no contemporary evidence, except the evidence of the Book of Exodus, upon which to found an inquiry: and the Book of Exodus, although it refers to two successive Pharaohs, unfortunately omits to give the name of either. If we turn from the Book of Exodus to the Book of Genesis, the same unaccountable omission confronts us in the histories of Abraham and Joseph. The king who entreated Abraham well for Sarah's sake, and the king who set Joseph over all the land of Egypt, are alike anonymous. In all four instances, the foreign ruler is called simply "Pharaoh," or "king." It is therefore only by means of a very strict analysis of the text that we are enabled to arrive at any conclusion regarding the historical epoch at which Abraham journeyed into Egypt, or Joseph rose to power, or the Hebrews suffered oppression and fled from captivity. There is, of course, but one way in which to conduct an analysis of the kind: that way being carefully to note every precise statement and every incidental allusion contained in the Hebrew narrative, and to collate such statements and allusions with cognate statements and allusions derived from Egyptian sources. "Cognate," be it observed; not "identical." We have always to bear in mind that Egyptian documents are silent as to the Hebrews from first to last; and that, for the purposes of this inquiry, such documents are available only as they enable the analyst to calculate probabilities of time and place, to identify localities, and to interpret those touches of local colour in which the Bible narrative abounds. Above all, it must be remembered that but for the Bible we should know nothing whatever of the Hebrews in Egypt, nor of their final settlement in the Land of Canaan. For these important events the Bible is our sole authority. Its information is invaluable, as far as it goes; but it does not go far enough. The stories of Abraham and Joseph, though told at some length, leave untold the very facts which would have determined their place in history; while the period of the oppression, which must have extended over several reigns, is dismissed in the briefest manner, and is so vaguely worded that it reads as if all happened under the rule of a single Pharaoh. These are the missing links which puzzle Bible students and baffle archæological inquirers. We may hope here and there to bridge over a chasm or fill up a blank; but it is impossible absolutely to re-establish the chain of events from Egyptian sources, so long as the cities and cemeteries of the Land of Goshen lie buried under enormous rubbish-mounds, which, in a corrupt but recognisable form, preserve to this day the ancient names of the sites upon which they have risen.

I may at once premise that Egyptologists are, for the most part, agreed in identifying the Pharaoh of the Oppression with Rameses II., and the Pharaoh of the Exodus with his son and successor, Menephthah I. This identification—originally proposed by the late illustrious Vicomte E. de Rougé—has undoubtedly more probabilities in its favour than any other. I will even say that it has, I venture to think, even more probabilities in its favour than have as yet been recognised; and that some of these unrecognised probabilities are so conclusive that they very nearly amount to proof. Before, however, we proceed to an analytical examination of the evidence which connects this Pharaoh with the period of the oppression, it will be well to give a general outline of the argument, and for this purpose I cannot do better than translate the following passage from M. de Rougé's preface to his "Notice Sommaire" of the Egyptian antiquities in the Louvre collection:—

"The chronology of Egyptian history and the chronology of the Bible (especially when it becomes a question of estimating the period of the Judges) is altogether too full of uncertainties to enable us, *à priori*, and by a simple comparison of dates, to determine under which king the Exodus took place. The difficulty is even greater as regards the time of the patriarch Joseph, because the length of time during which the captivity lasted is in itself a fruitful subject of controversy. Moses never employs any but the generic term 'Pharaoh,' which means 'the King.' But if we carefully note the salient points of the Bible narrative, we find, first of all, a king who compelled his slaves to build the city of Rameses, in Lower Egypt. Next, if we calculate the time during which Moses dwelt with Jethro, when he fled from the wrath of the king; if we remember that Moses smote the Egyptian just as he had attained to manhood, and that, according to the Bible, he was eighty years old at the time of the Exodus, it will at once be seen that the reign thus indicated must have been excessively long. The Bible says, in fact, 'After a long time, the king died.' But one Rameses answers to all these particulars—namely, Rameses II., who reigned for 67 years, and who did actually build a city in Lower Egypt, to which he gave his name. Moses came back from Arabia as soon as he heard of the death of the king whom he had angered. The Bible account of the plagues of Egypt, and of the horrible catastrophe which attended the departure of the Israelites, would seem to be compatible with only a limited number of years. Menephthah, son of Rameses II., is, without doubt, the Pharaoh of the Red Sea; but the Mosaic narrative does not give us to understand that the

* M. Chabas, an eminently learned and cautious Egyptologist, published an article nearly twenty years ago in his first series of "Mélanges Egyptologiques," wherein he sought to identify the Hebrews with a class of workmen called in Egyptian the *Aperu*, who were employed to extract stone from the quarries opposite Memphis during the reign of Rameses II. These *Aperu* are twice mentioned in the reports of certain overseers of the works named Kauser and Kenamon, which reports, written on papyrus in the Hieratic character, are among the treasures of the Leyden Museum. Unfortunately for M. Chabas's argument, however, a strict comparative examination of numerous Hebrew words imported into the Egyptian language shows that the Egyptians rendered the Hebrew *b* by a combination equivalent to *rp*, and not by *p*, as in *Aperiu*; while the latest researches show the *Aperiu* to be an Egyptian tribe of whom mention is made, according to Lenormant, as early as the VIth Dynasty. See Lenormant's "Histoire Ancienne de l'Orient," vol. ii., p. 271. 1882.

king himself was among the victims of this disaster. He would seem, in fact, to have reigned for nineteen years; and perhaps a less interval of time than nineteen years may have elapsed between the return of Moses and the passage of the Red Sea. No trace of these earliest relations of the Israelites with the land of Egypt has been found upon the monuments; and it would, indeed, be extraordinary if the Egyptians had recorded this disaster in their temple-sculptures, which never commemorated any military events except victories."

THE SEASIDE HEALTH RESORTS OF ENGLAND.

By Alfred Haviland.

INTRODUCTION.

It is proposed to publish in this magazine a series of short papers on those seaside towns to which people usually resort, with the view not only of interesting them about such places, but of guiding them in the selection of the most appropriate to meet their peculiar health requirements.

Hitherto, accident, popular caprice, convenience, or fashion have contributed principally, either collectively or singly, in rendering many places famous as health resorts. Some, however, have had their fame based upon more solid foundations, viz., upon the experience of learned and practical physicians, who, after studying diseases generally in relation to the various factors which constitute *climate*, have sought out the causes which influence their prevalence or scarcity, and have thus been enabled to recommend certain localities for the cure or alleviation of the diseases of their patients.

Hippocrates, 500 years before the Christian era, taught this mode of investigation, especially in his immortal work on "Airs, Places, and Waters," and it would have been well had his teachings been more treasured and acted upon by his successors during the last 2,000 years than they have been. However, during the last five-and-thirty years there have been accumulated such a vast number of returns of deaths from disease, that at last it has become possible to map them in such a manner as to show at a glance throughout England and Wales where are to be found the favourite haunts of those causes of death which characterise this country's mortuary returns. On the other hand, the same map will show where these fatal causes *do* not or *cannot* thrive. Hence we have, on a grand scale, health-guides as regards certain classes of diseases, and we shall see in the sequel that, by a study of the principal factors of the local climate of any place, we gain a clue to the kind of diseases that would either prevail or languish there. On the other hand, a map showing the distribution of certain diseases will give us an insight into the physical geography and climate of the localities where they abound, or are rare. For instance, a map pourtraying the geographical distribution of rheumatism and heart disease will, at a glance, show the sites of all the closed valleys of England and Wales, for it has been proved that these causes of death are to be found in the greatest abundance, without exception, in all those districts where the valley systems are so formed as to preclude the possibility of their being air-flushed by the prevailing winds. Again, a map showing the distribution of consumption will have defined on it, in unmistakable groups, not only those localities where social causes foster it, but where the native populations cannot, when inheriting this terrible lung trouble, withstand the full unchecked force of the prevailing winds. Such a map has all its exposed localities defined by the colouring of the high mortality degrees. One more illustration will suffice to prove our proposition that the physical and climatic features of a country may be predicted by a knowledge of its typical diseases. The remarkable distribution of cancer in females throughout England and Wales points out, by the colouring of the high mortality riparial districts, the courses of all the rivers in England and Wales that seasonably overflow their banks after wet seasons.

Now, all this information, however interesting it may be, would, after a time, cease to be so, were it not capable of being applied to our daily use.

A knowledge of how different diseases are distributed the great registration divisions of our country, its counties, and six hundred and thirty districts, teach us lessons and principles which would be valueless if not applicable to our towns, villages, and dwellings.

The distribution of heart disease and rheumatism teaches us a grand lesson in ventilation; it points out to us the true mode of street arrangement so as to offer every facility for thorough air flushing; it warns the invalid when seeking a health resort to avoid such as abound in gridiron clusters of streets, where diseases of the infectious class have their stronghold, simply because such a street arrangement precludes thorough flushing of the air sewage. It teaches also those subject to or recovering from rheumatism or rheumatic heart disease, to avoid pent up valleys, however lovely, where the benign influence of the sea winds is shut out. The lesson taught by the distribution of consumption must be remembered by those labouring under this lung trouble; they must not heedlessly select a health resort, for some there are which foster this disease, and even those which have a fair reputation for its prevention or alleviation, may have sites within their boundaries quite unsuitable for consumptive cases. Health resorts, especially those by the sea, are often selected, and, in many cases, very properly so, by masters and mistresses of schools for their establishments. Although at first it appears natural that a seaside health resort would be an eligible place for a school, yet we shall be able to show in the following series, that great precautions will have to be taken by those having the natural charge of children and young persons, before they send them away from home to be educated even at health resorts.

We must remember that the period of education is the period of developmental life, and that whenever there are hereditary taints in the young blood, whether of cancer, consumption, rheumatism, &c., that such places should be avoided during the scholar and student life that are known to be favourable to the development of any of these and similar diseases.

We shall endeavour, in the papers which will follow on the Sea-side Health Resorts of England, so to treat the physical geography, geology, climate, and vital statistics of each, as not only to interest the general reader, but clearly to explain the simple principles which should guide the health-seeker in the selection of a health resort.

POPULATION OF THE EARTH.

A CORRESPONDENT (Mr. H. Percival) sends us the following question:

The land surface of the earth comprises 52,000,000 square miles. The most densely populated region (East Flanders) has a population of about 700 to the square mile. If the whole land surface of the earth were on the average as densely *[illegible]* 36,100,000,000. *Assuming* [illegible] *to be* 1,500,000,000, *and* [illegible] *at the rate of* 1½ *per cent.* [illegible] *elapse before the earth's* [illegible] — i.e. 700 *to the square* [illegible]

The population increasing in the ratio of 1015 to 1000 each year, if n = the required number of years, we have the following relation:—

$$1,500,000,000\left(\frac{1015}{1000}\right)^n = 36,100,000,000$$

$$\text{or } 15(1\cdot015)^n = 361$$

Taking logarithms of both sides, we have—

$$n \log.\ (1\cdot015) = \log.\ 361 - \log.\ 15$$

$$\text{or } n(0\cdot0064660) = 2\cdot5611014 - 1\cdot1760913$$

$$\text{or } n = \frac{1385010l}{64660}$$

$$= 214\cdot1 \text{ years very nearly.}$$

Here is another curious question. Supposing the population of England and Wales to increase at the rate of 1½ per cent. per annum, and not to be affected by emigration, how long would it be before the population would increase from 26,000,000 till there would be one person to the square yard, or, roughly, 10,000 times as many persons as there are at present. To determine this, we have, taking n for the number of years,

$$\left(\frac{1015}{1000}\right)^n = 10000$$

$$\text{Or, } n \log.\ (1\cdot015) = 4$$

$$\text{Whence } n = \frac{4000000}{6466} = 619 \text{ years nearly.}$$

So that, apart from emigration, war, plague, pestilence, or famine, the population of England and Wales, six centuries hence, would be one to the square yard.

In a quarter of the above time, say in 154 years, the population of England, apart from such causes, would be ten times as great as at present, or there would be about 4,500, instead of about 450 to the square mile.

OUR ANCESTORS.

IV.—THE FINAL MIXTURE.

By Grant Allen.

After the English settlement in south-eastern Britain, two other ethnical elements of less importance were added at different times to the population of our islands. Both were originally Scandinavian (and therefore Aryan) by descent, but more or less mixed with other strains from elsewhere. The first was that of the heathen Scandinavians from the north. In the eighth and ninth centuries, large bodies of Danes and Northmen began to settle all round the coasts of Britain. In Ireland they occupied all the large river mouths and havens, such as Dublin, Wexford, Waterford, and Cork, where they formed a set of Scandinavian colonies which gradually coalesced with the native Celt-Euskarian population. In Scotland they seized upon Caithness, Sutherland, and Ross, on the mainland, together with Orkney, Shetland, and the whole of the Western Isles, from Lewis to Arran. In Wales they founded a few minor settlements around the south-west coast, near Milford Haven. Finally, in England itself, they occupied all Northumbria (including our Yorkshire), all Lincolnshire, Norfolk and Suffolk, and the greater part of the midlands. Important Danish "hosts" had their centres at Derby, Leicester, Nottingham, Huntingdon, Northampton, and Bedford. Norwegians also settled in the Lake District, till then peopled exclusively by the Strathclyde Welsh. How large an element in the population these Scandinavian invaders formed it would, perhaps, be difficult to estimate; but they must certainly have made a great accession to the number of light and fair-haired Aryan colonists. At the same time, since they came as mere pirates, they did not bring their women with them; and they therefore intermarried with the people of each district where they settled. Nor did they at all exterminate the earlier inhabitants. In Ireland their blood was thus almost lost in the prevalent Celt-Euskarian type; in the Lake district and the Scotch Highlands it has hardly had much more permanent influence; but in Eastern England, where the Scandinavians intermixed with the purest Aryan stock left in Britain, they must have afforded a very considerable reinforcement to the light type, and their fair hair has certainly left its mark upon a large part of the population.

The second Scandinavian admixture came later and more indirectly with the Normans from Normandy under William the Conqueror. These Normans were originally Danes like those who colonised eastern England; but they had intermarried with the native women of Neustria (northern France), where they settled; and the Neustrians were, of course, Celtic Gauls, largely intermixed with Euskarian elements. Moreover, the Conquest brought over, not these half-breed Normans alone, but many pure Celt-Euskarian Gauls or Frenchmen from the neighbouring provinces as well, together with a considerable sprinkling of pure Celt-Euskarian Bretons from Brittany—a very dark stock, like the Black Celts of Ireland and Scotland. Accordingly, so far as numerical preponderance of the dark and light races goes, the Norman Conquest left things in Britain pretty much where they were before.

Thus, then, to sum up the general result of this brief inquiry, we may say that the ethnical composition of modern Britain is somewhat after the following fashion. First, there is a substratum or oldest stage of dark, non-Aryan people, whom we call Euskarians for convenience, and who are the descendants of the very earliest aboriginal inhabitants in recent times, the Neolithic folk. These Euskarians are now nowhere to be found in very great purity, for they have married in with the later Aryan invaders till both are at present well-nigh indistinguishable. But they are still found in a fairly unmixed form among the Black Celts of Ireland and Scotland, where one or two little communities yet remain almost unaltered in the wilds of Connaught or the highlands of the central Scotch hills. They are also more sparsely recognisable in many parts of England itself, especially in the Yorkshire plain, in Lincolnshire, and along the Severn valley. And they are fairly frequent in Wild Wales. All over the country, too, persons or families of this dark early type occur here and there sporadically. Indeed, it is probable that some relics of Euskarian blood survive everywhere in Britain, and that every one of us is more or less remotely descended on one side or the other from neolithic ancestors. Dark children of true Euskarian type are liable to be born from time to time in almost all families. It may be well to add also, in a science which is so personal to most of us as ethnology, that there is absolutely no sufficient proof that any one type or race in Britain is mentally or morally superior to any other. We must not fall into the easy habit of supposing that an earlier race is necessarily either a better or a worse one: the facts do not go to prove either supposition.

Secondly, there is a superstratum or later stage of light Aryan people, who have broken over the islands in three distinct waves—Celtic, English, and Scandinavian, and have everywhere mixed more or less with one another, and with the old Euskarian race. Ireland is, perhaps, mainly peopled by Euskarians, intermixed, in most parts, with Celts (but least so in Connemara and Kerry), while round its east coast there is much Scandinavian blood; and in Ulster there are many Scots, who are really Strathclyde Celt-Euskarians from the western lowlands. So-called English settlers, many of them Welsh or Lancastrian, and others Norman, are scattered throughout the Pale. But, as a whole, Ireland is probably more Euskarian and less Aryan than any other part of Britain. In Scotland, the north and the Isles are Celt-Euskarian, with a large Scandinavian admixture; the Central Highlands are Euskarian with a very small Celtic element intermixed; the eastern Lowlands are mainly English; and the Western lowlands are peopled by Strathclyde Welshmen—that is to say, Celt-Euskarians, probably with a larger dash of Aryan Celtic and English blood than elsewhere. Wales is Euskarian at bottom, slightly Celticized, and with a little English and Norse blood. England itself is mainly English (or Low Dutch) in the south-east; English and Danish, with a little Celt-Euskarian admixture, in the Eastern Counties, the North, and the Midlands; English and Celt-Euskarian in the West country, and the Severn Valley; and Norse and Celt-Euskarian in Lancashire and the Lake District. Cornwall alone remains almost wholly Euskarian in type. All these statements, however, must be accepted merely in the rough, and they apply especially to the agricultural classes and the mass of the people. At the present day, the upper classes have intermarried all over the three kingdoms; the mercantile classes have moved about till Mac's and O's are as common in London as in Perthshire and Mayo; and even the artisans have poured into every great manufacturing town from all parts of the country. Ever since the beginning of the modern industrial movement, there has been a steady southward and eastward return-wave of Celt-Euskarian emigrants towards the more organized regions. Irishmen have poured into London, Liverpool, Glasgow, and South Wales; Highlanders into Glasgow, Edinburgh, and Paisley; Welshmen into London, Birmingham, Liverpool, and Manchester. At the present day, as Professor Huxley remarks, the dark type seems once more to be numerically superseding the light one.

Almost all of us are English in language, but most of us are only very partially English in blood. To put the same matter another way, our oldest element is the dark one, now scattered up and down through the population, and only gathered very sparingly into a little nucleus here or there in Ireland and Scotland. This element was Celticised, but not exterminated, by the Aryan Celts, and became with them the Celt-Euskarian "Ancient Britons" of our history books. Then the Celt-Euskarian was conquered by the Teutonic English, and Anglicised into the English of pre-Norman times. Next, these mixed English were conquered by Danes, whom they shortly absorbed. Dane and English were afterwards conquered by Normans, whom once more they absorbed. Dane and Irish in Ireland were next conquered and Anglicised by Norman-English, and the country further settled at various times by English and Scotch. Lastly, all these elements have coalesced with Welsh, Highland Scotch, and Scandinavians of the Isles, to form one heterogeneous British nation, so inextricably intermixed that its ethnology can now only be reconstructed in the rough. But all through, each earlier element has everywhere persisted in the resulting mixture, and it is probable that the numerical proportion of all the older elements, especially the Euskarian, is far greater than people generally at all imagine.

WINNING WAGERS.

BY THE EDITOR.

IT is rather singular that any writer who points out the folly, or worse, of wagering, is nearly always supposed by a large section of his readers to have wagered a great deal, and to be ready to wager a great deal more. An article I wrote about lotteries for the *Cornhill Magazine*, immediately brought me several invitations from the Continent and from America, to purchase tickets in sundry lotteries. Since I wrote about betting in KNOWLEDGE, I have been asked (who have never wagered a shilling on a race) to give hints for wise wagering whereby fortune may be gained without the usual equivalent of work done. My attention has been directed to the success which bookmakers have achieved, and I am asked to put the young and verdant sportsman on the track which has led to so agreeable a goal. I am further reminded that it is all nonsense for me to assert that betting and gambling must end badly in the long run, for if so much money is lost, much money must be won. "Why may not I," for instance, asks one, "be a successful votary of fortune, and win some of the money which you say is always lost by those who wager freely and often?"

Well, not only is this so (I have known a young City clerk win £1,500 on the Derby, and——regret it for years as the worst misfortune that had ever befallen him), but there are ways by which Fortune can be set on one side altogether, and money always won on a race, by anyone who, knowing how to proportion his wagers, can give time enough to the subject to get all the wagers made which the system requires.

At the outset let me note that it is by no means necessary that the system I am about to describe should be carried out in a precise and formal manner. If you have a tolerably large capital, or if, in case of failure, you have courage (greatly daring) to run away, you may leave a little to chance on every race, and then, if chance favours you, your gains will be proportionately greater.

The system is exceedingly simple; and it will be found that when the method of the great bookmakers is analysed a little, there underlies it the fundamental idea of the system; yet probably not one among them knows anything about it in detail, though he may thoroughly well understand that his method leaves very little to chance.

First, always lay odds against horses, never back them. This is not essential to the system regarded in its scientific aspect; but in practice, as will presently appear, it makes it easier to apply it.

Lay against every horse in a race as early as possible, when the odds are longest. If you lay against a few which are certain not to run, so much the better; that is so much clear gain to start with. Proportion your wagers so that the sum of what you lay against a horse, and what he is backed for, may amount to about the same for each horse. The precise system requires that it should be exactly the same, but you will find that you can often improve upon the system by taking advantage, in special cases, of your own knowledge of a horse's chance and your opponent's inexperience. In every case lay odds a point or two short of the legitimate odds against a horse. Suppose for a moment that the odds are ten to one against him, then it will always be easy to find folk who rather fancy the horse, and think the odds are not eight to one, or even six to one, against him; select such persons for your wagers about that horse. Convey carefully the idea that you also think his chance underrated at eight, or even nine, to one; but, as a favour, make the odds nine to one.

Of course, you need not search about for those who favour any given horse. Every greenhorn has a fancy for some horse, and is willing to take something short of the current odds for the privilege of backing him. You can, therefore, fill in your book *pro rata*, until at least you have made up your amounts for most of the horses engaged, when you will, of course, give more special attention to those whose leaf in your book is as yet incomplete.

Now let us take an illustrative case to see how this system works:—

Suppose there are nine horses in the race, to wit—A, B, C, D, E, F, G, H, and K. Let the odds be—

3 to 1	against	A
5 to 1	,,	B
7 to 1	,,	C
9 to 1	,,	D
9 to 1	,,	E
11 to 1	,,	F
11 to 1	,,	G
19 to 1	,,	H
23 to 1	,,	K

You should be careful to note that when these odds are reduced to chances, becoming respectively

[illegible]

their sum should be unity, or very near it. It does not matter at all—except to backers—if the sum is greater than unity, as it generally is, but if it should be less than unity, the exact application of the system would involve loss to you and gain to the backers, which is not your object.)

Well, then, you may let the wagers on each horse amount to £1,000 (or, for convenience, and to avoid fractions, say £1,200), if the race is important, and bets much in request; but the system, in its beautiful adaptibility, may be applied to shillings quite as well as to pounds.

Apart from the extra points you allow yourself, you ought to lay, in all—

£900 to £300	against	A
£1,000 to £200	,,	B
£1,050 to £150	,,	C
£1,080 to £120	,,	D
£1,080 to £120	,,	E
£1,100 to £100	,,	F
£1,100 to £100	,,	G
£1,140 to £60	,,	H
£1,150 to £50	,,	K

But you reason (with intending backers) that "the race is a moral certainty for A., and that it is giving away money to lay more than (in all) £800 to £300. Again, "B. is a much better horse than people think, so that £900 to £200 is quite long enough odds against him;" as for C., "no wonder backers stand by him at the odds;" for your part you "think him better than B.; and see what Augur says of him!" and so forth, wherefore you cannot find it in conscience to lay more than £950 to £150 (in all) against him. (It gets easier as you reach the non-favourites to get the odds shortened.) So you deal with each, cutting off £100 (let us say); but with the horses low in favour, you can easily cut off more, and the system not only does not forbid this, but encourages it. Say, however, only £100, and then your book is complete.

You can now watch the race (if you like) with thorough enjoyment. The pleasure of the backers of the favourite is a good deal impaired by anxiety, and though backers of non-favourites have less to lose, they have more to gain and less chance of gaining it: so they too are anxious. But *you* can take a real scientific interest in the race. You may, if you please, try to recognise Muybridge's "Attitude of the Galloping Horse," as the fleet steeds rush past your post of observation.

For, let the race go as it may, you clear £100. If A wins, you pay his backers willingly £800, receiving £200 from the backers of B, £150 from those of C, and so on—in all, £900. If B wins, you pay his backers £900, and receive from the backers of A, C, D, &c., £1,000, and so on, whichever horse may win. You need not, as a rule, be afraid about being paid; these are debts of honour, and to be paid therefore before all sordid trade debts—nay, so sacred are these debts, that many of your clients would deem it better to break open a till, or to embezzle a round sum from an employer, than to leave them unpaid. So that you need be under no anxiety.

It occurs to me that some of my betting readers may say, We have not time for this; we do not want to be bookmakers, but to make our occasional wagers on safe lines, as *they* do their systematic ones. In that case, you might back each horse in the race once, so that the total wagered about him by you and the bookmakers may be a fixed sum, *less* whatever you can get off the market odds. For instance, say the sum is to be £120, in the case of each horse in the above list; then you should back A at the odds of £90 to whatever sum less than £30 a bookmaker will take. Suppose (I cannot suppose it myself, but you may) he will give you £90 to £29; and that you can arrange similarly for each horse of the nine, offering to back him for a sum always £1 short of the true amount at the odds. Then you will gain £1, however the race may end. It is not much,—but I wish you may get it.

It is easier to tell you how to lose. This may be effected by adopting *the other part* of the bookmaker's system. *He* always lays the odds a little short: do you always take them so. Back the favourite boldly; but do not fail to take fancies for non-favourites, and back your fancies boldly too. It would be absurd to haggle about odds in the case of a horse which is morally sure to win, or to insist on ten to one when you feel sure the odds are not seven to one against a horse. When you win, assure yourself you are "in the vein," and go on betting; if you lose, assure yourself "the luck must change," and go on betting. By continuing patiently on this course, it will be strange if you do not learn before long—how it is that the bookmakers make so much money.

Let me, in conclusion, quote two short passages, one from a letter by Charles Dickens, the other from a speech by Lord Chief Justice Cockburn. The first seems to relate to the successful book-maker—"I look at the back of his bad head repeated in long lines on the racecourse, and in the betting stand, and outside the betting rooms, and I vow to God I can see nothing in it but cruelty, covetousness, calculation, insensibility, and low wickedness. . . . . If a boy with any good in him, but with a dawning propensity to sporting and betting, were but brought here soon enough, it would cure him." The other passage applies to the bookmaker and his victim alike—"the pernicious and fatal habit" of betting "is so demoralising and degrading, that, like some foul leprosy, it will eat away the conscience until a man comes to think that it is his duty to himself to "do his neighbour as his neighbour would do" him.

FOUND LINKS.

By DR. ANDREW WILSON, F.R.S.E., F.L.S.

PART VII.

A CORRESPONDENT, "J. Fisher, M.D.," in a letter addressed to the Editor of KNOWLEDGE, remarks that the names "Quadrupeds" and "Mammals," used by me as synonymous terms, and, I may add, in strict accordance with natural history usage, are apt to convey what he is pleased to call an "erroneous impression." He remarks that the whale is a "Mammal," but not a "Quadruped"—meaning, of course, that a whale has not four legs. Dr. Fisher may, perhaps, have heard the remark that a good deal in this world depends upon one's point of view; and his point of view happens in this case not to be mine. I carefully explained that I used the terms "Quadruped" and "Mammal" as convertible names, and this for the reason that in zoology —as, indeed, in every-day life—the names are so employed. Has Dr. Fisher ever heard of a frog (one of his examples) being called a "Quadruped," in the same breath with an ox? And does he not know that a whale possesses all the essential characters of quadruped-life which he himself rejoices in the possession of? As to a whale not possessing four limbs, perhaps Dr. Fisher, not being a zoologist, is not aware that in some whales (*e.g.*, the whalebone genus, or *Balæna*) there are actual representatives, not merely of the haunch-bones, but of the thighs as well. Hence, a whale may claim to be a quadruped, even although its hind-limbs are rudimentary. Dr. Fisher's somewhat querulous objections are overruled by the fact, that, as I started by defining "Quadrupeds" and "Mammals" as being one and the same, the scientific meaning (and, as I maintain, the popular meaning also) of these terms is not likely to be mistaken by any reader of ordinary intelligence. It is true, as Dr. Fisher remarks, that in many mammals, the clavicles, or collar-bones, are wanting, just as these bones are absent in some members of an order (*e.g.*, rodents) and present in others: or, as is the case with the guinea-pigs and rabbits, the clavicles may be wanting at birth, and become developed later. What I indicated in my paper (KNOWLEDGE, No. 25) was the typical condition of the quadruped shoulder. If Dr. Fisher maintains that it is more typical for a quadruped to want collar-bones than to possess them, that is his affair. He is not likely to find any comparative anatomist to agree with him.

In the present paper I purpose to give an outline of the means whereby the zoologist has been enabled to supply "links" between the *Vertebrate*, or "backboned" animals, and the *Invertebrate*, or "boneless" animals. Ever since the time of Lamarck, the distinction between the highest, or *Vertebrated* animals (fishes, frogs, reptiles, birds, and mammals or quadrupeds) and the *Invertebrate* groups, has been recognised as one of very clear nature. And modern zoology, dealing merely with the structure of the animals in question, fully recognises the apparent gap which intervenes between the great array of boneless animals—such as worms, insects, shell-fish, &c.—and the "backboned" group. But, as in many other cases, a closer examination of the lowest Vertebrate group seems to demonstrate that the gulf between the highest animals and their Invertebrate neighbours is by no means so wide or impassable as, at first sight, it appears to be. The lowest fish and Vertebrate is the *Amphioxus*, or Lancelet (Fig. 1). This is a little clear-bodied fish—formerly regarded as a kind of slug found inhabiting sand-banks in various quarters of the world. It attains a length of an inch or two, and is pointed at each end. It has a kind of back and tail fin, but possesses none of the "paired" fins, which, existent in most other fishes, represent the limbs of higher animals. The mouth (*o*) is an oval slit, and is fringed with gristly filaments. The lancelet has no brain, heart, bones, skull, ears, or kidneys. It is the only vertebrate which wants a heart, and it is likewise the only vertebrate in which the blood is colourless. Along the back runs the only representative of the skeleton—namely, a soft rod-like body, called the *notochord* (*n*). This structure, by the way, is found in the early development of every vertebrate animal, being replaced in all, save a few fishes, as time passes, by the spine itself. Above this rod lies the nervous cord of the lancelet. The mouth opens into a very wide throat or *pharynx* (*b*), whose walls are perforated with slits that open into the cavity of the body. The walls of this great throat are richly set with the microscopic processes called *cilia*, which, by their incessant waving, circulate the water admitted to the cavity. The throat leads into a simple stomach (*g*), and

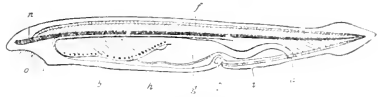


Fig. 1.—The Lancelet (*Amphioxus lanceolatus*), enlarged to twice its natural size. (*o* Mouth; *b* Enlarged pharynx; *g* Stomach; *h* Sac representing the liver; *i* Intestine; *a* Anus; *n* Notochord; *f* Rudiments of fin-rays; *p* Abdominal pore).

this, in turn, leads into the intestine (*i*). A liver (*h*) of the most rudimentary description also exists. The blood, in the absence of a heart, is circulated by the contractions of the bloodvessels, and it is interesting to note that the arrangement seen in all vertebrates, whereby a portion of the venous, or impure blood, is sent to the liver for the manufacture of bile, is represented even in this curious fish. When the lancelet breathes, water is received into the throat, passes over the network of bloodvessels in the walls thereof, and after giving up its oxygen to the blood, is sent by the ciliary action through the slits in the throat into the body cavity. Thence it is expelled through a small opening near the tail, and called the *abdominal pore* (*p*).

The lancelet differs from every other vertebrate animal in the absence of a heart, skull, brain, and kidneys, and in the colourless blood; in the peculiar and rudimentary liver; and in a digestive system, which, like the throat, is also lined with *cilia*. But that it *is* a vertebrate is proved by the presence of the *notochord* (*n*), already remarked as being developed in the early life of every vertebrate animal. The supply of venous blood to the liver is also a vertebrate character; whilst its development, studied from the egg onwards, no less clearly shows its right and title to be regarded as a true vertebrate.

HOME CURES FOR POISONS.

NO one who is wise will fail to send at once for a doctor when poison has been taken, either by inadvertence or otherwise. But there are often remedies or antidotes close at hand, which may be of great use, even to the saving of life, if taken at once. It is not with any idea of encouraging people in such cases to do without the doctor, but to indicate certain home cures for even the most violent poisons, to which recourse can be had before he comes, that we write this series of short papers. There are cases in which the nature of a poison taken inadvertently can be determined at once, when therefore the proper home cure, if such there be, is at once known. There are other cases in which, though it be not known what poison has been taken, the symptoms presently show at least the class of poisons to which the substance belongs; in many such cases the remedy is as certainly indicated as though the precise nature of the poison were known. We shall consider cases of both kinds. But first, as

PREVENTION

is better than cure, we may remind the reader that every substance, whether medicinal or otherwise—every drug or chemical which has poisonous qualities—should be not only properly labelled, but carefully kept out of harm's way, and where there are children, should be kept under lock and key. Better take precautions which seem unnecessary, than run risks which may be avoided. If people would treat a bottle of poison as they would (or rather as they *should*) treat a loaded fire-arm, we should less often hear of accidents about which, after they have taken place, the person who has really caused it can only say, "I never thought it *could* have happened."

ARSENIC.

Arsenic has very little taste in the form in which it is usually known in commerce—viz., as white arsenic or arsenious acid, the white oxide of arsenic. For this reason, it is often used for criminal purposes. But fortunately, if it can be given easily, it can be detected as readily in the body, not only when present in very minute quantities, but after many weeks and even months have elapsed from the time when the body was buried.

The first symptoms noticed after arsenic has been swallowed are sickness and faintness, following generally within half-an-hour after the poison has been taken, but often much sooner. Then follow violent and spasmodic pains in the bowels (increased by pressure), attended by a burning feeling, dryness, heat and constriction of the mouth and throat, increased flow of saliva, and an unquenchable thirst, itching of the face and neck, and palpitation of the heart, with full, hard, and frequent pulse. Vomiting and purging follow. Sometimes the skin is burning hot, at others icy cold and covered with clammy perspiration. The pulse sinks, becoming irregular and feeble. Then, if the poison has been given in sufficient quantity, convulsions come, and before long death ensues. In certain rare instances the symptoms above described are scarcely observable, yet within a few hours the patient sinks; in such cases the presence of arsenic is indicated by a lethargic sleep. In cases of slow poisoning by arsenic (which, however, do not belong properly to our subject, since in their case the physician only can be of service) there is often no recognisable symptom, no inflammation, no fever, constipation, or vomiting, but langour, weariness, and disgust for food, followed by torpidity of the nobler organs, especially the lungs, death coming as certainly, though not so swiftly, as when a single poisonous dose has been taken.

The best home remedy for arsenical poisoning is a mustard emetic, but if sulphate of zinc can be obtained, an emetic formed of from ten to twenty grains in about a quarter of a tumbler of water, is better. For a mustard emetic, take a dessert-spoonful of flour of mustard in a teacupful of warm (not hot) water. Large quantities of milk or warm water, or, better still, linseed-tea or barley-water, should be taken, to promote vomiting. Tickling the back of the throat with a feather, or with the fore-finger (if the patient has been accustomed to that way of producing vomiting) may be resorted to with advantage. The patient should note, in all cases where the stomach is to be cleared of its contents, that, while much is rejected after the throat has been tickled, it is well after a while to wait for the sort of after-throe which comes without such tickling, and seems to carry away a portion of the stomach's contents which is retained so long as the tickling is continued. It is better, however, to encourage vomiting rather by swallowing large quantities of the warm liquids above-named than by irritating the back of the throat.

After the stomach has been cleared of its contents by the use of emetics, &c., lime-water, or chalk dissolved in water, should be swallowed in large quantities. Or, if none is at hand, mix a pound of soap in two quarts of water, and take a teacupful every five or six minutes. Failing either of these, powdered charcoal, if at hand, may be taken with advantage. It will be well for the patient, however, if, before this stage of the treatment, a doctor is at hand to take the case in charge. The after treatment requires all the doctor's care in serious cases; for the above remedies are not, properly speaking, antidotes.

THE AMATEUR ELECTRICIAN.

OUR next task is to fix the inductor, &c. To do this, take a piece of brass plate a quarter of an inch thick, twelve inches long, and shaped according to the dimensions given in Fig. 7, which is a plan of the plate,

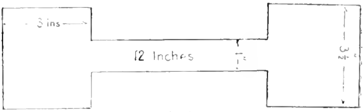


Fig. 7.

minus the parts which are to be fixed to it. It is represented in section by A B in Fig. 8. The lower pole-piece, E F (C, Fig. 6, May 26), is to be screwed on say at C C C, the heads of the screws being well sunk. P P′ are two brass standards, or pillars, about two inches high, to support the steel screws S S′, which form the centres upon which the armature will revolve. These standards should be very strong and firmly fixed*. They should be half an inch thick, and shaped (in a vertical plane at right angles to the axis), according to Fig. 9. This will tend to considerably increase the rigidity and durability of the machine. The centre-screws should, of course, be fixed by means of check-nuts on each side of the standards.

When all is done, the plate, AB, must be firmly screwed at available places (Fig. 8, G) to a stout wooden base, of which, however, more will be said when speaking of the motive power next week. We have advised the use of centres, as opposed to bearings, to obtain the best results with the least expenditure of force, and because, further-

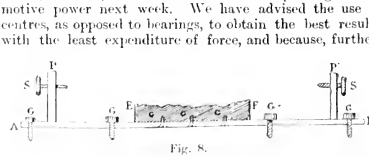


Fig. 8.

more, of the small weight which has to revolve. Where, however, a larger armature is used, or if even with the one described, a high velocity is attempted, bearings should be adopted; otherwise, the wear and tear would be very great, and we should soon spoil our machine.

As regards the commutator (Fig. 5, May 26), the one we are adopting is constructed on a principle which in-

* It would be better, where it is possible, to have the plate and standards cast in one piece, the standards being 9 in. apart.

volves a fractional loss of current, but, at the same time, it removes an element of danger. The ordinary commutator consists of a cylinder of metal cut crossways, and so dividing it into two parts. This, however, involves the short-circuiting of the armature for a brief fraction of time twice during each revolution; heat is in consequence produced. We have preferred, therefore, to recommend a total disconnection of the circuit twice in each revolution. This may seem a great loss, but really it is very trifling. It also tends to keep the armature cool, and, above all, it has been found to answer well in the Brush dynamo-machine. We must, however, take care that our disconnections are made at the right time. Our readers will recollect that in the introductory article we stated that a certain current was induced as one pole of a magnet was inserted in the coil, while the opposite current was induced by withdrawing the magnet. Similarly and conversely the approach of one pole, say the north, produces the same electrical effect as withdrawing the other or south pole. Referring once more to Fig. 6, we must regard the coil of wire as surrounding an ordinary soft iron core, whose ends (A. B., Fig. 1, May 5th) become north or south, according to the relative position of the armature. Let us for a moment

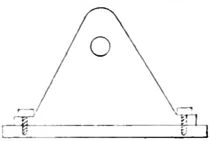


Fig. 9.

associate ourselves with one end or side of the core, and let the armature perform a quarter of a revolution, so that our end is uppermost. As it starts revolving (say to the right) it gradually leaves the north pole of the magnetic system, and at the same time approaches the south pole. Going *from* the north and *to* the south, it is necessarily subjected to the same magnetic influence, accompanied by a similar effect on the coil of wire. At the moment that our end is crossing the vertical line, no current is produced. Of course, as the end ascends on the opposite side, passing from south to north, the opposite magnetic, and therefore electrical, effect is produced. We must, therefore, to get the best effect, so arrange our commutator that the "brushes" or "collectors" rest on the small insulated pieces of metal (C. D., Fig. 5), when the core is in the vertical plane. How shall we do this? Space compels us to defer the answer to this question till next week.

Erratum.—In last week's article, page 619, second column, line 19, read ·7 lb. for 7 lb.

THE ECLIPSE.

We have received the following interesting communication from Mr. A. C. Ranyard, who kindly undertook to forward communications to us respecting the eclipse.

"Sohag, Upper Egypt,
"*May* 17, 1882.

"I am sorry that you were not able to come out to the eclipse. The weather has been all that could be desired, and the Corona magnificent, in a perfectly clear sky, with a bright comet within about half a degree of the moon's limb. The difficulties have been very slight, and the trouble caused by heat and flies much less than we were led to expect. We have lived in great comfort on board a steamer anchored alongside our tents. The Khedive has entertained us at his personal expense, and has had pillars built for our instruments, besides giving us a guard of soldiers and water-carriers, who have perseveringly endeavoured to keep down the dust round our station by means of water carried up from the hill and distributed from goat skins. I had made every preparation to defend my instruments from the wind which frequently springs up during totality, but instead of a wind there was a dead calm.

"The Corona was of the sun-spot maximum type, with no very marked rifts. As seen in the telescope it was full of structure, delicate lines of light curving hither and thither, and arranged in great groups. There was one very marked, long, straight ray, and several structures like great prominences stretching to a height of 15 or 20 minutes. These are shown in my photographs, as well as the comet, which has registered itself, together with about half a degree of its tail, on some of the plates. I did not succeed in obtaining a photograph of the spectrum of Young's reversing stratum, though the bright lines were well seen for about three seconds.—Yours sincerely, A. C. RANYARD."

BUTTERFLIES AND MOTHS.

By W. J. H. Clark.

We have now arrived at one of the busiest months of the year for the entomologist; every bush and tree teems with insect life, and both butterflies and moths in the *imago* or perfect state, and *larvæ* and *pupæ*, are to be found everywhere. The collector has only to take out his net or sugaring-pot, as the case may be, and a profusion of game is sure to meet his eyes.

Among the butterfles that are out now we may notice the handsome, but rather scarce, Swallow Tail (*Papilio Machaon*), seldom to be found but in the fens of Cambridge, the Brimstone (*Gonepteryx Rhamni*), the well-known Large Garden White (*Pieris Brassicæ*), the Small White (*Pieris Rapæ*), the Green-Veined White (*Pieris Napi*), the Orange Tip (*Euchelie Cardamines*), the Pearl-Bordered Fritillary (*Argynnis Euphrosyne*), the Greasy Fritillary (*Melitæa Artemis*), the Glanville Fritillary (*Melitæa Cinxia*), the Speckled Wood (*Satyrus Ægeria*), the Wall Brown (*Satyrus Megæra*), the Green and the Purple Hairstreaks (*Thecla Rubi* and *Thecla Quercus*), the Small Copper (*Polyommatus Phlœas*), Brown Argus (*L*[illegible] *Agestis*), Silver-Studded Blue, and Small Blue (*Lycæna Ægon* and *Lycæna Alsus*).

Great numbers of the moths make their appearance now, and many of the common hawk moths will be out some time during the month. In the course of the ensuing weeks we may probably find the following: The Eyed Hawk (*Smerinthus Ocellatus*), the Poplar Hawk (*Smerinthus Populi*), the Lime Hawk (*Smerinthus Tiliæ*), the rare Spurge Hawk (*Deilephila Euphorbiæ*), the very pretty small Elephant Hawk (*Chærocampa Porcellus*), the Humming-bird Hawk (*Macroglossa Stellatarum*), remarkable for its rapid flight and habit of hovering steadily over a flower whilst thrusting in its exceedingly long proboscis to obtain its food. The Broad and Narrow-bordered Bee Hawks (*Macroglossa Fuciformis* and *Macroglossa Bombyliformis*), two insects which take their names from the striking resemblance they possess to the Wild Bee.

The commonest of our Clearwing Moths, the little Currant Clearwing (*Sesia Tipuliformis*), is now on the wing, and is generally to be found on or near currant bushes.

The Common Swift (*Hepialus Lupulinus*) and Ghost Swift (*Hepialus Humuli*) are both out now. The male Humuli is a most handsome insect, the wings being pure white, with yellow edges on the upper, and of a dusky black on the under side; it is a very abundant species. The pretty little Green Forester (*I*[illegible] *Statices*), the Least Black Arches (*Nola* [illegible]), the Cinnabar (*Euchelia Jacobææ*), Wood Tiger (*Chelonia Plantaginis*), White Ermine (*Arctia Menthastri*), Pale Tussock (*Orgyia* [illegible]), and Lappet (*Lasiocampa Quercifolia*) are all on the wing.

Among the Geometræ Family, the Spotted Yellow (*Venilia Maculata*), Scorched Wing (*Eurymene Dolabraria*), Scalloped Hazel (*Odontoptera Bidentata*), Brimstone (*Rumia Cratægata*), the very [illegible] Currant Moth (*A*[illegible]*ta*), together with [illegible]ers, may be found [illegible]ing of this month.

Several of the C[illegible] are now out, the Puss Moth (*Cerura* [illegible]) and the Pebble Prominent (*Noto*[illegible]*nta Ziczac*) being most common.

A great [illegible] of the No[illegible] are now on the wing. Among them we may ex[illegible] find the following:—The Alder (*Acronycta Alni*), the Bramb[illegible] (*[illegible]* *R*[illegible]), Common Wainscot (*Leucania P*[illegible]), [illegible] Wing (*Dyptera Pinastri*), Doubtful Nutmeg (*M*[illegible]), Cabbage Moth (*Mamestra Brassicæ*), Treble L[illegible] (*[illegible]*), Double Square Spot (*Noctua Triangulum*), &c. These, and several others more or less scarce, are to be [illegible] the beginning of the month, but success depends in a great [illegible] on weather and other extraneous circumstances.

In [illegible] I have given, and shall continue to give, the Latin [illegible] with the English, the former being most important. The [illegible] Latin name shows to what family the insect belongs, the [illegible] specific name is used only for that particular individual. The specific name must be learnt together with the English, as genuine collectors invariably employ the former when [illegible] of a butterfly or moth, the advantage being that many [illegible] have purely local names, and an entomologist from, say, the [illegible] of England, would find the same insect called by a very different English name in the north country, but the Latin appellation is the same all over the world.

A great many caterpillars are to be found this month on the trees and hedges, and next week we will give a short list of them, together with their haunts and food. If the lepidopterist comes across any in the course of his travels he would do well to box them together with a piece of the tree on which they are feeding, and [illegible] them up. A hat-box with a piece of net stretched over [illegible] as a fair elementary breeding-house, but next week we will describe the manner of making a good one. Feed the caterpillar once a day with fresh leaves, but do not handle them, as they are very delicately organised, and a slight squeeze might do [illegible] considerable injury.

MASS AND WEIGHT OF THE BRAIN.

IN his [illegible] treatise, entitled "An Introduction to Human Anatomy," Professor Turner, of the University of Edinburgh, [illegible] on "The Mass and Weight of the Brain":—

The human brain is absolutely bigger and heavier than the [illegible] excepting the elephant and the larger whales. The [illegible] of the elephant is said to weigh from 8 lb. to 10 lb., and [illegible] whale between 5 lb. and 6 lb. The human [illegible] heavier relatively to the bulk and weight of the [illegible] are the brains of the lower animals, except [illegible] birds and mammals. Considerable variations, [illegible] the size and weight of the human brain, not only [illegible] races of mankind, but in individuals of the same [illegible] and in the two sexes. The heaviest brains occur in the white [illegible] The average weight of the adult European male brain is [illegible] 50 oz. (about 3 lb.), that of the adult female 44 oz. to 45 oz.; [illegible] brain of a man is, on the average, fully 10 per cent. [illegible] that of a woman. The greater weight of the brain in [illegible] compared with woman, is not in relation merely to his [illegible] it is a fundamental sexual distinction; for, whilst [illegible] of 10 per cent. in the brain weight, the average [illegible] is, according to Thurnam's calculations, only 8 per [illegible] of men.*

[illegible] that the average weight of the brain in the [illegible] is 11·67 oz.; in the female only 10 oz. The [illegible] which the brain reaches its maximum size has been [illegible] from the third to the eighth year by different [illegible] to increase in weight to 25, or 30, or even [illegible] the brain begins to diminish in weight; in aged [illegible] average weight is about 45 oz.; in females about 41 oz.

[illegible] the adult brain considerably exceeds the average [illegible] of several men distinguished for their intellec[illegible] have been weighed. The brain of Cuvier weighed [illegible] 63 oz.; of Professor Goodsir, 57½ oz.; [illegible] 55 oz.; of Sir J. Y. Simpson, 54 oz.; of Agassiz, [illegible] of Dr. Chalmers, 53 oz. But high brain weights have [illegible] there was no evidence of great intellectual [illegible] weighed four male brains, which ranged from 62·75 oz. to 61 oz.; Boyd, a specimen of 60·75 oz.; and I have in my possession one of a boy, aged 15, which weighed 60 oz. In the brains of the insane, high brain weights have also been observed. Bucknill met with a brain in a male epileptic which weighed 61½ oz.; Thurnam one which weighed 62 oz.; and in the West Riding Asylum, out of 375 males examined, the weight of the brain in 30 cases was 55 oz. or upwards, and the highest weights were 61 oz. in a case of senile dementia, 60½ oz. in a case of dementia, and 60 in a case of melancholia. No case has as yet been recorded of the weight of the brain in a woman of great intellectual attainments; but Boyd met with a woman's brain as high as 55·25 oz., and many instances of upwards of 50 oz. in women where there was no evidence of high mental endowment. Skae, in a female monomaniac, observed a brain which weighed 61½ oz.; and of 300 females examined in the West Riding Asylum, the weight of the brain in 26 cases was 50 oz. or upwards, the highest weights being 56 oz. and 55 oz. in two cases of mania.

The size and weight of the brain do not, therefore, *per se*, give an exact method of estimating the intellectual power of the individual, and a high brain weight and great intellectual capacity are not necessarily correlated with each other.

* [illegible] the brain of women are more massive relatively [illegible] for the weight varies, *cæteris paribus*, as the cube [illegible] that the weight of woman is less than that of man [illegible] 778688 is less than 1,000,000, or by more than 22 per [illegible] Ed.

TOO MUCH BRAIN-WORK.

"ON April 28, Dr. Richardson, F.R.S., delivering a lecture on 'National Necessities as the Bases of Natural Education,' before the Society of Arts, brought forward," writes F.C.S., "the following extract, which happened to be a report of the Chairman of the evening, Mr. Edwin Chadwick, C.B., to the British Association in 1860, to show what an evil effect too much brain-work, without a proportional amount of industrial occupation to support it, has upon young children. I give the extract *verbatim*, as it bears closely on a point recently under discussion:—

"In one large establishment, containing about six hundred children, half girls and half boys, the means of industrial occupation were gained for the girls before any were obtained for the boys. The girls were therefore put upon half-time tuitions; that is to say, their time of book-instruction was reduced from thirty-six hours to eighteen per week, given on the three alternate days of their industrial occupation, the boys remaining at full school time of thirty-six hours per week, the teaching being the same, on the same system, and by the same teachers, the same school attendance in weeks and years in both cases. On the periodical examination of the school, surprise was expressed by the inspectors at finding how much more alert, mentally, the girls were than the boys, and in advance in book attainments. Subsequently, industrial occupation was found for the boys, when their time of book instruction was reduced from thirty-six hours a week to eighteen; and after a while, the boys were proved, upon examination, to have obtained their previous relative position, which was in advance of the girls."

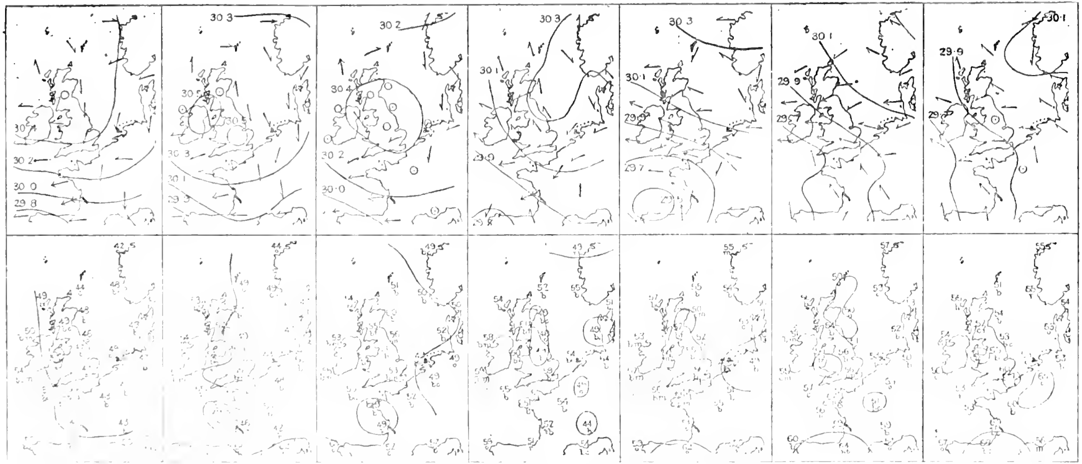
BRAIN TROUBLES.

I HAVE carefully read "Brain Troubles," and have met with many changes which might seem alarming to one who knows not the influence of digestion on the mind. The cases I am now going to give are due to indigestion or some irritation of the stomach on the controlling powers of the brain. After a heavy meal, especially after a heavy breakfast, I find some of my patients cannot write proper English. They say they can express their thoughts, but not in proper style. Other times they cannot express them at all. If they try to do so, they find they have forgotten half of their subject. If they continue to write in spite of this, they run words into each other. Thus, in writing "other rogues," they put down "other ogues," and often drop a word out of the sentence. Sometimes they mis-spell a word, know that it is wrongly spelt, and yet cannot find out the mistake, unless they consult a dictionary. The same in adding up a sum, or multiplying; when they come to prove a sum they find it wrong, yet cannot find out where the mistake is for a time. They may change letters in different words, thus in writing "good boy" they may put down "goob doy." There are other little things which an observer may notice, and which are not signs of brain troubles, but of indigestion, or of some improper material in the blood giving rise to these symptoms. These are not usually seen before a meal, or after a light one.

Again, irritability of temper most often means indigestion, or too full bloodvessels. Whenever I feel vexed at any trifling annoyance, I know I am suffering from too much food. I go for a walk or take some exercise, and so get rid of my spleen! I hope this may be taken in its true light, and not as a criticism on "Brain Troubles."

T. R. ALLINSON, L.R.C.P., &c.

WEATHER CHARTS FOR WEEK ENDING MONDAY, MAY 22.



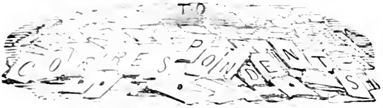
EXPLANATION OF CHARTS.—The two charts for each day show the general condition of the weather over Western Europe at 8 a.m. In the upper chart the height of the barometer is expressed by "isobars," the value of each line being given in figures. The prevalent winds are shown by arrows, which are drawn flying *with the wind*, the force being indicated thus: ⟶ = a heavy gale; ⟶ = a gale; ⟶ = a fresh to strong breeze; ⟶ = a light to moderate breeze; and ⊙ = a calm. In the lower chart the weather is indicated as follows:—b = blue sky; c = detached clouds; o = overcast; m = misty (hazy); f = foggy; q = squally; r = rain; h = hail; s = snow; l = lightning; and t = thunder. The general distribution of temperature is shown by "isotherms," and the readings at certain places are given in figures. Diagonal lines = rough sea, the shading being proportional to the disturbance.

OUR WEATHER DIAGRAM.

WE have finally decided on the plan to be followed with respect to weather diagrams in KNOWLEDGE. We propose to give each week eight such diagrams (the 6 P.M. diagrams) as appear in the *Times* for six days only in each week, repeating always the last diagram of one week as the first diagram for the next week. Thus, in this and future volumes of KNOWLEDGE there will be a continuous weather record, very valuable and convenient for reference.

THE COMET.

WE had intended to republish this week our map of the Comet's path, which appeared in KNOWLEDGE for May 19. But the chance of seeing the Comet at all with the naked eye is now so small that it has not seemed worth while so to use our limited space. The map, as published, gives the place of the Comet up to the very latest time when it could be seen in the night. Later, it will only be above the horizon in the day-time. It is unlikely to be a conspicuous object when seen in the southern hemisphere. It will be interesting to see whether the comet, which is now near the sun in the skies—we may call it the eclipse comet—will appear in the skies of either the northern or the southern hemisphere.



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of KNOWLEDGE; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

∴ All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.

All Letters or Queries to the Editor which require attention in the current issue of KNOWLEDGE, *should reach the Publishing Office not later than the Saturday preceding the day of publication.*

(I.) Letters to have a chance of appearing must be concise; they must be drawn up in the form adopted for letters here, so that they may go untouched to the printers; private communications, therefore, as well as queries, or replies to queries (intended to appear as such) should be written on separate leaves.

(II.) Letters which (either because too long, or unsuitable, or dealing with matters which others have discussed, or for any other reason) cannot find place here, will either be briefly referred to in answers to correspondents, or acknowledged in a column reserved for the purpose.

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"There is no harm in making a mistake, but great harm in making none. Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

"God's Orthodoxy is Truth."—*Charles Kingsley.*

Our Correspondence Columns.

MACAULAY ON SMALL-POX.

[414]—As an addendum to what Macaulay says (as quoted in your edition of Saturday last), in respect of the prevalence of small-pox 200 years ago, permit me to call your attention to his opinion as to the value of vaccination as a preventive.

"In spite of these eloquent eulogies (on the introduction of Heming's lamps for the purpose of lighting the streets of London) the cause of darkness was not left undefended. There were fools in that age who opposed the introduction of what was called the new light, as strenuously as fools in our age have opposed the introduction of vaccination and railroads; as strenuously as the fools of an age anterior to the dawn of history doubtless opposed the introduction of the plough and of alphabetical writing."

As showing the intensity and prevalence of the disease at that time, I may parenthetically mention that three of the leading characters of that reign suffered most severely, viz., William, Mary, and Bentinck; Mary dying of it.

Direct and positive evidence of the terrible nature of a visitation of small-pox on a population entirely (or nearly so) unprotected by vaccination, is afforded by the accounts which reach us of the outbreak now raging in the Island of Hayti (reported in the *British Medical Journal* a week or two since), when the number of deaths during this single outbreak, and amongst a sparse population, is estimated at no less than 20,000 victims. OBSERVER.

A MISPLACED SPA.

[415]—Most people must have noticed that new brick buildings are often defaced by a white incrustation which disappears in damp weather and reappears in sunshine, and often obstinately continues to do so, on parts of buildings sheltered from rain, even after the structure is no longer new. An example may be seen in a handsome Wesleyan church in the Anerley-road, near Anerley station, and in new houses and walls about Red Hill, and at Thornton Heath, near Beulah Spa; and in what other localities is a question deserving investigation.

On asking the cause of this from workmen, foremen, builders, and even from a local architect, I have received the various answers that it was lime, saltpetre, and that sea salt had been used in the mortar; only yesterday, I was told confidently, "that, sir, is the brick drying out." It is curious that so remediable an unsightliness has not been better examined by these experts, for it is Glauber's salt, and therefore easily removable.

At the foot of the Surrey Highlands, where the Dorking and Reigate sand begins, east of Reigate, to diverge from the chalk, and to give place, between it and the chalk, to a basin of blue clay, and in the cellar of a house which I inhabited at Gatton Point, I found exuding from a wall built against the clay, crops of long feathery crystals, which I thought at first were some kind of vegetable mould. These constantly reappearing, I gathered in a gallipot, lixiviated, strained, and found to be pure sulphate of soda. I have no doubt the deposit continues still.

People there sometimes complained that the well-water had an aperient effect. I gathered the salt at the brickfields, and on the then newly-built Gatton-park wall, and it appeared concentrated in the water in which they puddled the clay. There are fuller's earth quarries at Nutfield, in the locality; but I believe the soda in fuller's earth is not in the form of sulphate. I thought at first the sulphur might come from the breeze with which the bricks are burnt; but the deposit in the cellar came from unburnt clay. There must be hundreds of tons of it in these clay beds; and, in certain bricks, it appeared to me to be in sufficient quantity to pay for soaking the bricks. Whether the valley surrounding the high Weald of Sussex was anciently invaded by high tides, and this is altered sea salt—how altered?—or whether it is a fresh-water deposit, may be questions having some interest; but it would evidently be of immediate advantage to scrub this misplaced aperient from handsome buildings. CURIOSITY.

TIMBRE OF TRUMPET, ETC.

[416]—Can any of your readers tell me how the difference of tone in the trumpet and cornet is to be accounted for? I have looked into all the books on physics and music I know of, but this link between the science and art is wanting. Is the finer tone of the trumpet due to the fact that it has a greater length of tube for the same pitch (as it seems to me to have)? If so, I suppose that trumpet and cornet have much the same relation to each other as grand and cottage piano have. Or, does the tone of the instrument depend on the number and form of the bends in the tube? If so, how is the greater difficulty in playing the trumpet to be accounted for?

In the horn, trombone, bombardon, &c., I notice that the tube gradually increases in width from a point near the mouthpiece to the bell (the ratio of increase varying in the different instruments). With this exception, these instruments seem to be exactly similar in form to the trumpet and some forms of cornet, and this makes me think that the number and form of the bends in the tube cannot appreciably affect the tone. Information and correction on any of these points will greatly oblige, P. E. SWINSTEAD.

POPULATION OF THE EARTH.

[417]—Adverting to your article, "Population of the Earth," p. 584, KNOWLEDGE, may I be permitted to remark that it suggests a lesson which all moralists and philanthropists may well take to heart.

You show that had mankind during the past 4,000 years been as free from the decimating influences of disease, war, &c., as, during the past year England has been, the human race then had been in number sufficient to throng the surface of a globe having a diameter 5,000 times that of the earth's. Whereas, it is highly probable that the actual number of persons who have existed during this period could stand on a plain in extent less than 70 miles long and 60 miles wide. That is, if we may reckon an average population of 750,000,000, and 160 generations of 25 years each. Thus—

750,000,000 average population.
160 generations.

$$\frac{120{,}000{,}000{,}000 \text{ total population.}}{30{,}000{,}000 \text{ to a square mile.}} = 4{,}000 \text{ square miles.}$$

But, even taking the present population of 1,500,000,000 as the average, and calculating for 6,000 years, then it would appear that the whole human family—all who have had an existence [in that time] could stand on a plain 150 miles long and 80 miles wide, or little more than the surface of the Principality of Wales. Thus—

1,500,000,000 average population.
240 generations.

$$\frac{360{,}000{,}000{,}000}{30{,}000{,}000} = 12{,}000 \text{ square miles.}$$

or 150 miles × 80 miles.—A. WOOD.

Answers to Correspondents.

**** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded; nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

J. HARTINGTON. You consider that with our present circulation (which you under-rate, by-the-way, for our first volume has reached many more than the 20,000 you mention) we ought not to think of increasing our price. We do *not* think of so doing. But we think it probable you form inadequate ideas of the relation between the expenses and the returns of such a journal as this. You speak of 20,000 twopences; at trade rates 20,000 *pence* would be very much nearer the mark. These are sordid considerations, are they not? why, certainly; and the thought of daily meals is an animal thought, is it not? Try raising your soul entirely above this animal thought for a week or two, and then give us your ideas about KNOWLEDGE.—UNITAS. Yes; the vibrating periods of the different rays of the spectrum have been accurately determined. The information will be found in any treatise on the spectrum. There are 458 billions of undulations per second in the extreme red, 727 billions in the extreme violet.—NEMO. Those stories of marvellous eyesight have often been found to be untrue. I should imagine Brussels paper of 1875 or 1876, from which you send an extract, appeared in the great gooseberry season. Let telescopists judge:—It tells us that Jean Trubell could see the four moons of Jupiter and the two rings of Saturn. Not a true bill, you may be sure.—J. GOTTFRIED. The Magic Square, combined with the Knight's Tour, is good in its way; but we cannot find room for it. We want a plan for getting a quart into a pint pot; it always beats us.—SIMPLEX. Many thanks—W. W. FAWCUS. Your theory of lightning hardly consistent with the production of the electric spark in perfectly dry air.—G. B. FRASER. I ought long since to have thanked you for the very interesting book by Mr. Lindsay, which you have kindly lent me. It is full of matter of great value to me.—J. E. J. Thanks for note on change of colour of hair in case of one of the survivors of Isandula.—THOUGHTFUL. Will find space if possible.—CORBEAU. Yes; La Fontaine's familiar fable makes the crow act rather foolishly. In Chaucer's Nun's Priest's Tale, it is Chanticleer who is beguiled by Reynard's flattery, and then Reynard is beguiled in turn. But this is a lesson in sense, not in science,—to show us

> What it is for to be reckeless,
> And negligent, and trust on flattery;

and also that he is

> Indiscreet of governance,
> That jangleth when that he should hold his peace.

Æsop's fable of the "Crow and the Pitcher" might be used the other way, if fables counted.—EUCLID. Thanks for account of fire-ball on May 4 at 9.30 p.m. If the same object was seen by others far away from your station (Bolton), and a good account of the apparent path can be given, the observation may be useful in determining the real path of the meteor in our air; otherwise not. JAS. SMITH. There is no rigid arch, and practically no arch at all, the curvature of the earth's superficial strata being so slight. If the Himalayas were twenty miles high there would be some reason for wondering at their stability. To all intents and purposes the pressures existing within the earth are such as would result if the whole earth were fluid. The cohesion even of a granite stratum, of whatever thickness, small or great, does not prevent the whole stratum from pressing downwards, and communicating downwards the pressure it receives from above, with practically unchanged effect. Sir W. Thomson's argument is, in fact, just this, that there is no solid shell with fluid nucleus relieved by rigidity of such shell from external pressure, but that the earth's whole globe is continuous, with no freed fluid mass within. If you consider that, were the whole earth water, an ice mountain of any height (consistent with the rigidity of ice) could rear itself above that fluid surface, sustained by fluid pressures alone, you will see how little force there is in the argument you derive from the Himalayas. E. S. INSULL, points out that in the Pharmacy Act, 1868, preparations of morphine, as well as opium and all preparations of opium are specifically mentioned as poisons.—F. T. JONES. We would print your thoughtfully-written letter in full, were there space; but there is not. The answer to your difficulty is simply, that within the period covered by astronomical observation the day has altered so slightly that, until quite recently, it was regarded as constant; the slight change would not affect [illegible] length of the year. You refer, I [illegible], to what I have stated as the result of the investigations of others as if it were my own special statement. J. HARGREAVE. You ask in what sense the term "moment of gravitation" as used by Dr. Siemens in his letter is incorrect. In this: the word "moment," in all mechanical questions, means motion, not the force causing motion; Dr. Siemens applies it to mean the moving force on a mass of gaseous matter at the solar poles; a moving force is measured by the "momentum" or "moment," or quantity of motion it can generate, but to the mathematician, calling a moving force *moment* is as incorrect as it would be to call a printing-machine a printed volume.—SOME MORE FELLOWS. Why, certainly; so I supposed.—A. JONES.—To deal with your problem, we must know the coefficient of elasticity between billiard-ball and cushion, and coefficient of friction between ball and baize.—ELECTRON. Others think a great deal too much space given to that subject.—E. L. H. Letter duly received, and shall appear. E. M. O. Nay, but the transit will soon be over. Comets come and go all the time.—H. A. B. Sheet lightning is quite distinct from forked; the electricity is of small tension, and there is no thunder. A flash of lightning being a discharge between cloud and earth, or between cloud and cloud, can never be said to be dispersed in air.—F. T. PIGGOTT. Paper on Foresights in type; thanks. ALEX. SMITH. Surely a note to Mr. D. Bogue, publisher of the now defunct *Popular Science Review*, would bring you what you require.—PECCAVI. *Peccavisti*—in this respect, that the ink you have used has become so smeared that I cannot read all your questions. (1) A ray of light appears to travel onwards without measurable diminution within measurable distances. (2) Do not know experimentally whether ascending air bubble in water casts a shadow, though rarer than the water. Theoretically it should, as a light ray will not pass out of water into air at small angles. (3) Stanley's book on Fluids, reviewed in KNOWLEDGE a few weeks back, will help you as to the other questions, so far as I can guess their purport from the few unobliterated words.—F. W. CORY, F.M.S. I try a new arrangement for weather this week. You say, in passing, that many readers probably "usurp an Englishman's prerogative of grumbling—very often at nothing." I would not mind *that* so much; what troubles me is, that some will grumble at everything. This does not apply to your letter, though you *do* describe the weather reports as "simply abominable." I think you are about right; hence the change. Possibly, with the first number of Volume II., which opens in June, an improvement on this may be tried. Of course, there are many difficulties. R. M. HANDS. The passage in the Pyramid points too far from the Pole to aim at our present Pole Star, which is much nearer the Pole than Alpha Draconis ever was or ever could be.—BOYD MOSS. Are you not thinking of a screw nearly "home," and overlooking the fact that Sir E. Beckett's device is to help chiefly when the screw is "far from home?" He is no theoriser about such matters, but eminently practical. I am sorry I overlooked your astronomical query. Will you kindly repeat it?—A. J. I. Thanks for story of omnibus horse stopping when lady hailed unobservant conductor. It certainly suggests intelligence and observation.—S. S. An intra-mercurial planet, if such exists, must be very much smaller than Mercury, and being farther off when in transit, would seem smaller still. It can readily be shown that the largest intra-mercurial planet which can exist consistently with the observed constant absence of any naked-eye object during total eclipses, must be utterly invisible when in transit (to unaided eyesight).—E. G. I do not know of any complete tables of logarithms giving results to ten or twelve digits.—THOMAS LYONS. Pray do not think us uncourteous in omitting your query; it is quite true that the term "knowledge" is very wide, but the journal KNOWLEDGE is not very large, and something has to give way when an attempt is made to make the less enclose the greater. "Five of Clubs" and "Mephisto" will be proud of your favourable opinion of their columns.—SHEFFIELD. Thanks for your kind letter. We feel that, as you say, it would be unfair to make a change in the direction of "enlargement with increased price." SELENIAT. The keepers of second-hand book-stalls would be able to tell you where to get old copies of the examination questions for matriculation at London. I do not know. FUSIYAMA. Alas, our readers "will not away with" more magic squares! How can your lotus-leaf problem be dealt with, without some data as to the lotus leaves? J. LAUDER HAYNES. I do not know in what paper you could get weekly information of the rainfall in Sarthe and Loir. J. F. Description of microphone in hand, as promised; but want of space troubles us at present. "Electron" and others want more electricity and scarcely any astronomy; "J. Hemming" and others [illegible] "Blowpipe Chemistry," and want more natural history; and so on all down the scientific subjects.—J. GROSVENOR DAWE. An index to Vol. I. will be issued immediately.

[About two pages of "Answers" have been unavoidably held over.]

Our Mathematical Column.

INVERSE PROBABILITIES.

THE [illegible] obtained show that in a set of drawings [illegible] some results are more probable than others. [illegible] if we took a set of twelve balls out of a bag [illegible] 40,000 balls of four colours equally divided, we should be more likely to draw three of each kind contained in the bag, than [illegible] specified kind, two of another kind, also specified, [illegible] specified kind, and five of the remaining class, but less likely to draw three of each kind, than one of one kind, two of another, four of another, and five of the remaining class, *without* specification.* And so in a variety of cases we can compare the chances of different results when the antecedent conditions are known. But it is clear that this power of partial forecasting implies a power of inferring antecedent conditions from observed results. We may now enter upon this interesting department of our subject. In so doing, we are preparing to discuss that application of the laws of probability which is chiefly to be considered in discussing the results of observation and experiment. But it is well to premise that the two departments of the science of probability are most intimately associated together, insomuch that one cannot well be studied without the other. This will appear, indeed, at the very beginning of our discussion of indirect probabilities.

We know from the laws of direct probability that if there are in a bag ten balls, three white and seven black, the chance of drawing a white ball is $\frac{3}{10}$, and the chance of drawing a black ball is $\frac{7}{10}$. Now, if we suppose the ten balls all alike in colour (say all white), but three of them bearing a mark not discernible by the drawer (who, however, is supposed to be aware that three *are* marked), it is clear that when he has drawn a ball, although he cannot tell whether it is one of the three marked balls, he knows that the probability of his having drawn a marked ball is $\frac{3}{10}$. Now suppose these ten balls put into a bag with twelve others, these others being black; and that a white ball is drawn. In this case, as in the former, the drawer knows that the probability of the white ball being one of the marked three is $\frac{3}{10}$. The addition of the twelve black balls diminishes the chance of drawing one of the marked three, but when the fact is known that a white ball has been drawn, the chance that this ball is one of the marked three is [illegible] not a whit affected by the addition of the black balls.

Now, suppose that instead of twenty-two balls in one bag there are two bags, each containing eleven balls—in one bag the three marked white balls and eight black ones; in the other seven white and four black balls. If a bag is to be selected at random and a ball to be drawn at random from the bag thus selected, it will be [illegible] that the chance of drawing one of the marked balls is precisely the same in this case as in the former; for the chance of [illegible] the right bag of eleven balls is precisely the same as the chance that one of the eleven balls now in the bag would be drawn from the original twenty-two, that is, is *one-half*. Otherwise, the chance of drawing a marked ball *would* be affected by separating the twenty-two balls into two sets. For instance, if the three marked balls were put into one bag, and the remaining nineteen into another, it [illegible] that the chance of drawing one of the marked balls would [illegible] one-half instead of $\frac{3}{22}$. But the two bags containing the same number of balls,† the chance of drawing one of the marked balls is unchanged.

But we have seen that when a white ball has been drawn from the set of 22 (all in one bag), the probability that it is one of the marked balls is $\frac{3}{10}$. Hence, when a white ball has been drawn from one of the two bags of eleven balls the chances that this ball is one of the marked balls—in other words, the chance that it has come from the bag into which the marked balls were all placed—is still $\frac{3}{10}$.

Now the marking was only a device for distinguishing certain of the white balls from the others; and in the case where the balls are put into separate bags the three marked balls are in effect distinguished by being put in a different bag. So that we need no longer imagine any marking; and may thus present the conclusion we have arrived at:—If there are two bags, one containing eight black and three white balls, the other containing four black and seven white balls, then if a bag is selected at random and a ball taken at random from this bag is white, the probability that the bag containing three white balls was selected is $\frac{3}{10}$.

And by following the method whereby this special result was obtained, it is easily seen that the following general law can be deduced:—If there are in each of two bags p balls in all, q of the balls in one bag being white, and r of those in the other; then if a bag is selected at random and a ball drawn at random from this bag is white, the probability that the bag containing q white balls was selected is $\frac{q}{r+q}$. Of course, the probability that the other bag was selected is $\frac{r}{r+q}$. It will be observed that p does not appear in either result.

Now take the case where the bags do not contain the same number of balls. Suppose one bag contains eight balls, three of which are white and five black, and the other twelve balls, seven of which are white and five black; and supposing a white ball drawn, let us inquire what is the probability that it came from the former bag?

Here we can obviously reduce the problem to the former case by changing the number of balls in the two bags without modifying the proportion of black and white balls. Thus, taking 24, the least common multiple of 8 and 12, we see that the first bag may be replaced by one containing 24 balls, of which 9 are white; while the second bag can be replaced by one containing 24 balls, of which 14 are white. The chance of drawing a white ball from one or other bag is in no way modified by these changes, and consequently the inferences to be deduced when a white ball has been drawn are not modified. But the numbers being now equal, we learn from what was shown in the former case, that if a white ball is drawn the probability is $\frac{9}{9+14}$ or $\frac{9}{23}$ that it was taken from the first bag.

---

* As examples remove much of the seeming mystery of general laws, I will compare these three chances together. The chance of the particular result is the same appreciably as though a ball were drawn at random and returned, the operation being repeated twelve times, and this chance, again, is exactly the same as though the bag contained only 1 red, 1 white, 1 black, and 1 green ball. So that p, q, &c., of our formula are each equal to unity, the total number of trials is 12, and the first probability we require relates to the drawing of each ball three times. The value of this probability is, therefore—

$$\frac{\underline{|12}}{\underline{|3}\;\underline{|3}\;\underline{|3}\;\underline{|3}} \cdot \frac{1^3.1^3.1^3.1^3}{4^{12}} \qquad \text{(i)}$$

([illegible] 1, 1^3, &c., in full, to show the connection between the [illegible] and our formula.) Now, the second probability we require relates to the drawing of a definite number of each kind, specifying what kind is to be drawn once, twice, &c. If the chance were required that 1 red, 2 white, 4 black, and 5 green balls would be drawn, the expression for the probability would be—

$$\frac{\underline{|12}}{\underline{|1}\;\underline{|2}\;\underline{|4}\;\underline{|5}} \cdot \frac{1^1.1^2.1^4.1^5}{4^{12}} \qquad \text{(ii)}$$

And we should get the same probability, whatever the specifications might be. Further, since there are $\underline{|4}$, that is 1.2.3.4 different specifications possible, the third probability which relates to the drawing of 1, 2, 4, and 5 of different kinds, without specifying which kind is to appear once, twice, four times, and five times, is equal to

$$\underline{|4} \cdot \frac{\underline{|12}}{\underline{|1}\;\underline{|2}\;\underline{|4}\;\underline{|5}} \cdot \frac{1^1.1^2.1^4.1^5}{4^{12}} \qquad \text{(iii.)} .$$

Now, by striking out common factors, it is readily seen that the expressions (i), (ii), and (iii) are to each other as $\frac{1}{3\,.\,\underline{|3}\,.\,\underline{|3}}$, $\frac{1}{1.1.5}$ and $\frac{1}{4.5}$; or, as $\frac{1}{108}$ to $\frac{1}{480}$ to $\frac{1}{20}$; so that (iii) is the greatest, and (ii) the least, as was to be shown.

† The reader should most carefully note the point of the reasoning here. If we put an equal number of balls into each bag, we have not modified the probability that the ball actually drawn will belong to one set or to the other equal set; the chances were equal before the separation, and they remain equal after the separation. But if we put into one bag a smaller number of balls than we put into the other, we *have* modified the chance that the ball actually drawn will belong to the larger or to the smaller set; the chances were not equal before the separation, but they *are* equal after it.

Now let us apply this method to a more general case. Suppose one bag contains p balls, of which q are white, and that another bag contains p' balls, of which q' are white; a white ball is drawn—what is the chance that it came from the former bag?

Here we take $p\,p'$, the common multiple of p and p, and replace the first bag by one containing pp' balls, of which $p'q$ are white; the second by a pp' balls of which pq' are white. The numbers are now equal, and, therefore, our former rule gives $\frac{p'q}{p'q+p'q}$, as the chance that the drawn white ball came from the first bag; and $\frac{pq'}{p'q+pq'}$ as the chance that this ball came from the second bag.

If we divide the numerator and denominator of these expressions by pp' we obtain expressions for these chances which are readily interpretable into a law for all such cases. The former expression becomes

$$\frac{\frac{q}{p}}{\frac{q}{p}+\frac{q'}{p}}, \text{ the latter becomes } \frac{\frac{q'}{p'}}{\frac{q}{p}+\frac{q'}{p'}}$$

and since $\frac{q}{p}$ is the probability of drawing a white ball from the first bag if this bag is selected, while $\frac{q'}{p'}$ is the probability of drawing a white ball from the second bag if selected, we have this general law:—

If the chance of drawing a white ball from first bag is C_1 and the chance of drawing a white ball from the second is C_2, then if a white ball is drawn, the chance that it came from the first bag is $\frac{C_1}{C_1+C_2}$, the chance that it came from the second is $\frac{C_2}{C_1+C_2}$. But the bags of balls are merely illustrative, and we can obviously proceed at once to this general law:—

If there are two hypotheses equally likely, and one of which *must* be true, and on the first hypothesis the chance of a certain event is C_1, while on the second hypothesis the chance of the event is C_2, then, if the event happen, the probability that the first hypothesis is the true one is $\frac{C_1}{C_1+C_2}$, and the probability that the second hypothesis is the true one is $\frac{C_2}{C_1+C_2}$.

The importance of this formula will be more readily understood when it is applied to illustrative cases, to be considered in our next number.

PROBLEMS.

Problem 43.—A tapering beam is 30 ft. long. At a distance of 10 ft. from the thick end it is in equilibrium. The fulcrum is shifted 2 ft. nearer the small end, and the beam is then in equilibrium when a weight of 60 lb. has been suspended to the thin end. Find the weight of the beam.—W. D. B.

Problem 44.—There are two drums; the diameter of the larger is, say, 3 ft.; that of the smaller is, say, 2 ft.; the distance from centres is, say, 10 ft.; required the exact length of belting necessary for them.—W. D. B.

---

[40].—The equation belongs to a well-known class. It may be depressed by putting p for $\frac{d\theta}{dt}$, when it becomes

$$\frac{dp}{dt}+ap^2=-b\theta,$$

$$\text{or, since } \frac{dp}{dt}=\frac{d\theta}{dt}\cdot\frac{dp}{d\theta}=p\frac{dp}{d\theta}=\frac{1}{2}\frac{d(p^2)}{d\theta},$$

substituting and multiplying by 2 we get

$\frac{d(p^2)}{d\theta}+2ap^2=-2b\theta$, a linear equation of the first order and first degree.

$$\text{whence} \quad p^2=\frac{1}{e^{2a\theta}}\left\{C-\frac{b}{a}e^{2a\theta}\left(\theta-\frac{1}{2a}\right)\right\}$$

$$\text{Therefore} \quad \frac{1}{p}=\frac{dt}{d\theta}=\pm\frac{e^{a\theta}}{\sqrt{C-\frac{b}{a}e^{2a\theta}\left(\theta-\frac{1}{2a}\right)}}$$

an expression which cannot be integrated in a finite series of terms.—J. R. C.

Our Whist Column.

By "Five of Clubs."

A GAME FOR STUDY.

The following hands are given by Clay to illustrate a case—or, rather, a class of cases—where it is necessary to disregard rule:—

THE HANDS.

A.
Spades—Q, Kn, 10, 4, 3, 2.
Hearts—5, 3.
Clubs—Q, 9, 8, 3.
Diamonds—9.

B.
Spades—A, K, 6.
Hearts—K, Kn, 2, 4.
Clubs—5, 2.
Diamonds—K, Kn, 3, 2.

Y.
Spades—8, 7.
Hearts—9, 7, 6.
Clubs—A, K, Kn, 10.
Diamonds—10, 7, 6, 5.

Z.
Spades—9, 5.
Hearts—A, Q, 10, 8.
Clubs—7, 6, 4.
Diamonds—A, Q, 8, 4.

B; Y; Z (Dealer); A.
Trump Card, Five of Spades.

Score:—
A, B, = 1.
Y, Z, = 4.

Singular Hand and Singular Ill-Fortune; Yarboroughs.—The following is said to be a remarkable hand of cards dealt to the Duke of Cumberland, as he was playing at Whist at the rooms at Bath, by which he lost a wager of £20,000, not winning one trick. The Duke's hand consisted of King, Knave, nine and seven of trumps (clubs); Ace and King of diamonds; Ace, King, Queen, and Knave of hearts; and Ace, King, and Queen of spades. The Duke leads a small trump. Right hand of the Duke five small trumps, all the other cards hearts and spades. Left hand of the Duke Ace, Queen, ten and eight of trumps; Queen, Knave, ten, nine, eight, seven, six, five, and four of diamonds. This hand, after winning the first trick, leads a diamond. The Duke's partner's hand all insignificant cards." The above is extracted from the *Kaleidoscope* of Feb. 4, 1823. It may interest the readers of your "Whist Column." Was the Duke's lead judicious? In January last my partner had a Yarborough hand dealt, and many years ago I was at a party where one was dealt. I imagine few people came across *two* such.—R. G.

[In "Cœlebs on Whist," there is a somewhat similar case, only instead of failing to make a trick, the holder of the strong hand loses five by tricks. Cœlebs says, a lead of trumps from such a hand is wrong. But ninety-nine players out of a hundred would lead trumps; and in my opinion the hundredth would lead wrongly. We must not judge by the event in such cases. The whist-player can only play according to probabilities; and the chances are in favour of the trump-lead turning out well. It is far more likely, for instance, that, if a Heart is led (the Hearts suit being already established, be it noticed), the adversary will ruff it, and perhaps establish a cross ruff, than that the cards would be so singularly distributed in the other hands, as they were in this case. I suppose, for example, that the cards had lain thus.—The Duke's hand, as above (call it *A*'s hand); *B*'s, small cards, no trumps; *Y*'s hand, the four trumps named above, no spades, four hearts and diamonds; *Z*'s hand, five remaining trumps, no hearts, three spades and diamonds. Then, if *A* leads from his long suit, he loses two by tricks, which, with such a hand, and a plain suit lead, is singular ill-fortune.

Yarboroughs are more common than our correspondent supposes. Within the last eight months we have come across three. The editor of the *Westminster Papers* mentions two as occurring to himself at the same sitting.—Five of Clubs.

Our Chess Column.

SOLUTIONS.

Problem No. 26, p. 461.

1. Q to Ktsq	Q to Q6 or		1.	P takes KtP
2. R to QR2	K to Kt3 (*a*)		2. Kt to Kt7(ch)	K to R5
3. R to R6	Any move		3. R to R2 (mate)	
4. Kt to Kt7 (mate)				

(*a*) If 2. Q takes Q. 3. Kt to Kt7(ch). 3. K to Kt3. 4. R to R6(mate).

Problem No. 39, p. 580.

1. Kt to Kt6(ch)	BP takes Kt or		1.	RP takes Kt
2. Q to B8(ch)	B to Ktsq		2. Q to R4(ch)	K to Ktsq
3. Q takes P(ch)	K takes Q		3. Kt to Q7(mate)	
4. B to B6(mate)				

End-game by Leonard P. Rees (p. 597).

No. 40.

1. [illegible] K [illegible]
2. [illegible] K [illegible]
3. [illegible] B6(ch) K [illegible]
4. [illegible] Kt8 mate

No. 41.

1. R to Q4(ch) K to R4
2. R to R4(ch) K takes R
3. Kt to B5(ch) and wins

if 2. K to Kt3

3. R to Kt4(ch) wins

PROBLEM No. [illegible], by [illegible].

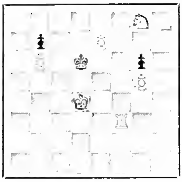
BLACK.

WHITE.

White to play and mate in three moves.

PROBLEM No. 43, by J. L[illegible]nce.

BLACK.



WHITE.

White to play and mate in two moves.

VIENNA INTERNATIONAL TOURNAMENT.

On Saturday night, the 27th ult., the 15th round was completed. The score stood as follows:—

Mackenzie	10½	Noa	8½	Fleissig	6
Steinitz	10	Schwarz	8½	Tschigorin	6
Winawer	10	Wittek	8	Paulsen	5½
Blackburne ...	9½	Hruby	7½	Weiss	5½
Mason	9	Zukertort ...	7½	Meitner	5
Englisch	8½	Bird	6	Ware	3½

Of special importance was the encounter between Blackburne and Zukertort, which took place on May 21. Blackburne won. On the same day Mackenzie lost his first game (out of eleven) to Noa, an experienced Hungarian player. In the course of the week, Blackburne, however, lost two games—one against Paulsen, the other against Noa, also an Hungarian.

Steinitz showed great improvement, and out of the six games played in the week he won five and drew one (Mason). We are sorry to hear that Zukertort is indisposed, and owing to his bad state of health he is doing badly. Out of the six games played he has lost four and won two. Mason won two, lost one, and drew three (Blackburne, Steinitz, Fleissig).

By Telegram. Vienna, Tuesday night.

Score of English team:—Mackenzie, 11½ (beat Meitner); Steinitz, 11 (beat Schwarz); Blackburne, probably 10 (at the time of wiring the score, his game with Englisch assumed a drawn aspect); Mason, 10 (beat Weiss); Zukertort, 8½ (beat Bird).

REVIEW.

A [illegible] to the Game of Chess. By H. F. L. MEYER.

"Chess is such a noble game,
How it does the soul inflame!"*

There are moments in our lives when we have nothing particular to do. In these moments we might peruse the above book, which is a novelty of its kind. It contains a vast amount of useful information for a beginner, hitherto not contained in any other book. The book may be called a "Chess Dictionary," as it deals with every item connected with Chess. For instance, speaking about the board, the author says, "The best boards and men are those made of hard wood or metal, and the latter should be made so strong that in case they should drop from the table they would not be liable to break." In dealing with the laws of Chess, he says: "Any player wilfully disturbing his adversary shall be admonished." (We quite agree with that.) Problems are very largely dealt with; there are no less than 110 problems given. [illegible] A good four-mover might take as much as five [illegible]." Now, if we look at the prodigious array of good four-movers composed by an eminent German problemist, we conclude his age must be something approaching to that of Methuselah.

The game department is also dealt with in great detail, and there are numerous illustrative games. But also in this department—as indeed, throughout the whole book—we meet the remarkable and utter. We find a game played by the author, "Mr. H. F. L. Meyer playing *blindfold, looking* at the same time *at pictures*, and *conversing* with *two* bystanders." But of far more importance than these little peculiarities of the author, is the fact that he has adopted some fad of his own, in the shape of a new annotation, which we regard as a joke perpetrated at the publisher's cost. People will not go out of their way to study the author's notation. We take this opportunity of expressing our most decided opinion that the English notation is far superior, and more pleasant to follow, than the German system, aggravated by the author's improvements on it.

* What is inflammation of the soul?

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess-Editor.*

Leonard P. Rees.—Thanks for your generous offer; but tourneys are not included in our Chess Programme for the present. End-games welcome.

Francis J. Drake.—Solutions of Nos. 39, 40, 41, and 42 correct.

Senex Solitarius.—Solution of No. 38 correct.

J. B., Queenstown.—Solution of Nos. 39 and 40 correct; also Nos. 41 and 42. Correct solution of No. 42 received from G. W., Alfred B. Palmer, H. A. N., Moleque; 40, 41, 42 of Muzio; 38 of Dr. H.; 40 and 41 of Red Ink; 39, 40, and 41 of J. Naper.

Correct.—If 1. Kt to B2(ch), 1. K to B1, and there is no mate. Solutions are usually given about three weeks after publication of problems.

Contents of KNOWLEDGE *No.* 30.

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KNOWLEDGE

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PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, JUNE 9, 1882.

CONTENTS OF No. 32.

THE GROSVENOR GALLERY.

A FOREIGNER who should take a hasty glance through the Grosvenor Gallery might at first suppose it was intended as a place of refuge for works of art (Heaven save the mark!) which elsewhere would be regarded as insults to the public. Looking more carefully through the collection, he would find many charming works manifestly placed here for their excellence, not for the grossness of their defects. It would probably remain a mystery to him how works so unlike in character came to be side by side in the same collection, did not some English friend tell him of the idiocies of the æsthetic school of art, and of the insolent madness of that school of which Mr. Whistler is the most peccant—we wish we could say, the only—representative.

In the early youth of painting (passing over the Egyptian, Greek, and ancient Roman schools, of whose works we know very little), artists had crude ideas of drawing and colouring, they knew very little of perspective and anatomy, and they had scarce any models worth copying. They had, as children have, a taste for bright colours; and they possessed what children, as a rule, do not possess, the power of depicting beautiful colours, though in inharmonious combinations. Thus we find in their paintings imperfect perspective, angular figures, impossible bones and muscles, unwholesome complexions, and gaudy ornamentation—but, occasionally, very beautiful tints. Of aereal perspective the early painters knew simply nothing—or, if they knew anything, they made not the slightest attempt to apply their knowledge.

The paintings of the early schools are therefore necessarily defective, and so far as general effect is concerned, they are, for the most part, in the artistic as well as ordinary sense, simply hideous. But they are full of interest. Moreover, scarcely one of the paintings by the ablest of the early painters fails to show here and there features which, considered alone, are of exquisite beauty. The charm of antiquity appeals to us as we study these ancient paintings. The practised eye can see in them also the germs of the noble works of the great painters who came afterwards. In every national collection these old paintings have a place of honour; every student of art examines them with loving care; and if occasionally there is something of the feeling with which we look over a portfolio of pictures by a child, if there is sometimes a sense of amused wonder at the quaintness of the conceptions and the inadequacy of their rendering, the feeling is softened, much as when, looking at pictures by a child who is dead, the thought comes to us that his tiny fingers never learned to hold pencil or brush with firmness and vigour, that he was never more than the child-artist.

And because men of sense and of artistic skill study with love and tenderness these quaint old beginnings of modern art, there "come you in" certain idiots, hoping to beguile us of our esteem by copying the defects of those beloved old masters who flourished during the childhood of painting. As if some inane noodle of middle age should take the grotesque drawings of a child, and copy all their absurdities, these imbeciles of the present day (when art, though it should at least have reached its full manhood, ought not to be in second childhood) carefully picture sickly, ill-shaped beings, in impossible attitudes (they call them mediæval, but people in the middle ages were not all crippled and deformed), adorned with tawdry, ill-arranged frippery, and wanting even what the quaint old pictures possessed, occasional touches of beautiful colouring, and occasional bits of effective drawing.

Take, for instance, "The Feast of Peleus," by E. Burne Jones, No. 157 (East Gallery). For what earthly reason is a long-suffering public to be insulted by a picture in which the Laughter-Loving Goddess of Beauty is represented as a high-shouldered, hideous skeleton? and in which the two rival goddesses who claim the apple (marked by Discord "for the fairest!") are as ugly and dyspeptic as their dreary rival?—uglier they could hardly be. There was some excuse for a Ghirlandajo or a Botticelli who represented a saint as one who had lived an ascetic life—in other words, as a pale, half-starved weakling. But there is not common sense or even decency in picturing these wan and wasted wretches as "the three great goddesses who claimed the golden apple as the prize of beauty." In the "Tree of Forgiveness," by the same (No. 144) we are pained perhaps more by the offensiveness of the subject (in an artistic sense) than by the hideous complexions and expressions (we say nothing about the utterly incorrect proportions of Demophoon's chest, belly, and limbs, seeing that the painters of this school *must* be all wrong anatomically, or they would not be mediæval). A lady who had been an almond tree for a while might have such a colour (for aught we knew), and a man upon whom such a creature suddenly sprang out might be excused for wearing a very uncomfortable expression. But Venus Aphrodite sick and sorry, worn, wan, and wasted, we really "cannot away with." Of the three ladies in "The Mill" (No. 175), by the same painter, we can only say that they are suggestive rather of stale rhubarb than of faint lilies; and a similar remark applies to the Angel with complicated wings in No. 292, whose melancholy expression by no means accords with the usual ideas respecting angelic happiness.

It is, indeed, easy to fall into a way of lightly ridiculing this absurd school. But their offences merit more serious chastisement than mere ridicule. The mischief such paintings do is very serious. Among the inexperienced they create utterly false tastes. They are not only bad in themselves: they are bad in their indirect influence. They kill men's love for the works of the old painters. If there are any who have done more than others to destroy our appreciation of those works, to make them positively hateful and disgusting to us, instead of interesting and delightful (as rightly viewed they should be), it is their so called followers, who admire them for their defects, carefully copy their defects, and have nothing in common with them but the worst of their defects.

But if we feel contempt for the paltry affectation of the old style, with what feelings must we regard the mad new style, the Nocturnes in Blue and Silver, the Harmonies in Flesh-colour and Pink, the Notes in Blue and Opal! We are shown a sooty-faced, ill-shaped creature, with limbs entirely out of proportion (do *look* at that left arm!), on a dirty-black background, with smears of vermilion on necklace, lips, and hat, and we are told it is—not a Horror in Soot and Ochre, as our eyes tell us—but (forsooth) a Harmony in Black and Red! A dark bluish surface, with white dots on it, and the faintest adumbrations of shape under the darkness, is gravely called a Nocturne in Black and Gold. A few smears of colour, such as a painter might make in cleaning his paint-brushes, and which neither near at hand nor far off, neither from one side, nor from the other, nor from in front, do more than vaguely suggest a shore and bay, is described as a "Note in Blue and Brown," and purports to present that well-known and lovely spot, St. Brelade's Bay. Criticism is powerless here, because one who found these pictures other than insults to his artistic sense, could never be reached by reasoning. We are not sure but that it would be something like an insult to our readers to say more about these "things." They must surely be meant in jest; but whether the public have chiefly to thank Mr. Whistler, or the managers of the Grosvenor Gallery, for playing off on them this sorry joke, we do not know, nor greatly care. *Meliora canamus!*

(To be continued.)

ENGLISH SEASIDE HEALTH-RESORTS.

BY ALFRED HAVILAND.

CLASSIFICATION.

BEFORE describing the seaside towns usually resorted to for health or change, either singly or in groups, it is necessary that they should be classified in such a manner as to assist the reader in forming a correct idea of their general and social climatic differences: for, when this part of the subject is clearly understood, health-seekers and their advisers will be less likely to err in the too-frequent direction of expecting from certain health resorts what Nature has never given them to bestow, and will be more likely to find what they want, when, after first ascertaining what their bodily conditions absolutely require, and what, from their hereditary tendencies or other peculiarities of constitution, must be carefully avoided, they study each group and each member of it, with all the knowledge they possess of its characteristic climatic properties, and, after doing so, select such a resort as will fulfil their health-requirements, without evoking latent tendencies to disease—a most important point to be considered, although one unfortunately too frequently neglected.

Health-resorts must be studied—I. As to latitudinal and longitudinal position: for the English coast, including that of Wales, is between 6° 1′ 45″ degrees of the former, and 7° 11′ 55″ of the latter, and thus stretches over an area including a remarkable variety of climatic factors. As regards latitude, the most southerly point is the Lizard Head, in the district of Hel-ton, Cornwall, 49° 36′ 35″ lat. N.; the most northerly, Berwick-upon-Tweed, in Northumberland, 55° 38′ 20′ lat. N. As to longitude, the most easterly point is Lowestoft, in the district of Mutford, Suffolk, 1° 31′ 25″ long. E.; and the most westerly, the Land's End, in the district of Penzance, Cornwall, 5° 40′ 30″ long. W.

II. As to their position on the seaboard; whether they enjoy the warm moist air from the Gulf Stream, the bracing air of the North Sea, or an atmosphere brought by the winds after it has lost its sea character by passing over thousands of square miles of continent.

III. As to their site on the coast; whether they are elevated on precipitous cliffs, having a protective influence, or on low-lying, flat shores, over which the winds find no resistance; or in deep valleys facing the sea, where the natural force of the wind is increased, like that of the tidal wave, in funnel-shaped estuaries; as to the heights behind them, whether, although they may be protected by them from some winds, these heights do not act injuriously, on the whole, by preventing due air flushings when the winds from the sea are only moderate in force, especially in the case of large towns where there is much smoke.

IV. As to the depth or shallowness of the sea; whether the beach offers opportunities for exercise and recreation, or whether at low tide there is a wide expanse of mud exposed.

V. As to their exposure to or protection from certain prevailing winds, and whether their street arrangement is such as to afford the health-seeker opportunities of availing himself of natural advantages.

VI. As to the prevalence or scarcity of certain diseases in the resorts themselves and in the neighbouring districts, and as to the zymotic death-rate.

VII. As to the geology and physical geography of the site and its neighbourhood.

VIII. And, as far as practicable, as to the temperature, its monthly mean, daily range, its mean monthly maximum, minimum, and range, the rainfall, and, wherever it can be ascertained, the temperature of the sea.

The above is an outline of what we hope to present to our readers, and we need hardly say that we shall be grateful to all who will kindly assist us with reliable information on the above or any other points of interest connected with the seaside health-resorts of England. We will now give a list, under our first heading, of some of the resorts which will more or less command our attention in future papers.

I. LATITUDINAL POSITION. On the East Coast.—Between 51° and 52° N., Deal, Ramsgate, Margate, Herne Bay, and Southend. Between 52° and 53° N., Lowestoft, Great Yarmouth, Cromer and Huntstanton. Between 53° and 54°., Great Grimsby. Between 54° and 55° N., Bridlington, Filey, Scarborough, Whitby, Redcar. On the West Coast.—Between 50° and 51° N., Sennan (Land's End), St. Ives. Between 51° and 52° N., Ilfracombe, Burnham, Weston-super-Mare, Clevedon, and Tenby. Between 52° and 53° N., Aberystwith and Bournemouth. Between 53° and 54° N., Beaumaris, Bangor, Penmaenmawr, Llandudno, Rhyl, New Brighton, Southport, and Blackpool; and between 54° and 55° N., Morecombe Bay. On the South Coast.—Between 51° and 52° N., Dover, Folkestone, and Hythe; and between 50° and 51° N., Hastings, and St. Leonards, Eastbourne, Seaford, Brighton, Worthing, Littlehampton, Bognor, Isle of Wight, Bournemouth, Weymouth, Lyme Regis, Exmouth, Dawlish, Teignmouth, Torquay, Dartmouth, Penzance, and the Lizard.

The reader will kindly correct the following errata in the first paper, p. 3, col. II. For "seasonably," read "seasonally"; after "distributed" insert "in"; for "teach," read "teaches"; and "before such places" omit "that"

ANTIQUITY OF MAN IN WESTERN EUROPE.

By Edward Clodd.

PART III.

SCANTY as are the bones of Palæolithic man, no unprejudiced person can deny that the tools and weapons of the Drift are products of human skill, low in the scale as this may be; for they have defined, purposeful shapes, which were artificially produced, because they can be thus formed only by the application of blows or of pressure in a peculiar way, as modern experiments show. Moreover, they indicate selection on the part of their fashioners, since they cannot be made from every kind of flint. They are found, in striking correspondence of form, wherever man is known to have wandered, or may be presumed to have wandered, over the earth*—in the alluvials of the East, the laterite or brick earth of Madras; in the river-gravels of sacred and classic lands, by the Sea of Galilee, and along the valley of the Tiber; in brief, in every explored part of the Old and New Worlds "from China to Peru." They witness to the wide distribution of rude tribes of hunters in the lowest stage of culture, of whose aboriginal home we can only speculate, of whose ultimate fate nothing whatever is known.

> Into this Universe, and *why*, not knowing,
> Nor *whence*, like water willy-nilly flowing;
> And out of it, as wind along the waste,
> I know not *whither*, willy-nilly blowing.†

The description of rude Northern tribes given by Tacitus may not unfitly—rather with added force—be applied to them. "They are wonderfully savage and miserably poor. They have no weapons, no horses, no homes; they feed on herbs, and are clad with the skins of beasts; the ground is their bed, and their only hope of life is in their arrows, which, for lack of iron, they sharpen with tips of bone. The women live by hunting, just like the men, for they accompany the men in their wanderings and seek their share of the prey. And they have no other refuge for their young children against wild beasts or storms than to cover them up in a nest made of interlacing boughs. Such are the homes to which the young men return, in which the old men take their rest."‡

The implements of the ancient Stone Age are certainly not more recent than the water-laid beds in which they are found hitherto undisturbed, and the height of these, ranging from 50 ft. to as much as 200 ft., in some places, above the present river-levels, is proof of enormous antiquity. An approximate estimate of the time required for the deepening of a valley is furnished by the quantity of sediment carried yearly by the river flowing through it to the sea. The data at hand for this result are slender, but Professor A. Geikie shows that the removal of one foot of rock occupies in some cases a few centuries; in others as many chiliads. For example, the Po appears to lower the surface of the area drained by it at the rate of one foot in 729 years, while the Mississippi takes 6,000 years to effect a like result. And although the larger volume and flood of the Pleistocene rivers—betokened by the coarse gravel, the large unrolled stones, and the mingled remains of different species of animals which alternately occupied the land, as the climate of Pleistocene times was now genial, now arctic—scooped out the valleys at a quicker rate than the rivers of to-day, the removal by the Somme, for example, of masses of chalk and overlying Tertiary *débris* (of which its valley entirely consists) to the depth of 150 ft., through a channel many miles in length, demands an immense period. Subsequent to this, what vast lapse of time is required to explain the gap between the Drift and the early pre-historic period when the polished stone-using peoples arrived, so that, as Dr. Evans remarks: "we must, for the present at least, judge of the antiquity of these deposits rather from the general effect produced upon our minds by the vastness of the changes which have taken place, both in the external configuration of the country and its extent seaward, since the time of their formation, than by any actual admeasurement of years or of centuries."*

But these implements of the river gravels do not tell the whole story about Palæolithic man. Speaking broadly, he falls into two divisions—Drift-man and Cave-man: the tools and weapons found in the limestone caverns of Western Europe marking a distinct advance, perchance due to another race, over those of the earlier period. For while, as has been remarked, the gravel-beds yield only oval-shaped flints and leaf-shaped flakes, the caves furnish flint saws, lance heads, awls, barbed weapons, bone needles (in one place a stone drill lying near them), imbedded with charcoal and the *débris* of animals eaten, as the musk sheep, bison, and others, especially the reindeer. From the enormous numbers of this creature, which appears to have formed the chief food of the rude hunters, the cave deposits are often spoken of as belonging to the Reindeer period, in contradistinction to the Drift or Mammoth period. The precedence of decoration over dress noticeable among savages, perhaps finds illustration in rude strings of animals' teeth and shells; while a soft red ochre (oxide of iron), which occurs among the relics, shows that the Reindeer men painted their skins. But we are anticipating.

From the earliest times, "the clefts of the valleys, the caves of the earth, and in rocks," have formed the natural shelters of barbaric races. And, although the traces of bone and other relic-yielding caverns of tertiary and early quaternary times appear to have been swept away in the momentous changes of land surface, the caverns of subsequent periods are rich in remains which enable us to construct a more vivid outline of man in the ancient Stone Age than do the scanty and rude relics of the Drift. Implements of the Drift type occur among the oldest layers in caverns, but the upper deposits supply the evidence of advance to which reference has been made. Following M. de Mortillet's divisions for a moment, the Thenaisian and Acheulian epochs embrace the Drift period; the Mousterian, Solutrian, and Magdalenian epochs the Cave period. Not that these latter divisions are to be taken as hard and fast, but as overlapping, because they may, in fact, represent no great difference or extended succession of time. And for the present purpose it is better that in place of explanation of, or comment upon, the method of selecting specific implements as types of each period adopted by M. de Mortillet, an account be given of the deposits and contents of one of our most celebrated English caverns, premising that these will afford a fair idea of the bone-caves and rock-shelters of the continent, except where the latter have furnished certain remarkable specimens of primitive art to be presently referred to.

Before entering our cave, which shall be Kent's Hole, near Torquay, let us briefly explain how the deposits in it, and in like caverns found in limestone rock, have been

* Scandinavia must be excepted, the finds there being exclusively Neolithic.

† Rubáiyát of Omar Khayyám, xxix. ‡ Germania, c. 46.

* "Ancient Stone Implements," p. 621.

formed, because the almost imperceptible rate at which, in some cases, they have been laid down has an important bearing on the age of the contents imbedded within them. The surface-water finds its way through some crevice or fissure in the rock, and being more or less charged with carbonic acid derived from the atmosphere, and from decayed vegetable and other matter in the soil, becomes a very powerful solvent, under which the rock, converted into carbonate of lime, is carried away in solution. But while much thus runs off, Nature, true to her cyclical action, begins to refill the cavity which she has eaten away. Drops of water, holding the lime in solution, ooze from the roof, and, falling on the floor, gradually form beds and bosses of stalagmite, which hermetically seal whatever *débris* may happen to be lying about, while such portions of the dissolved limestone as remain clinging to the roof after evaporation of the water from them hang icicle-like therefrom, and gradually form the beautiful columns of stalactite which adorn many of the famous caverns of the world.

CRYSTALS.

By William Jago, F.C.S., Assoc. Inst. Chem.

No. III.

In our last paper we studied crystals, artificially prepared, under the microscope; it is our purpose in this number, still using the microscope as our means of investigation, to examine crystals which have been formed naturally. From what has already been stated, it will be seen how universal is the tendency which matter has, when assuming the solid state, to also become crystalline. Rocks form no exception to this rule, and in many specimens of the granitic type, large and well formed crystals are found embedded in the finer portions of the rock. The name "porphyry" is now restricted by geologists to rocks of this class. The stone of the large polished granite fountain in St. Paul's Churchyard contains some very fine crystals of the minerals felspar and hornblende; but not only is granite distinctly made up of crystals, but even the finer grained rocks, which to the naked eye appear perfectly uniform in texture, are also found on minute examination to be more or less crystalline in structure. Of recent years the application of the microscope in geology has been much extended, and now the description of any rock would not be considered complete without mention of its microscopic characteristics. To examine rocks with the microscope, by means of transmitted light, in the way most usually adopted, it is necessary to prepare and mount extremely thin sections, these sections being often much thinner than paper. At present we shall not be able to give directions for the preparation of such specimens, but, with the Editor's permission, may make practical directions for section-grinding and mounting the subject of a separate paper on some future occasion.

In the first paper of this series it was stated that the black, pitch like form of lava is instanced by the geologist as the type of glassy or non-crystalline rocks. Fig. 1 is a sketch made of such a piece of glassy lava, "obsidian" from the Lipari Isles, magnified to about 250 diameters. It is almost a pure natural glass; the small black specks are probably embryonic crystals of magnetite (one of the natural oxides of iron). Such a rock is produced by the rapid cooling and solidification of molten rock material; with slower cooling, "obsidians" are formed in which a decided step further in advance towards crystallisation is made. Fig. 2 represents a spherulitic obsidian from Iceland. (This, and all the succeeding figures, are magnified from about 25 to 30 diameters.)

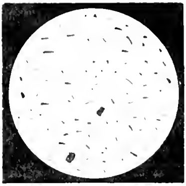


Fig. 1.

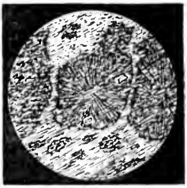


Fig. 2.

Although the main portion of the rock is glassy, there are yet a few small crystals to be noticed; the most interesting point, however, about the specimen is that it contains a number of small spherules, one of which occupies the centre of the field. It may be noticed that it has a radiated structure. Precisely the same formation is often seen in glass which has been maintained at a temperature near its melting-point for a considerable time. The writer has several interesting examples of such glass in his possession. But, to proceed to some further proof of the crystalline nature of these spherules. Students of physics are aware that a ray of light undergoes a peculiar change on passing through a block of Iceland spar; among other modifications, it is so altered that it is incapable of passing through a second block of the same material if placed in a certain position with regard to the first. The light under these circumstances is said to be *polarised*. Microscopes for the study of rock sections are fitted with a pair of specially-prepared pieces of Iceland spar, called "Nicol's Prisms." One of these is fixed under the stage; the other is either fitted over the eyepiece, or into the body of the instrument. These being placed in position, on rotating one of them, a point is reached at which, on looking through the instrument, it is seen that no light is transmitted. Most crystalline substances, on being placed between the prisms, possess the property of so modifying the beam of light as to effect its passage through the second or upper prism, and thus to the eye, neglecting for the time being those crystals inactive in this respect. This affords us a most ready means of discriminating between crystals and glass. The glass of the microscopic slide has no action on the light, neither has a purely glassy piece of rock; but let there be crystals present, and they are immediately seen, illuminated on a black ground. Viewed in this way by polarised light, the darker spherules of the obsidian become bright, while the rest of the rock appears black.

Leaving the glassy rocks, we may now glance at some specimens in which crystallisation has still further asserted itself. The rock called Felsite is one which, instead of being glassy, is micro-crystalline in structure: the crystals are very small, but their optical behaviour leaves no doubt as to their nature. There are many rocks which contain, imbedded in a base of this kind, larger, but still microscopic, crystals. Figs. 3 and 4 are examples of such. The crystals, though so small, are often wonderfully perfect.

Fig. 3 is a sketch of a micro-porphyritic basalt, from Unkel, on the Rhine; the largest crystal occupying the centre of the field is one of felspar, several smaller crystals of the same shape may be detected, the remainder of the work being micro-crystalline. The next figure gives a section of a fine crystal of nepheline, in Phonolite basalt, from Sellberg Eisel. The crystal in shape is a hexagonal prism, and has been cut almost at right angles to its base. During its growth it has enclosed within it other small crystals and part of the base of the rock. Round the

Fig. 3.

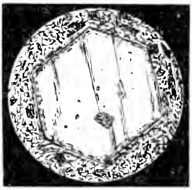


Fig. 4.

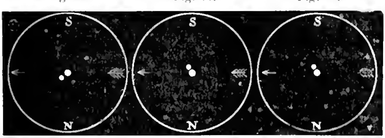
outer edges this may particularly be noticed: it would seem as though the power which determines the crystalline form, at the last, had just sufficient energy to complete the shape of the crystal; but, with the growing rigidity of the cooling mass, lacked the strength to expel these foreign particles, and was perforce content to enclose them within itself.

NIGHTS WITH A THREE-INCH TELESCOPE.

By "A Fellow of the Royal Astronomical Society."

To the east of Bootes lie the constellations Corona Borealis and Serpens, which we shall now proceed to examine. Beginning with the former (which really does present more than the ordinary resemblance to the object whose name it bears), we shall find a very interesting double star in ζ (map, Vol. I., p. 626), the components exhibiting well-contrasted colours. Its aspect, as seen with a power of 160, is shown in Fig. 33. σ Coronæ is a very pretty pair indeed; it is delineated in Fig. 34, as viewed with the same power as the last star. σ will be found in the sky as nearly as may be 10° N.E. of α Coronæ. This is sometimes ranked as a triple star, as the pair shown in our sketch are followed, at a distance of 51″ or 52″, by a minute blue star. σ itself is one of what are known as binary stars—*i.e.*, physically connected pairs; and, in the description of their orbits, about their common centre of gravity, its com-

Fig. 33. Fig. 34. Fig. 35.



ζ Coronæ Bor. σ Coronæ Bor. δ Serpentis.

ponents have separated from 1″.3 in 1830, to something like 3″.5 now. One of the most interesting of these binary systems, that of η Coronæ, is unfortunately quite hopelessly beyond the power of our instrument, as the two stars are now less than 0.5″ apart, and are closing. Their distance varies from about 1.4″ to 0.3″, and their orbit is described in something over forty years. There are several pairs of telescopic stars in this constellation, all of them tolerably easy to divide, but it is very difficult to give directions for finding them in the absence of an equatorially-mounted telescope with divided circles. An easy one (Struve, 1,964) will be found a little to the south-west of ζ described above. While going over Corona, the student should not omit to glance at that most astonishing object, T Coronæ; the star which blazed up suddenly as a second magnitude one in the year 1866. Examined by our greatest English spectroscopist, Dr. Huggins, on May 16 in that year, it was found to exhibit a double spectrum; one analogous to that shown by our own sun, the other one that of glowing gaseous hydrogen; this (possibly) indicating a conflagration on a stupendous scale. Subsequently to this the star faded to the 9th magnitude, revived again somewhat, and has since been irregularly variable. At present it appears as a star of about the $9\frac{1}{2}$th magnitude. It is situated on an imaginary line drawn from ε Coronæ to π Serpentis, at rather less than one-third of the distance between the two from ε.

Serpens, to which we shall next devote our attention (Map, Vol. I., p. 626), is one of those straggling and sprawling constellations so difficult to follow in the sky. Nevertheless it is one containing many beautiful and interesting objects. To begin with, α is a very wide and unequal pair, the smaller component requiring a good deal of looking for with a small telescope. We insert it here for the pretty contrast in colours which it presents. δ Serpentis, shown in Fig. 35, is a very neat and pretty binary star. The components are at present separating. β is, like α, a widish and very unequal pair, the small star, as in the former case, being bluish. θ Serpentis is comparatively wide and easy. It will well repay examination from the richness of the region in which it lies. ν Serpentis, 4° north-east of η, is also wide and easy. As before, we mention it for the pleasingly-contrasted colours of its components. 5 Serpentis (9° south-west of α) is much closer, and very unequal. It will repay examination. $10\frac{1}{2}$° to the north-east of α Serpentis, on a line drawn from that

Fig. 36. Fig. 37. Fig. 38.

49 Serpentis. 59 Serpentis. 13 M. Herculis.

star to Vega, will be found 49 Serpentis a fine pair shown in Fig. 36. This is a binary system, with a supposed period of 900 years! 59 (or *d*) Serpentis is a beautiful object, the colours of its close and unequal components being strongly contrasted. It is represented in Fig. 37. Smyth's directions for finding this star are, perhaps, as good as any. "To identify 59 Serpentis," he says, "let an east-south east ray be shot from β Herculis through α, which will be found two-fifths of the way" (*i.e.*, from β Herculis to 59 Serpentis).

Libra (Map, Vol. I., p. 626) is neither a striking constellation to the naked eye, nor does it contain many objects accessible to the class of instrument we are employing. A small, but easy, pair of stars will be found in No. 62 of Piazzi, XIVth hour. It lies 15° east by north of Spica Virginis, or $2\frac{1}{2}$° south-west of ι in the same constellation. 9° due west of β Scorpii will be found P. XV. 91, a not very close, but considerably unequal pair. ι Libræ is a very wide and unequal pair, but worth looking at for its prettily contrasted colours. Just to the north-west of 5 Serpentis, of which we have previously spoken, will be found that fine, compressed cluster of very small stars, No. 5 of Messier's Catalogue. It is scarcely resolvable in a 3-in. achromatic, and merely appears like a nebula, brightening conspicuously towards the centre.

We now arrive at that somewhat unintelligible constellation, Hercules, who appears on the maps and globes head downwards between the constellations of the Northern Crown and the Lyre. As our present object, however, is less to endeavour to reconcile the configuration of the stars composing this constellation with the counterfeit presentment of an inverted hero, than to select from them curious and beautiful objects, suitable to the instrument we are employing, the map we use will supply all the aid necessary for this purpose. We say all the aid; but, in truth, the map which should give the position of a quarter of the interesting objects with which this constellation teems, would have to be a very elaborate and crowded one indeed. We must then, perforce, confine ourselves to a few of the most easily identifiable. Beginning upon the confines of Corona Borealis, about 1½° a little to the east of south of ν Coronæ, we shall find 23 Herculis. This is a wide pair, but we insert it here for the marked colour of the smaller star, which will be seen below, and just to the right, of its primary. ζ Herculis, a remarkable binary star, is quite beyond the power of our telescope—in fact, appears single with the means at our disposal. If, though, we fish along a line connecting η and ζ Herculis about one-third of the way η, we shall light upon an object which will amply repay us for any disappointment we may experience in connection with this. The object to which we refer is No. 13 of Messier's Catalogue, and consists of a most glorious globular cluster of stars. How far we shall succeed in detecting its stellar character will depend upon the excellence of our instrument and the acuteness and training of our vision. We have tried to indicate its character in Fig. 38. One-and-a-half degrees N. by E. of η Herculis will be found another cluster (Messier 92), which the average eye and instrument will only show as a bright nebula. We may further note here that there are two planetary nebulæ in this constellation; but that only one of these is at all within the reach of a three-inch telescope; and neither can be found with certainty, save in an equatorially-mounted telescope.

PHOTOGRAPHY FOR AMATEURS.

By A. BROTHERS, F.R.A.S.

PART IX.

If kept standing in the dark slide for any length of time, the sensitive collodion film will dry, and the time it will remain in a condition fit for use will depend on the temperature of the air. Another disadvantage is that the silver solution required to form the picture while under development drains away, and if the weather be very hot, and the corners of the dark frame are not clean, markings, known as "oyster-shell," are likely to form, and often spoil the negative. Two or three folds of red blotting paper wetted and placed at the back of the plate will retard evaporation and keep the film sensitive for a considerable time, and if the plate have lost much of the silver, it may be restored by redipping in the silver solution. But after all, the results on plates so preserved are seldom satisfactory.

Various methods have been adopted for keeping the plates in a moist state, such as coating with solution of sugar, honey, glycerine, or other suitable vehicle that will retard the drying of the film. It is obvious that if the sensitiveness of the film could be retained in a *dry* state, we should have a convenient substitute for the wet process. The labour involved in working with wet collodion away from home conveniences, the necessity for some kind of tent, the possibility of breakages, and occasionally the discovery that some important article has been left at home—all these disadvantages set many minds working to discover a practicable *dry* process. To enumerate or describe the processes at various times introduced would be tedious. Most of them, in the hands of their discoverers, gave excellent results, and some of them came into general use. The collodio-albumen process may be named as one of the best, and has been used very extensively. It has the disadvantage, however, of being very slow, but the results, in the hands of careful workers, have been quite equal to wet collodion. It will be sufficient to say here that the plates are prepared, first, with bromo-iodized collodion in the usual way. On the removal of the plate from the bath, it is washed and then put into a weak solution of iodide of potassium and again washed. The plate is then coated with albumen, containing iodide and bromide of potassium in various proportions, and also liquor ammonia. It is then dried by a fire, and is ready to be sensitised, or rather to be re-sensitised, which is effected by immersion in a bath of nitrate of silver in the ordinary way, and it is again washed. The plate is then allowed to dry without the application of heat. The plates will keep in good condition for many months, and the latent image may be developed at pleasure, and after the lapse of many weeks or months. The development is effected by using pyrogallic acid, citric acid, and nitrate of silver in certain proportions; and hyposulphite of soda is used for fixing the pictures.

I have described this process in general terms first, because it gives most excellent results, and should not be passed over; and, next, because the amateur, if he desire to make use of it, will seek particulars in treatises devoted to the subject.

Another method by which the silver bath may be dispensed with is by adding nitrate of silver to the collodion, forming an emulsion which may be poured on to the plate in the ordinary way, and when dry is ready for use. The development is effected by the alkaline method.

The practice of out-door photography may be said to have been entirely changed during the last three or four years by the introduction of the *gelatine dry plates*, and not only for out-door work, for these plates have now almost superseded collodion and the silver bath in the studio work of the professional photographer—at least for portraiture. The extraordinary rapidity of the gelatine film has effected this result. As compared with collodion, the time of exposure necessary to obtain a picture has been reduced to the fraction of a second; so rapid, indeed, is the action of light upon the plate, that, for out-door work, the effect is as instantaneous as the exposure can be made by mechanical means, and for studio work the change may be said to be ten or twenty times less than by the old method.

In a future paper we may return to the subject, and describe the method of preparing the gelatine plates. To do so now would be unprofitable to the tyro, owing to the delicacy of some of the operations. The plates can be purchased ready for use, of various degrees of sensitiveness, from five to twenty times that of wet collodion, and, if desired, this degree of sensitiveness may be exceeded;

the sun, even if their astrologers understood this they could find no recorded law of recurrence of solar eclipses within that period by which to predict them. Because, though they recur in fixed order within the cycle, they are not visible at the same places on their repetition, as where first observed, whereas all lunar ones are, of course, to be seen at all parts of the earth having the moon above the horizon. That the Assyrians ever arrived at the truth is very questionable, although Professor Sayce seems to think that the problem of calculating solar eclipses by tracing the shadow as projected on a sphere had presented itself to them; for, when we first hear of a correct prediction of a solar eclipse, it is by a man who gained his wisdom not in the astrological observatories of Assyria, but in the sacerdotal colleges of Egypt.

The quotations already given (which might easily be multiplied) are ample to prove that whilst the Babylonians were far from perfect in their calculation of solar eclipses, yet they so thoroughly understood those of the moon, and were generally so far advanced in astronomy, that they knew much better than to predict an eclipse of the sun on the 20th of a lunar month. In fact it is evident that their months must have been so arranged that these phenomena could take place upon any one of the days. For instance, in what are termed "Portent Tablets," translated by Prof. Sayce, are numerous lists of omens arising from lunar eclipses on such days as the 13th, 14th, 15th, 16th, 20th, 21st, &c. It does not follow from other days not being mentioned that eclipses were not anticipated on them, because their omission may be owing to parts of the portent tablets being wanting; or, their occurrence upon these other days, not being associated with any omen, are unnoticed. Mr. Sayce tells us that records of eclipses for every day of the year were kept. In the "Cuneiform Inscriptions of Western Asia," vol. III., p. 56, published by the British Museum, we have lists of events to be apprehended if an eclipse happened on any day of the month Tammuz up to the 15th. Elsewhere we read—"In Tammuz, from the 1st to the 30th, if an eclipse happen the altars are destroyed," &c.; and, again, "In the month Sivan, from the 1st to the 30th, an eclipse failed, the crops of the land are not good;" and, as a final instance, this curious sentence may be given relating to an unexpected eclipse—"If, in the month Tammuz, an eclipse happens, which has not been calculated, the heart is established." That the disappointment in the one instance, and the unexpected good fortune in the last, refer to miscalculated *solar* events is evident from what has been said above.

It only remains to be ascertained what was the length of the Babylonian months, and to this there is now no doubt that the correct answer is, as stated by Prof. Sayce, that they were months of thirty days,* as were those of the time of the flood (Gen. vii., 11; viii., 3, 4); thus their year would be one of 360 days, corresponding with the Egyptian vague year. That this is the true state of the case is evident, because we know that every six years an extra month was intercalated, the Ve Adar, in order to make the year coincide with the solar year. The year of 360 days being five short, in six years the correction was made, because then the error amounted to a month. This, however, was not sufficient to entirely rectify the difference, being about thirty-five hours in error, and in 124 years the deficiency would amount to a whole month of thirty days, and so we accordingly find another intercalary month mentioned in the inscription, the "second Elul." Now, whilst a 360 day year is about five days less than the solar, it is nearly si[x] days more than a lunar year; thus in about five years the days of the month would advance through a whole lunar month, just as in six years they would retrograde a whole month as compared with the solar year. The effect of this would be that in a period of five years eclipses could and would take place on any day of the month. A curious confirmation of this is to be found in the report tablets consisting of records of careful observations for the new moon on the 1st and 30th days of the month; these, doubtless, being accounts of observations made at the end of the five year periods to see if the error of six days annually had rectified itself, and the new moon once more coincided with the 1st of the month. The Egyptians, it is well-known, rectified the (360 day) vague year, with the solar, by intercalating five days annually; but there is reason to think this practice did not exist in the earliest times, because each of these five days is sacred to one of the great gods, which seems as if it were a plan of the priests introduced with the innovation in order to render it permanent.

It is not supposed that these explanations clear up all the difficulties of the Babylonian calendars, because there is reason to believe that sometimes one of the intercalary months was a second Marchesvan, and Mr. Pinches finds evidence of there occasionally, in some sense, being intercalary days; but they are offered in the hope that they may be a preliminary step towards arriving at the truth.

Joseph Offord.

* M. Lenormant ("Ancient History," 451) argues that the months, like those of the Jews after the time of Moses, were alternately of twenty-nine and thirty days; practically lunar ones, but two of those to which he assigns only 29 days, Iyar and Marchesvan are mentioned in inscriptions, translated by the late Geo. Smith as months of thirty days.

SIEMENS ON SOLAR ENERGY.

We have received from "X, University Club, Dublin," a letter respecting Dr. Siemens' scheme of the solar energy. The letter is marked "private," but how an anonymous writer can claim that his letter should be regarded as a private communication, we fail to see. We therefore disregard the injunction.

Beginning with the remark that our argument from the light of the stars seems to dispose of Dr. Siemens' theory, "X" presents Dr. Siemens' dynamical argument as akin to the following statement:—

"If a globe (representing the sun and its rotating atmosphere) be made to rotate in the still air of a room, there will be produced an outflow of air all round the equator from which will result inflow at both poles."

And he adds, "Surely this proposition needs only to be stated to be accepted."

We accept all except the words in parentheses. The globe hanging in the still air of a room, and exerting scarcely any appreciable attraction on the air, does not and cannot represent the sun rotating in the atmosphere of space. The rotating sun cannot generate any such tangential velocity as could lead to equatorial outflow,—the rotating globe in a room can.

The fundamental error of Dr. Siemens' position is the assumption—in which X follows him—that gaseous matter outside the sun's rotating atmosphere, will yield to the influence of any centrifugal tendency which may be communicated to it, but is not under the influence of solar attraction.

The same fallacy underlies, I suspect, the following assertion (I suspect *only*, because X does not tell us what he really means):—

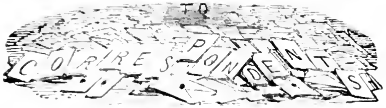
"You have only to reconsider the statement about 'the pressures which could exist opposite the polar regions of the sun', and *the consequent resistance to inflow*,' to see that the underlined words must not stand."

Of course, if, as X and (manifestly) Dr. Siemens suppose, the interplanetary atmosphere were free from solar attraction, and the sun were like a ball spinning in the still and apparently uniform air of a room, the underlined words could not stand. As matters are otherwise, they can, and do. If X will examine the conditions as they would actually exist (the interplanetary atmosphere being assumed), he will see that, whether the pressures opposite the polar regions are at any moment in excess or in defect of those which would result in equilibrium, there can never be other than oscillatory movements in the interplanetary atmosphere. There will always be resistance to inflow—that is, to the constant inflow, which the theory requires: there will equally be resistance to constant outflow.

Richard A. Proctor.

Winning Wagers.—It will hardly be believed, but our paper thus named has actually been understood by some of our readers as a guide to successful wagering! It is as painful to have to interpret sarcasm as to have to explain a joke; but for the benefit of those (very few we trust) who have misunderstood us, we explain that the whole aim and purport of our paper was to indicate the rascality of the only kind of wagering which is ever systematically successful,—the system pursued by the bookmaking fraternity. We might as reasonably be supposed to inculcate the true principles of pocket-picking, if we warned readers against the tricks of street thieves, as to advocate the true principles of wagering, when we show how bookmakers swindle verdant betters.

Killing Entomological Specimens.—In the column on "Butterflies and Moths," p. 606 of Knowledge, several methods of killing the animals are described. Some twenty years ago, I tried many experiments with this intent, and finally discovered that the bisulphide of carbon is effectual. It is a very volatile liquid, its vapour very dense. The insects, either before or after pinning out, may be placed in a wide-necked bottle or a tin box in which is a piece of wool that has been slightly wetted with the bisulphide. It should remain there a few minutes, as a shorter time only produces temporary insensibility. I described this method in the ninth volume of *Nature*, and it has since been extensively used in France for the destruction of phylloxera. W. Mattieu Williams.



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of KNOWLEDGE; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

⁂ *All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

All Letters or Queries to the Editor which require attention in the current issue of KNOWLEDGE, *should reach the Publishing Office not later than the Saturday preceding the day of publication.*

(I.) Letters to have a chance of appearing must be concise; they must be drawn up in the form adopted for letters here, so that they may go untouched to the printers: private communications, therefore, as well as queries, or replies to queries (intended to appear as such) should be written on separate leaves.

(II.) Letters which (either because too long, or unsuitable, or dealing with matters which others have discussed, or for any other reason) cannot find place here, will either be briefly referred to in answers to correspondents, or acknowledged in a column reserved for the purpose.

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"There is no harm in making a mistake, but great harm in making none. Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

"God's Orthodoxy is Truth."—*Charles Kingsley.*

Our Correspondence Columns.

TOBACCO AND CONSUMPTION.

[418]—In letter No. 411, page 630, Mr. W. B. Wicken proposes the use of tobacco as a preventive and cure for consumption.

The fact that the Turks are comparatively free from consumption is, I believe, beyond doubt; and it may be, though I do not think so, that their habit of inhaling the smoke into the lungs keeps away that dreadful disease. On the other hand, how is it that consumption is so prevalent in our own country? We are a great nation of smokers, and if we do not make it a point of inhaling the smoke into our lungs, a fair percentage of it must necessarily find its way to the organs of breathing. Personally, I do not place any faith in tobacco as a cure for consumption, for I believe that climate has more to do with it than anything else. As a preventive it *may*, possibly, be of service, by keeping the cells of the lungs open, and thereby prevent the accumulation of morbid secretions. Tobacco smoke has, undoubtedly, some soothing effect, and allays irritation of the lungs; for I find that when my laboratory is filled with acid fumes, that I have no inclination whatever to cough, as long as I use my pipe.

With regard to the tobacco used by the Turks, I may say that I have never smoked a stronger kind than that used with the nargillah. When on a visit lately to Constantinople, I one day ordered, out of curiosity, a cup of coffee and a nargillah. The latter, however, soon proved too much for me, though the smoke was drawn through three yards of tubing and about six inches of water. After passing through so much, the smoke was still so powerfully noxious, that one puff satisfied me fully, and I was glad to resign the pipe to a stander-by, who finished it in happiness. The tobacco used with the pipe is different from that used for cigarettes.

In Spain, too, the smokers draw the smoke into their lungs, and will frequently engage in a very spirited argument before emitting it again. They seem to have no difficulty whatever in swallowing the smoke—in fact, it is their usual custom: but their tobacco is not unlike chopped hay in mildness.

In conclusion, I will repeat that Englishmen consume a great deal of tobacco, and yet consumption is very prevalent amongst us. I believe that it is to our changeable and humid climate that the cause must be assigned, and this applies not only to consumption, but to all the diseases that the chest and lungs are subject to. Perhaps some of our medical contributors will give us their experience in this matter, which I am sure is of great interest to many. I would just say one thing, and that is, that rather than believe the Turk's freedom from tubercular diseases is due to the manner in which they use tobacco, I should say it is because of their abstinence from intoxicating liquors.

W. O. PROSSER, F.C.S.

THE LATE MR. DUNMAN.

[419]—The recent death of Mr. T. Dunman has already been noticed in your columns. He may be said to have sacrificed his life to his self-denying zeal in the work of popular education, and to an intense interest in the teaching of Science. Will you allow me to mention that a fund is being raised to help his widow to place herself in a position to support herself and her two children? Several members of the Council of the Working Men's College are on the Committee, and I am authorised as treasurer to receive contributions.—R. B. LITCHFIELD, 4, Bryanston-street, Portman-square, W.

TRICYCLES.

[420]—In reply to H. R. L., I fear I can add little to the information I have tried to give in my two articles on recent tricycles, which have so lately appeared in KNOWLEDGE, but if the writer will ask for details of any particular machine he may find wanting in what I have written, I shall be very glad to furnish the information to the best of my power. JOHN BROWNING.

MILDNESS OF THE SEA COAST.

[421]—The effect of the near neighbourhood of the ocean in moderating cold seems to be well illustrated by comparing the minimum temperature for Valentia, given in your weather reports for three weeks, ending April 29, with those observed at this station—Killarney—distant inland from Valentia 50 miles.

The minima here were *lower* than at Valentia on those 21 days as follows:—(The amount is given in whole degrees)—5, 8, 4, 2, 1, 0, 6, 8, −1, 4, −1, 1, 2, 2, 0, 1, 6, 8, 6, 1, 1.

The mean difference is 3°. This is a somewhat striking exemplification of the well-known effect of the moderating influence of the presence of the sea. I may add that the instrument used here has a Kew verification. It would be, I think, an improvement to give the *hour* of the barometer readings in your Weather Reports.

G. R. WYNNE.

THE "COLD SNAP" IN MAY.

[422]—Permit me to suggest as a reason for the low temperature of a week in May that there is usually formed in that month a region of high barometric pressure in the north, causing prevalent easterly winds over England. Frequently this wind is light and anticyclonic, and, after a period of cloudy skies, there is a clear sky for several nights. This, with the comparative calmness of the atmosphere, promotes rapid radiation from the earth. The ground temperature falls decidedly below freezing-point, and the air is cooled rapidly in the stratum next the earth.

I believe in this direction must be sought the cause of the cold snap. Later on in the season the amount of heat received from the sun in its longer period above the horizon is sufficient to prevent the excessive loss by radiation experienced in May, even in the clearest calmest summer nights. G. R. WYNNE.

POPULATION OF THE EARTH.

[423]—On a globe 2 ft. diameter, the Dead Sea appears as a small coloured dot, but if it were frozen over there would be room on its surface for the whole living human race, allowing six square feet for each person, and were they suddenly to be engulfed, it would merely raise the level of the lake by some four inches.

One hears at times very wild statements as to the depth the earth would be covered if all the people who have lived were laid side by side on its surface, estimates running from four feet upwards; but if we suppose the earth to have been as populous as now for 6,000 years (200 generations), the whole number could have been decently buried in graves 5½ ft. × 2 ft. within the British Isles, and some 7,000 square miles to spare.

I have taken the present population, as given by the German statisticians, at 1,456 millions (nearly). W. W. M.

STAR SPECTROSCOPE—GLASS STYLOGRAPHS—MAGNIFYING POWER.

[424]—With a good 4 in. Cooke, provided with a Maclean's star-spectroscope, but mounted on an ordinary altazimuth tripod, without slow motions, the faintness of star-spectra, and especially the unsteadiness of the motion, made it extremely hard to determine the best focus. The way I succeeded is simple, and may be useful. Slide out the prisms and replace the concave cylindrical lens, fit the instrument as usual in the place of the eyepiece, focus on the Pole

star, till an intensely narrow and brilliant *line* of light is seen, and mark the focus obtained. Then, if the prisms are reinserted, very good definition is obtained in the brighter parts of the spectrum. I have thus been able to see a wonderful amount of detail in the spectrum of Arcturus, and the general character of the spectrum of a star of the fourth magnitude. Several scratches thus made in the dark on different occasions do not differ in position $\frac{1}{20}$th of an inch; of course the focus will differ considerably with different people, but with the same observer it suffices perfectly to set the instrument by the mark on each occasion, and saves a great deal of fatigue and annoyance.

I noticed a remark in KNOWLEDGE, No. 21, that glass tubes for ink writing are very hard to make, and break easily; as I have habitually used glass-tube pens of my own make for every kind of writing, including this, during the last two years, I venture to differ. Perhaps it depends on the way they are made; but most people who use mine think them superior to the ordinary stylographs (12s. 6d. each). Anyone can make them for himself if he knows the way.

Apropos of the magnifying power of a deep eyepiece; a microscope with a micrometer on the diaphragm *in the eyepiece* will measure the power of the deepest lens very accurately and quickly. I tried it on the posterior lens alone of a 300-power eyepiece, and it gave 411 diams. as the result; the image of the object-glass was so sharp that it could be easily thus measured to $\frac{1}{3000}$th of an inch.

H. L. C.

SCREW-DRIVERS.

[425]—May I suggest, through the medium of KNOWLEDGE, that the simplest and cheapest method of improving screw-drivers, would be to make the heads of all screws concave, and the ends of all screw-drivers convex.

With a little care at first, the driver would never slip off the screw, and one could always see if the screw were going in straight.

C. CARUS WILSON.

[I have long been of opinion that instead of a single cut in the screw-head, two cuts forming a cross would be better, the screw-driver being made to match.—ED.]

THE MOUNTAIN "HERCULES."

[426]—E. C. R. (413) is surprised that no expedition has been sent to verify Captain Lawson's discovery of the mountain "Hercules" in New Guinea. The reason is the same as that which has stood in the way of a verification of Captain Gulliver's discoveries of Laputa, &c. Every traveller who has had any experience in mountain climbing knows how to treat an account of an ascent which commenced at 4 A.M. at the base of the mountain, which completed the first 14,000 ft. by 9 A.M.; then reached the snow-line at a height of 15,000 ft., and the summit, 10,314 ft. above the snow-line, and temperature 22° below freezing, at 1 P.M. The book is altogether a hoax, and a very feeble one. It was snuffed out immediately it appeared. W. MATTIEU WILLIAMS.

Answers to Correspondents.

**** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded; nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

J. L. M. Certainly; you would be most unwise not to insure your life, in a good office. We propose presently to publish in KNOWLEDGE a series of short papers on Insurance.

M. DOUBLEDAY. The lottery method which you describe gives a perfectly fair and equal chance to all concerned. It has the disadvantage that some might get two prizes; that might be obviated by arranging that, when a given number was drawn a second time, the drawing should be cancelled.—SIGMA. Possibly some of our readers may be able to tell us about Whitechapel needles (*re* Witchcraft), white witches, &c.—CLOUD. Such clouds are always spoken of as *cumulus* clouds, not *cumuli*.—E. D. GIRDLESTONE. Many thanks. You will see I have retained your quotation unchanged.—C. J. L. Lord Dundreary used to consider that puzzle, about the increasing number as we go back to great grandparents $(\text{great})^1$ grandparents, &c., to $(\text{great})^n$ parents. The true answer is that not a few thousand million-billions, but the whole of your large number, except a few hundred millions, must be struck off for marriages of cousins, &c., for we are *all* cousins, if men came from a single stock.—A CHURCHMAN. Pardon me; Darwin never taught—no man of science ever has taught, or could (when in his senses) teach—that there is nothing more than a First Cause setting the earth in motion and then leaving it. Darwin slightly (in reality, though to our ideas vastly) extended our recognition of the domain of law,—outside remains infinity. Biology teaches that there is a Cause setting an egg in existence, and that then, under natural conditions, the egg becomes a chick, which developes into a fowl. There is as much in this to shake your faith in Deity, as there is in the development of a world,—in other words, there is *nothing*. When you say that the truth and authority of God's Word is an established fact, you assert a truism. God's word must be true. God's works must be true also. We may misunderstand these; may we not also misunderstand those. Moreover, we are certain that everything that is, is God's work (though the very conception of a God and of His mode of working may be quite outside our powers); we may not be quite so certain that this or that book, or chapter or verse of any book is God's word. If you are "A Churchman" of one denomination—it matters nothing which—you assuredly accept as such *some* writings which churchmen of other denominations reject, and *vice versâ*. In one of the books which you probably (but how can I *know?*) regard as God's word—at any rate, it was and is so regarded by the Jewish people, and has been accepted as such by a large portion of the non-Jewish world—you will find that one whose words are there spoken of as specially approved by God, says that, "As touching the Almighty, we cannot find Him out," meaning, I take it, that we cannot by observation or experiment recognise the specific working of something outside the laws of nature. Darwin taught this—or, to speak more truly, he *was* taught this by observation and experiment. If you assert that he was wrong, you must be prepared to show on what grounds you except that particular book, or chapter, or verse, from those which a great part of the religious world regard as God's Word.—T. G. FULWOOD. Let e be the modulus of elasticity; M the momentum lost by moving ball (A), and gained by the ball (B) which was at rest, during contact and compression; then the momentum generated by the force of recovery after impact $=eM$; and the total momentum lost by A and gained by $B=(1+e)M$. Therefore, if v' be the velocities of A before and after impact, u the velocity of B after impact, we have (if m is the mass of either ball)—

$$mv' = mv - (1+e)M \qquad (1)$$
$$mu = (1+e)M \qquad (2)$$

Now if the balls were inelastic, and w their common velocity after impact, we should obviously have—

$$mv = 2mw\text{; or } w = \frac{v}{2}$$

$$\text{and } M = m(v - w) = m\left(v - \frac{v}{2}\right) = \frac{mv}{2}$$

and as M is the momentum generated before elasticity comes into play, it is the same in value whether the balls are elastic or inelastic. Hence, substituting in (1) and (2), we have—

$$mv' = mv - (1+e)\frac{mv}{2} = \frac{mv}{2}(1-e)$$

$$\text{or } v' = \frac{v}{2}(1-e)$$

$$\text{and } u = \frac{v}{2}(1+e)$$

If the balls are of great elasticity, or e very nearly equal to unity, v' the velocity of A after impact is very nearly evanescent, and u the velocity of B after impact is very nearly equal to v. In other words, in this case the moving ball is brought very nearly to rest, and the other, which had been at rest, advances with very nearly the velocity which the moving ball had had. Thus, if both balls are of glass, for which substance the modulus of elasticity $=\frac{15}{16}$, the moving ball will have its velocity reduced to $\frac{1}{32}$nd part of what it had been, and the other will have communicated to it a velocity of $\frac{31}{32}$nds of the velocity originally possessed by one ball alone.—BON ACCORD. Are not the words "Art is long" aptly associated with the reference to the shortness of life? The lesson is to do what we can each for our special art, remembering that time is fleeting,

And our hearts, though stout and brave,
Still like muffled drums are beating
Funeral marches to the grave.

M. STRONG. I fear your question whether Italian was derived from Latin or Latin from Italian would hardly suit KNOWLEDGE. There is an interesting discussion of the origin of Italian, French, Spanish, &c., in Hallam's "Middle Ages." It seems likely enough that Latin was a special form of a language spread over Western

Europe, long before the time when Latin literature began—just as the English of our best authors is a special form of a language spread over Britain and parts of Europe, long before English literature began. Rome could never have forced her language on so many nations.—J. V. M. Thanks. There are passages in Dr. Draper's works which are warm, but I have seen none unfair. The other writer you name (with whom, however, I thoroughly sympathise), has been at times a hard hitter. It is very gratifying to know that you find KNOWLEDGE free, as I have wished it to be, from sectarianism.—W. SAUNDERS. (1) For lectures on the moon nothing can be more suitable than photographic slides, say from Nasmyth's Moon, used either with the oxyhydrogen light or a good stereoscopic lantern. (2) Probably, a submerged thicket: but careful survey would be required to determine the point.—W. S. No; the word was correctly enough printed "barometer." Prof. Huxley did not, however, imply that the barometer is highest on hot days, but that on the hotter of two days of equal atmospheric pressure, and when therefore the barometer should be of the same height, the mercury stands a little higher in the barometer tube. This is correct, but not for the reason he assigns. It is the diminution of the specific gravity of the mercury, not the change in the bore of the tube, which causes the difference. A READER AND AN ADVERTISER. Thanks. I quite agree with you about having the articles as popular as possible. I scarcely see how they can be made much more popular without becoming trivial. Of course, some, as in our mathematical column, are not meant to be popular, but are for the benefit of special classes of readers. But we always give a fair supply, and rather more, of popular matter.—J. L. WHITAKER. We gladly insert your letter.—W. SHAW HAYLER. It was unquestionably a sun-spot. You do not mention the power you used.—M. C. C. It would not be easy to explain a real objective change in the colour of sunlight from golden to pure yellow during a partial eclipse. The effect was, I should think, subjective; there was a real diminution of light, and an illusory loss of colour.—T. MORGAN. Sorry your letter has remained so long unanswered; but the truth is, we get about three times as much correspondence as we can deal with, consequently some of it is four weeks old. If you send a short letter expressing your views respecting pyrological matters, we will gladly insert it.

THE TELESCOPE.

A. B. C. There are only two Nebulæ, 10 M. Ophiuchi and 12 Messier Ophiuchi, in the neighbourhood of which you speak. As, however, the former is very nearly on a line joining μ Serpentis and ζ Ophiuchi, and produced as far again, while you say definitely that the object you observed was above such a line, there can be but little doubt that it really was 12 M. that you saw. This will be referred to in due course when Ophiuchus comes to be treated of in the "Nights." Doubtless the reason why "F.R.A.S." ignored α Cassiopeæ as a double star was that its companion is more than 1' 30" from it, so that they are really two separate and distinct stars, and in no legitimate sense whatever a pair or a double one.—W. H. HARRIS. The simple numerical formula for calculating the focus of a lens equivalent to the two in a Huyghenian eye-piece is this:—Divide twice the product of their foci by their sum. Let us apply this to your own eye-piece, of which you say that the field lens has a focal length of $\frac{9}{8}$ths of an inch, and the eye lens a focus of $\frac{3}{8}$ths of an inch: then multiplying these together (according to the precept), and the product by 2, we get $\frac{27}{8}$ by 2, or $\frac{54}{8}$. Next we take the sum of the foci $\frac{12}{8}$, and dividing $\frac{54}{8}$ by $\frac{12}{8}$, we get $4\frac{1}{2}$; so that $\frac{4\frac{1}{2}}{8}$, or $\frac{9}{16}$ inch is the focus of a single lens of equal power to your combination. Finally, dividing 36 inches, the focal length of the object glass, by $\frac{9}{16}$, the focal length of the eye-piece, we obtain 64 as the magnifying power of the latter with that object-glass.—J. SMITH. The amplifying power of a Barlow lens depends upon its position in the cone of rays from the object-glass. If we call the distance of the lens from (i.e. within) the focus of the object-glass d; then if its negative focal length be $2\,d$, it will exactly double the power of every eye-piece. In other words it would give an amplification of 160 with your 80 eye-piece and of 800 with the 400 one. In your case this result would obviously be attained if you had a Barlow lens of 8 inches (negative) focus placed 4 in. within the focus of your object-glass, or, in other words, 56 in. from it.

[About three pages of "Answers" have been unavoidably held over.]

Our Mathematical Column.

THE LAWS OF PROBABILITY.

IT seems better to give the most general law for inverse probabilities before proceeding to deal with illustrative examples. This we proceed to do:—By extending the reasoning employed in the last paper, the reader will have no difficulty in seeing that if there are three or more bags, each containing the same number of balls, of which p in the first bag are white, q in the second, r in the third, and so on; then, if a bag is selected at random, and a ball drawn at random proves to be white, the chance that the first bag was selected is $\frac{p}{p+q+r+\&c.}$; the chance that the second was selected is $\frac{q}{p+q+r+\&c.}$; the chance that the third was selected is $\frac{r}{p+q+r+\&c.}$; and so on. Nor will he have any difficulty in making the requisite modifications where the several bags contain different numbers of balls. The method to be followed is precisely the same as I employed in the simpler case of two bags, and the result is similar, viz., that if the chance of drawing a white ball from the first bag is C_1, that of drawing a white ball from the second bag C_2, that of drawing a white ball from the third bag C_3, and so on; then, if a white ball is drawn from a bag selected at random, the chance that the first bag was selected is $\frac{C_1}{C_1+C_2+C_3+\&c.}$; the chance that the second bag was selected is $\frac{C_2}{C_1+C_2+C_3+\&c.}$; and so on.

This result, extended to the more general case of which the bags of balls are merely illustrative, becomes the following general law:—

If there are three or more hypotheses all equally likely, and mutually exclusive, so that only one can be true, and if on the first hypothesis the chance of an event is C_1, on the second the chance of an event is C_2, on the third C_3, and so on; then, if the event occur, and we know, further, that it must have resulted from some one of the conditions inferred by the hypotheses, the chance that the first hypothesis is the true one is $\frac{C_1}{C_1+C_2+C_3+\&c.}$; the chance that the second is the true one is $\frac{C_2}{C_1+C_2+C_3+\&c.}$; and so on.

One step further, and we have the most general law of all. The above law supposes all the hypotheses to be equally likely in the first instance—a state of things obviously corresponding to the equal chances that any one of the bags will be selected. To illustrate the case where the hypotheses are not equally likely in the first instance, we must assume that the chances of drawing the several bags are not equal. Now, if we consider the case of two bags, we shall be able to deduce the general law we require. Thus, suppose there are two bags, and that the chance of selecting the first is $\frac{2}{5}$; that of selecting the other being $\frac{3}{5}$ (for, since one or other must be selected, the sum of these probabilities must be equal to unity); and, as before, let the chance of drawing a white ball from the first bag (if selected), be C_1, that of drawing a white ball from the second bag being C_2. Then we may represent these two chances by supposing that there are two bags of the first kind and three of the second kind, all equally likely to be taken; for it is obvious that the chances that the selected bag belongs to the former or latter kind are, respectively, $\frac{2}{5}$ and $\frac{3}{5}$. Now, by the general law already obtained—if a white ball is drawn, the chance that it came from a specified bag of the first kind is,

$$\frac{C_1}{C_1+C_1+C_2+C_2+C_2}, \text{ or } \frac{C_1}{2\,C_1+3\,C_2},$$

and the chance that it came from one or other of these two bags is $\frac{2\,C_1}{2\,C_1+3\,C_2}$. Similarly, the chance that it came from one or other of the three bags of the second kind is $\frac{3C_2}{2C_1+3C_2}$.

Noticing how this result has been obtained, and proceeding at once to the law which the bags of balls illustrate, we obtain finally this general law, including all the preceding laws (of indirect probabilities):—

If an event cannot happen unless some one of a set of hypotheses, H_1, H_2, H_3, &c., be true (these hypotheses being mutually exclusive), the antecedent probability of H_1 being c_1, that of H_2, c_2, and so on; and if on the hypothesis H_1 the chance of the event happening is C_1, on the hypothesis H_2 the chance of the event happening is C_2, and so on; then, if the event happen, the chance that H_1 is true is

$$\frac{c_1 C_1}{c_1 C_1 + c_2 C_2 + c_3 C_3 + \&c.};$$

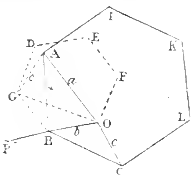
the chance that H_2 is true is

$$\frac{c_2 C_2}{c_1 C_1 + c_2 C_2 + c_3 C_3 + \&c.};$$

and so on.

(To be Continued.)

SOLUTION OF Y'S PROBLEM.—Upon the line OB, taken $=b$, construct the n-sided polygon, OBGD, &c. (in the figure $n=6$). Join the two alternate corners, O and G, by a diagonal OG. Upon OG as a base construct the triangle GAO, making the two sides OA and GA $=a$ and c respectively, and taking care that A and B lie on opposite sides of OG.



Join AB, and on it construct the polygon of n-sides ABCLKI, which is the polygon required. For

By construction OA $=a$, and OB $=$ b; also the triangles GAB and BOC are equal; because GB $=$ BO, AB $=$ BC, and angle GBA $=$ CBO (each being equal to the interior angle of the n-sided polygon diminished by the angle ABO). Hence OC $=$ AG $=c$. Q. E. D.

SCHOLIUM.—If the point P^1 be determined *on the same side* of OG with B, then the line BP^1 will be the side of a polygon fulfilling the conditions of the problem, except that the point O will lie *outside* of the polygon.

Our Whist Column.

By "FIVE OF CLUBS."

PLAY THIRD HAND.

THE general principles which should guide the play third in hand are—First, and chiefly, to help and strengthen your partner as much as possible in his own suit; secondly, to derive all possible advantage from any strengthening card he may play in your own suit; and thirdly, to retain as long as possible such partial command as you may have in an opponent's suit. You can generally tell (from the lead, the play second hand, and your own hand) whether your partner has led from strength, or to strengthen you, or from a weak suit in which he has no means of knowing your position. This will be obvious from what we have already said about interpretation of the lead and the play second hand. Your play will be guided accordingly.

Let us begin, then, by considering the play third in hand: and afterwards, as heretofore, with the lead and second hand, we can consider the inferences to be drawn from the play of particular cards third in hand.

If you hold Ace third in hand, and neither King nor Queen, you play it in plain suits, unless King or Queen has been led. The only exception to this is when ten has been led and you hold Ace, Knave, when it is best to pass the ten. With Ace, King, you put on King, as a rule. But with Ace, King, and more than one small one, a good hand and four trumps, you should not put King on your partner's Knave, but pass the Knave; fourth in hand is sure to take the trick; but when trumps are out you are tolerably sure of getting in again, when you make two tricks at least, and probably three in the suit. On the other hand, with Ace, King, and small ones, but only three trumps, you should not pass the Knave. The principle here applied is general. With good strength in trumps, you may usually finesse with advantage in a suit in which your partner has led a strengthening card; but when short in trumps, such a finesse is unadvisable.

With Ace, Queen, alone or with others, you should finesse the Queen, or the lowest card in sequence with the Queen—unless a single trick will make or save the game, when, of course, such a finesse would be a Whist atrocity.

With King, Knave, &c., some players finesse the Knave. This is only right when you have such strength in the suit as to feel sure your partner has led a strengthening card from a short suit. It is nearly always wrong to finesse in your partner's suit. The finesse from Ace, Queen, &c., is almost the solitary exception to this rule. You should, therefore, in general play King, from King, Knave, third hand. When nine is led, and you hold King, Knave, and others, you pass the nine, if strong in trumps, and the state of the game is not critical (supposing always that second player has not covered the nine). Otherwise, you may either finesse the Knave, or not, as you may deem best. Fourth player is as likely to hold Ace and no other honour, as Queen and no other honour: if he holds both Ace and Queen, it is indifferent what you play; he will, in any case, remain with an honour over you.

(To be continued.)

A correspondent points out what, of course, I had noticed myself, that there is a double—really a single—error in my notes to the "Hand for Study," in No. 30. I had originally written out the hands and play from memory, being away from my books. I supposed B had three trumps, whereas in the actual game he had but two. Hence, in my notes, referring to second trick, I said B returns the highest of two cards left; and referring to third, A leads trumps again, though he is drawing two for one. Of course, when I saw the play of the hands, which had been taken direct from Cavendish, I recognised my mistake. But from some cause or other the necessary corrections were not made. The point of the game, however, is not affected by the mistake.

VALUE OF GOOD PLAY.—A correspondent asks whether good play really counts much at Whist, and describes several tests to which he has subjected the matter, with the result that good players have no better chance than bad ones. There is so much chance, unfortunately, in Whist as actually played (it might be immensely improved in this respect) that a casual observer, or one who watches play for only a few weeks, or even months, might very well suppose that bad players have quite as good a chance as the best players. But no one at all acquainted with the game practically can doubt that in the long run good play must invariably get the better of bad play. Not a Whist evening passes but a practised player will note half-a-dozen cases or more in which tricks—sometimes two or three at once—have been lost by bad play; while not more than one or two cases will occur during the same time, in which bad play has, by an accident, turned out well or good play ill.

Cavendish's experience should suffice—owing to its wide extent and carefully noted results—to settle this point finally and for ever. He tells us that of 30,668 rubbers played from January, 1860, to December, 1878, he won 15,648 rubbers and lost 15,020, and counting points, which tell far more, he won in all 85,486 points and lost 81,055, gaining thus a balance of 4,431 points. It is practically impossible that so large a balance in his favour should be due to mere chance. The difference must have been due to play. Were two good players matched in as many rubbers against two bad ones, the difference would be far greater.

Our Chess Column.

By MEPHISTO.

VIENNA INTERNATIONAL TOURNAMENT.

After the finish of the 20th round on Saturday, June 3, the score stood as follows :—

Mackenzie	13½	Zukertort	11½	Tschigorin	8
Steinitz	13½	Hruby	11	Weiss	8
Mason	13	Wittek	9½	Bird	7½
Winawer	13	Schwarz	9	Ware	6½
Englisch	12½	Meitner	8½	Fleissig	6
Blackburne	12	Paulsen	8		

Dr. Noa has withdrawn from the Tournament. From the above score it will be seen that the English players are well to the fore, and we think that they will still more improve their position for final place.

On Thursday, June 1, Blackburne had to meet Steinitz, and the former won he conquering his mighty opponent in only twenty-seven moves. Nevertheless, Steinitz has drawn well, he having reached Mackenzie's score, who had been leading, by personally vanquishing his rival for the time being, in their second game, which was played on Saturday, the 3rd inst. Steinitz's victory over Mackenzie will have an important influence on the final issue. Zukertort drew with Mackenzie and Winawer, but he defeated Mason, who is doing very well, as can be seen from the above score:—

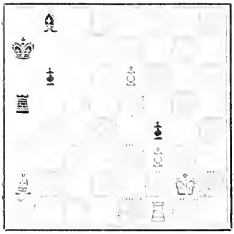
B. *Telegram.*] Vienna, Tuesday night.

The leading players are Steinitz, with 15, Winawer 15, Mackenzie 14½, Mason 14½, Englisch 13½, Blackburne 13, Zukertort 13, Hruby 11, Schwarz 10½, Weiss 10½.

We surmise from the above telegram that the second game between Steinitz and Zukertort must have resulted in a draw.

PROBLEM No. 45. End Game by B. Horwitz.

BLACK.



WHITE.

White to play and win.

1. P to K7	1. R to K4

If 1. R takes B(ch), 2. R to B2 and the Pawn will Queen.

2. B to Q5	2. P to Kt4

White threatens mate by R to Rsq. If Black plays his B then R to Rsq(ch) and R8(ch) and Pawn Queens.

3. R to Ksq	3. R takes R

4. B to K4 and Pawn Queens and wins.

Game played in the Vienna International Tournament on May 14, 1882.

TWO KNIGHTS' DEFENCE.

White. Bird.	Black. Tschigorin.	White. Bird.	Black. Tschigorin.
1. P to K4	P to K4	19. Q to K2 (*f*)	Kt takes P
2. Kt to KB3	Kt to QB3	20. P to Kt3	Q to B4
3. B to B4	Kt to B3	21. K to Kt2 (*g*)	R to K3
4. Kt to Kt5	P to Q4	22. QR to Ksq (*h*)	QR to Ksq
5. P takes P	Kt to QR4	23. R to KRsq	P to KR4
6. B to Kt5 (ch)	P to B3	24. QR to KBsq (*i*)	Q to Kt3 (*j*)
7. P takes P	P takes P	25. Kt to Qsq (*k*)	P to K6 (*l*)
8. B to K2	P to KR3	26. B to Q4 (*m*)	Kt takes BP
9. Kt to KB3	P to K5	27. R takes Kt	Q takes P (ch)
10. Kt to K5	Q to B2 (*a*)	28. K to Bsq	P takes R
11. Kt to Kt4 (*b*)	B takes Kt	29. Kt to K3	P to QB4
12. B takes B	B to Q3 (*c*)	30. B to B3	R takes Kt (*n*)
13. P to KR3	Castles	31. P takes R	R takes P
14. Kt to QB3	Kt to B5	32. Q to Qsq	P to R5
15. P to QKt3	Kt to K4	33. B to Q2	P to R6
16. B to Kt2 (*d*)	KR to Ksq	resigns (*o*)	
17. Castles	Kt f K4 takes B		
18. P takes Kt	Q to Q2 (*e*)		

NOTES.

(*a*) This move is less attacking than Q to Q5, but it gives Black a good steady game.

(*b*) This defence is awkward; we prefer 11. P to KB4, B to Q3. 12. P to Q4, Castles. 13. P to B3, P to B4. 14. Kt to R3, P to R3. 15. Kt to B2.

( ) The Bishop occupies a good position on Q3; for the present it hampers White's development, and prevents his Castling.

(*d*) The Black Knight is very well placed on K4. White ought not to have hesitated any longer to withdraw his Bishop from its awkward position on Kt4 to K2.

(*e*) This gives Black a decided advantage.

(*f*) An effort to save the Pawn would have been unsuccessful; if, for instance, 19. P to B3, then Black plays B to B2, threatening Q to Q3, but if White replies to B to B2 with 20. Kt takes P, then Kt takes Kt. 21. P takes Kt, R takes P again, with a good game.

(*g*) A natural move; it enables White to oppose R on Rsq, should Black play Q to R4.

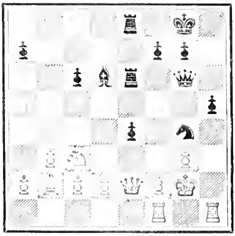
(*h*) We should have preferred 22. Kt to Qsq, to be followed by Kt to K3, or R to Rsq. QR to Ksq was not a defensive move; it would have been better to wait till the Queen's Rook was wanted; for, as actually occurred later on, this Rook played to Bsq, thus losing time.

(*i*) White has, as we pointed out in our former note, uselessly lost a move with his Queen's Rook.

(*j*) Black is playing with great tact; he initiates an ingenious combination, based upon the possibility of taking the Bishop's Pawn with the Knight, and then winning by taking the Knight's Pawn with the Queen, as she would be supported by the Bishop. We give a diagram of this interesting position:—

TSCHIGORIN.

BLACK.



WHITE.

BIRD.

(*k*) White ought to have seen the danger and played 25. R to R3.

(*l*) Highly ingenious, if now P takes P, then Kt takes P (ch), Kt takes Kt, R takes Kt, and wins. Of course, he dare not take with the Bishop's Pawn, on pain of Q takes P (mate).

(*m*) Although White's game is apparently hopeless, we should even now have preferred 26. R to R3, and, if Black replied, P takes BP, 27. Q to Q3, but it was only a question of which way to die. 26. P to KB4 would have been met by Black with P takes QP, 27. Q to Q3, R to K7 (ch), 28. Kt to B2, Kt to K6 (ch), &c.

(*n*) This brings matters to a speedy termination.

(*o*) As he cannot escape the ingenious mate prepared by Black, for if 34. B takes R, Q to Kt7 (ch), 35. K to K2, P to B8 Queens, with a double check and mate.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess-Editor.*

Correct solution of Problems Nos. 43 and 44 received from Francis J. Drake, C. W. Croskey, Clarence John Watson, Senex Solitarius, T. A. S., Berrow, Kit, H. A. N., G. W., J. B. of Berford, Moleque, B. G. Sergeant, Alfred B. Palmer, Leonard P. Rees, J. Bunyan, J. A. Schmucke, J. P., Herbert Jacobs.

No. 42 correctly solved by Brenton, C. W. Croskey, J. B., and Herbert Jacobs.

Novice. Tell us where you stick; we will help you.

G. R.—We did not consider it necessary.

Kit.—In No. 351, Q to Bsq., 1. P takes P, and there is no mate.

NOTICES.

The First Volume of KNOWLEDGE will be published this week, bound in red cloth, gilt lettered. Price 10s. 6d. Vol. I. will comprise the numbers from the commencement (Nov. 4, 1881) to No. 30 (May 26, 1882). As there is only a limited number of copies, the Publishers advise that orders should be sent in without delay, to prevent disappointment.

The Index to Volume I. will also be published, price 2d., post-free 2½d.

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KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, JUNE 16, 1882.

Contents of No. 33.

THE GROSVENOR GALLERY.

[Second Notice.]

Art and science are so closely akin, and both are so manifestly included under the general head Knowledge, that we need make no excuse for treating works of art from the artistic as well as from the scientific standpoint. Yet we shall not dwell further on those enormities of the æsthetic and maniac schools which are manifest at once to the artistic eye. We must, in passing, note that a word in excuse may be said for the followers of the modern Mediæval school. There is a natural temptation for those who find that, though eager to cover canvas, they can neither draw nor paint, to take work in hand which requires skill neither in colouring nor in drawing. "You are not pretty, my child," said a clever mother to her daughter; "therefore, you had better be odd. It is your only chance of attracting attention." This, which is the *raison d'être* of the æsthetic school generally, is a sufficient principle for the painters of that school. Any one can copy a mediæval picture without faults detracting from its mediæval character: a little change in an impossible limb does not make it less mediævally impossible; a slight difference in some ghastly tint gives only another ghastly hue, which still remains mediævally hideous. Therefore, if we were advising a would-be artist who could neither paint nor draw (and who was too lazy to learn) how he might obtain an easy notoriety, we should tell him to try the mediæval school. "You are too unskilful or too idle," we might say, "to paint anything really good; therefore go in for oddity. Even *your* drawing will not spoil a mediæval figure. You know as much of perspective, linear and aerial, as the mediæval painters did (who knew nothing); you cannot err much more egregiously through want of talent and energy than they did through want of experience. Follow, then, their school. Carefully copy all their faults. Pretend that you find in deformity beauty which others cannot see, in sickly tints a delicacy of hue which others cannot appreciate. Remembering that as there are always many foolish people, you may be sure of a following, after a fashion." In every age there have been these affectations, though we learn it, unfortunately, not from any works which have survived, for all the works of such schools have a fatal facility in fading out of view, but from occasional passages of ridicule in writings by contemporaries who have survived. In this way the memory of even æsthetic absurdities may be handed down—to an amused posterity.

Of the Whistler school it need only be said that as there are some who take idiocy for ecstacy, there may be a few who find genius in insanity.

It would be unfair to class Mr. Paget's "Odysseus" (No. 26), with either the idiotic or the insane schools of art. He has honestly and painstakingly—almost painfully—endeavoured to work out a certain idea: only, unfortunately, the idea was not altogether a good one, or what was good in it only a very great artist could effectively educe. Ulysses steering towards the setting sun, his body illuminated by the rays of the sinking orb, a dark purple gloom gathering over the mountains behind, broken only here and there by touches of ruddy light—this were a subject, indeed, for a noble painting. How finely might the worn but resolute face of the wanderer be presented, sadness and courage contending over it even as the gloom and glory of sunset were contending on sky and sea and mountain height! In such a work a great painter would not have suffered the thoughts to be distracted from the poetry of the main idea by trivial accessories. He would not (apparently for no other purpose) have added to the artistic difficulties of his subject, by endeavouring to do what no artist has ever yet done successfully in ideal painting,—to represent, namely, one half only of a boat (in other words, to present the picture from an impossible point of view). It is this which Mr. Paget has done, and herein, we conceive, began the difficulties which led to this picture becoming a rather painful failure instead of a decided success, as it might have been if the artist had not overweighted himself with difficulties. Albeit the hero's face is hopelessly coarse and commonplace; and in a scientific sense we must object to the head which Mr. Paget has assigned to the man of keenest intellect and widest experience among the heroes who fought before Troy: Ajax Telamon rather than Ulysses is here depicted.

If we had not known that Mr. Holman Hunt can paint, and paint well, we should not have discovered it from the ridiculous picture which he has chosen to call "Miss Flamborough." Ill conceived, ill drawn, and worse painted, it is utterly unworthy of him.

Mr. Muybridge has, we believe, left England for America. We trust he did not, before he went, observe Mr. Clarke's picture "Labour" (No. 38), with its impossible horses, or Mr. Barclay's "Early Steps" (No. 13), with its very singular calf. "Flora," in No. 47 (R. W. Macbeth), ought, if she were wise, to get rid as quickly as possible of those hounds, whose villanous faces accord ill with their ridiculous shapes.

The "Release of Prometheus by Hercules" (No. 57, by Mr. Richmond), and the "Entombment" (No. 51, by Julian Story), are pretentious but ill executed attempts, a very long way "after the" great master whose style is aped.

Of Mr. Richmond's portrait of Mr. Gladstone (No. 77), it were well to say nothing, since nothing good can be said. But there are some excellent portraits by Mr. Richmond, showing that if he has painted Gladstone so that the Premier's worst enemies must feel a touch of sympathy for him, he can do what is very good when not over taxed by the wish to do something very great.

The finest portrait, however, in the Grosvenor collection this year is among the sculptures, Mr. E. Roscoe Mullins's bust of the Rev. Stopford Brooke (No. 368). We do not remember to have seen for many years a sculptured portrait so full of character. Compare this work with another by the same sculptor—the bust of Mr. Shaw in the Royal Academy—and it will be seen that as wide a range of character can be covered in sculpture as in the sister art, and that sculpture is admirably suited (in skilful hands) for the delineation of subtle shades of character. That Mr. Mullins should have succeeded in indicating intellectual power in one bust, and business capacity in the other, is, of course, little. But he shows the precise quality of the intellect in one case; in the other the special character of the aptitude for business.

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

By AMELIA B. EDWARDS.

II.—JOSEPH'S PLACE IN HISTORY.

M. DE ROUGÉ'S argument, steering clear of chronology, hinges principally upon the name of the "treasure-city" built for Pharaoh by the Israelites; but this argument, strong as it is, would be greatly strengthened if we could show a distinct correspondence between the space of time assigned to the Hebrew sojourn and the space of time which divides Joseph from Rameses II. Before any such test can be applied, it is, however, essential that we endeavour to find out as nearly as possible under what Pharaoh Joseph rose to power. Now, the time of the sojourn in Egypt is expressly stated at 430 years (Exodus, chap. xii., verses 40 and 41), and the age of Moses at the time of his return from Midian (not at the time of the Exodus from Egypt, as M. de Rougé puts it) is as expressly stated to have been eighty years (Exodus, chap. vii., verse 7). To those who know not the chronological pitfalls which enliven the paths of Egyptology, it may probably seem that nothing would be easier than to allow eighty years for the age of Moses, and thence, by a retrograde calculation of 430 years, to arrive at the Pharaoh of Joseph. The method is doubtless excellent; and if by counting back 430 years from Mr. Gladstone's return to office in 1880, we sought to determine under whose reign Jack Cade made himself master of London, it would answer the purpose quite satisfactorily. But not thus can we go to work when dealing with Moses and the Pharaohs. It is not possible, indeed, to apply ordinary chronological methods to inquiries concerning early Hebrew or Egyptian history, because neither the Hebrews nor the Egyptians had any fixed era from which to reckon. Neither had they any exact system of reckoning. The Hebrews counted by generations—that is to say, by a rough and-ready system of averages. The Egyptians counted by the regnal years of the Pharaohs, and these regnal years were liable to much miscalculation. Sometimes an old king shared the throne with his heir during the latter part of his reign; and in many cases a Pharaoh began by reigning with his father and ended by reigning with his son. Rameses II., for instance, with whom we are now especially concerned, reigned as Pharaoh-Coadjutor during the latter years of Seti I., and himself resigned the cares of government to his successor, Menephthah, twelve years before his death. Again, a king's reign was sometimes counted from the beginning of the year in which his predecessor died, and sometimes from the day of his own coronation. Nor do the possibilities of confusion end here. All dynasties were not legitimate, or even successive; and not merely certain Pharaohs, but whole lines of Pharaohs, were consequently passed over by conservative historians, as though they had never existed. There are, in fact, very few even approximately certain dates in Egyptian history before the period of the XXVIth dynasty, and those few (among which Mr. R. A. Proctor's astronomical date for the building of the Great Pyramid must henceforth occupy a foremost place) can only be regarded as landmarks planted here and there in a wide waste of uncertainty.

Granted, then, the impossibility of conducting our present inquiry upon a purely chronological basis, we are reduced, firstly, to the evidence of tradition; and secondly, to the internal evidence of the text.

According to the evidence of tradition as handed down by two early Christian writers (Eusebius, A.D. 300, and George the Syncellus, A.D. 800), Joseph was sold into slavery at a time when Lower Egypt, and possibly the whole of Egypt, was occupied by a race of foreign invaders known as the Hykshos, or Shepherds. The nationality of the Hykshos is not exactly determined. We only know that they were predatory tribes of Asiatic origin (probably Syrian and Sinaitic), and that towards the close of the XIVth dynasty they descended on the land in vast hordes, slaying, ravaging, and confiscating all before them. Their rule extended over three dynasties, namely the XVth, XVIth, and XVIIth, and is supposed to have lasted for five hundred years. The native princes, meanwhile, were driven southwards, and some would seem to have ruled as tributary chieftains at Thebes.

These hieroglyphs are:—1. A little garden, pronounced *Sh*. 2. An eagle; *a*. 3. A young shoot; *Su*. 4. A chick; *u*, being a confirmation of the vowel-sound. 5. A man signifying the general sense of the word. 6. Three upright strokes, meaning "many," or a noun of number.

The name "Hykshos" is supposed to be derived from *Hyk*, "ruler," and *Shasu*, "shepherd," or plunderer; *Shasu** being a word used in a general sense to denote the tribes of the Eastern frontier; and thereby seeming to indicate that the Hykshos were originally tent-dwellers and herdsmen, like the wandering Bedaween Arabs of the present day. Abraham's visit to Egypt probably took place during the reign of some Hykshos king of the XVth dynasty; while Joseph is traditionally said to have flourished towards the close of the XVIIth. This, the last Hykshos dynasty, was governed, in the opinion of the late Mariette Pasha, by kings of Hittite nationality. It is, at all events, a singular and a significant fact that Set, or Sutekh, the great god of the Hykshos, was also the god of the Hittites.

We will now turn from tradition to the internal evidence of the text.

I need not recapitulate the beautiful and affecting story of Joseph—a story in which every touch of local colour, whether as regards names, customs, or incidents, will bear the strictest archæological scrutiny. For our present purpose, I need only quote Joseph's instructions to his brethren, before he introduces them to Pharaoh:—

"I will go up," he says, "and show Pharaoh, and say unto him, My brethren and my father's house (*i.e.*, household), which were in the land of Canaan, are come unto me;

"And the men are shepherds, for their trade hath been to feed cattle; and they have brought their flocks, and their herds, and all that they have.

* The Abbé Vigoureux has pointed out how the Hebrew root שסה, *sâsah*, or שסס, *sâsas*, "to devastate," "to pillage," is used in the Bible to designate the forays of the Bedaween heathen. See "La Bible et les Découvertes Modernes," vol. ii., p. 86. 1882.

"And it shall come to pass, when Pharaoh shall call you, and shall say, What is your occupation?

"That ye shall say, Thy servants' trade hath been about cattle from our youth even till now, both we, and also our fathers: that ye may dwell in the land of Goshen; *for every shepherd is an abomination unto the Egyptians.*" (Genesis, Chap. xlvi., verses 31, 32, 33, 34.)

In accordance with these instructions, we presently find them saying to Pharaoh:—"*Thy servants are shepherds*, both we, and also our fathers;" to which statement Pharaoh replies by making them welcome, and assigning "the best of the land" for their place of dwelling."

Now it is hereby evident that if to be a shepherd ("*Shasu*") was an abomination to the Egyptians, it was a recommendation to Pharaoh. That the name should be hateful to the conquered race was inevitable; and although the invaders had become so thoroughly naturalised that they now ruled in all respects after the manner of the native Pharaohs, it was impossible that the Egyptians should forget the horrors of the past. But to one of *Shasu* origin that name would be dear and honoured. And it would convey a sense corresponding to "son of the desert," rather than to "shepherd," or "plunderer." Also it would imply a Semitic, and therefore, in this case, a common ancestry. Granted that Joseph was the favourite minister of a Hykshos ruler, he could have given his brethren no better advice than when he bade them tell Pharaoh that they came from the land of Canaan, and had been shepherds from their youth. Just so might a poor laird from Roxburgh or Dumfries, who had risen to office under James I., counsel his raw kinsfolk from the northern side of the Cheviots. If King Jamie questioned them, they must surely tell him they were Lowland Scots, and as such had played their part in many a border fray; and this notwithstanding that a Lowland Scot was an abomination to the English. The Percys and the Stanleys would, it is true, despise them for cattle-stealing barbarians; but to be a Lowland Scot was a sure passport to the favour of the king. The internal evidence of the text confirms, in short, the evidence of tradition, and shows that the Pharaoh of Joseph can have been none other than a Hykshos.

(*To be continued.*)

THE AMATEUR ELECTRICIAN.

ELECTRIC GENERATORS (*continued*).

THE simplest device for collecting the current from the revolving armature is to have two upright springs, S S' (fig. 10), metallically connected to the terminals or binding-screws, T T'. With the commutator in the position illustrated, the current passes from the brass sections, A B, the circuit being completed through whatever apparatus may be connected to T T'. When the armature has performed a quarter of a revolution—that is to say, when the sections C D are in contact with S S' the circuit is disconnected, and accordingly no current is passing. This lasts, however, for a very brief space of time, and is not noticeable. Where this plan is adopted, A B must be fixed to the ebonite in such a way that when in contact with the springs the armature shall be in the position illustrated in fig. 6 (KNOWLEDGE, May 26). A more satisfactory plan, however, and one that will lend itself to modifications in the general details of the machine, is to employ what may be called a "rocker." Fig. 11 will illustrate it. R R is a part of a brass ring, not less than an eighth of an inch thick, and about half an inch wide. A slot is cut in the ring at E, about half an inch long, a screw holding it firmly to the base plate. Caps of ebonite or such like insulating material (F F) are fixed to the ends of the rocker, and thin strips of brass (K K) on to the surfaces of the caps. Similar strips of brass (L L) are

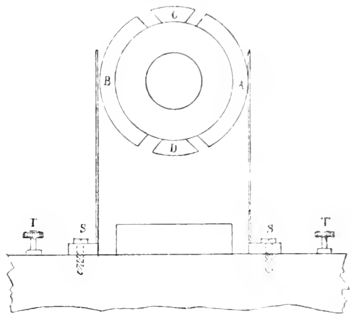


Fig. 10.

attached by the thumb-screws to K K. Between these pairs of brass strips or plates, the copper brushes (M M) are clamped. They are simply strips of sheet copper, cut for about half their length, so as to present the appearance of combs, with very close, but rather broad, teeth. The ebonite should, for various reasons, be of larger section than the rocker (say one inch by three-eighths to a half) while the surfaces should be inclined at such an angle as to make the distance between the brushes a little less than 1¼ in.,

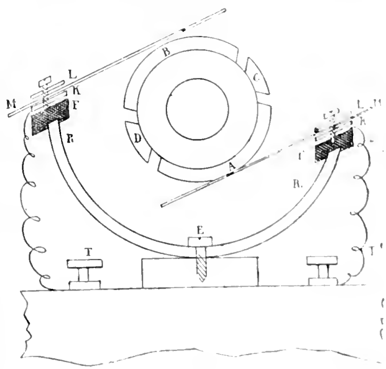


Fig. 11.

both inclinations being at the same angle, one inwards, the other outwards. Care must be taken that the ebonite effectually insulates the brushes from the rocker; spiral springs (made by winding rather stout copper wire round a pencil) being used to connect the brushes to the terminals T T. In the diagram, the brass plates are drawn slightly away from the ebonite caps for the sake of clearness. The object of the slot (E) is to allow of the alteration of the point of contact between the brushes and the commutator—a necessary feature, as will be seen by experience.

One of the most important points in connection with an electric generator is the motive power. This may take the form of a treadle or an ordinary multiplying wheel turned by hand. To a great extent, we must leave the arrangement of this matter with the experimentalist; but the wheel should be as far as possible from the armature, say 18 inches, the wooden base, where a multiplying wheel is used, being about 11 inches by 24 inches. It may be pointed out, however, that the width is not necessarily the same throughout. Owing to the smallness of the armature pulley-wheel, an endless gut band is requisite,

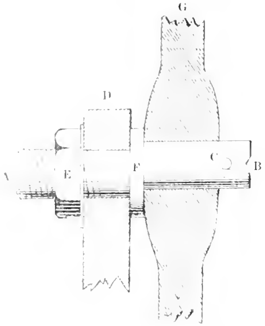


Fig. 12.

but some arrangement to compensate for its stretching is essential. Fig. 12 illustrates a simple device; D represents a standard 1 inch thick, if of wood, ½ an inch if of metal, through which passes a shaft A B, of the section shown, cut from a five-eighth rod to half-an-inch in diameter at each end. It is provided with a screw thread at the extremity A, and a slot like that on a screw-head at B, a pin (C) being driven through to hold a light metal or wooden wheel (GG) 9 to 12 in. in diameter, in position, sufficient freedom being allowed for the wheel to revolve easily. E is a nut, screwed on at A, to pull AB tight up to the boss F. On first adjusting the band, the end (B) of the shaft should be turned towards the machine. As the band stretches, B should be gradually turned towards the remote side, thus increasing finally the distance between the centres of the wheel and the armature by a quarter of an inch.

HOW TO GET STRONG.

(Continued.)

WE have first to notice that it is by no means necessary, as many imagine, to give much time daily to exercise in order to acquire a strong and hearty body. On the contrary, many who, dissatisfied with the condition of their health and strength, have begun to take more exercise than before, have defeated their purpose by taking too much exercise. To exhaust the frame by long walks and rides, or by undertaking some difficult and arduous system of training, would be unwise, even if the sole object were to acquire strength; but where the ultimate object is to increase the capacity for the work of life, and this work is only indirectly dependent on bodily strength, it is next door to madness to exhaust the frame by efforts for which it is unfit.

Let it be noticed, then, that apart from such exercise as falls naturally into the day's work, an hour a day, or even four times a week, devoted to systematic exercise, will suffice first to restore and afterwards to maintain the strength of the body. It was with this small amount of daily training that Maclaren attained such remarkable results, adding girth to the chest and limbs, increasing the weight and muscular development, changing actually the shape of the bony framework of the body,—in grown men,—not in long periods of time, but in a few weeks.

Next it is to be noticed that for successful efforts in this direction we do not want heavy dumb-bells and clubs, or gymnastic apparatus for the achievement of difficult feats. No apparatus at all is, indeed, absolutely necessary, but light dumb-bells (from 3 lb. to 6 lb.) may be used with advantage, and light clubs are still better; while by some simple contrivances, costing a few shillings, a bed-room, bath room, landing, or hall, as may be convenient, may be turned into a temporary gymnasium, containing everything necessary for exercising every muscle of the body. It is always well, however, to include among the exercises some which require a certain degree of practice for their proper accomplishment, as this gives interest to the work. For this reason, ball-play (outdoor or indoor) was deservedly approved by ancient physicians. Fencing, single-stick, and other such encounters are good, if entered upon with due moderation, both as to time and as to the spirit with which they are carried on.

THE CHEST.

First and foremost in all exercises comes the development of the chest, because this development means the increase of lung-power and heart-power, improvement in the breathing, and in the circulation. Scarce one in a hundred among men in middle life has his breathing apparatus in respectable order. A man in good health ought to be able to run a mile at a moderate pace without inconvenience. But how many can do this? We do not invite paterfamilias to try the experiment, unless he is prepared to stop the trial so soon as he is satisfied that he cannot run the mile *without inconvenience*. For there is danger in the experiment, if the question is whether, by sheer endurance, he can get through the mile at any pace resembling a run. Let any man, even as young as twenty-five or thirty, who has let day after day pass for several years without duly exercising his chest, content himself by running until it would be distressing to him to continue the exercise: he will very quickly recognise how much beyond his power running a mile, without distress, has become,—entirely through his neglect of daily exercise.

Not a day should be allowed to pass without exercise by which—at least three times each day—every air-cell of the lungs has been filled to its utmost capacity. Once, at least, each day this should be done by active exertion, such as a sharp, but not distressing, run, increasing gradually until two or three hundred yards are covered at full speed, or from half a mile to a mile at a steady swing. But any run long enough to set the lung bellows actively at work will suffice for this purpose. Instead of running, however, some may prefer sparring. This is capital exercise for the chest, and is good also for the arms and shoulders. A live opponent is not needed—in fact, is not desirable; for where there is one the exercise is apt to be continued too long, and repeated only intermittently, whereas it should be carried on daily, and for a limited time only. A calf-skin bag, fourteen or fifteen inches in diameter, hung by a stout cord from the ceiling (if there is a beam to it, or from a cord stretched between two high nails on opposite sides of the room), will make a capital dumb boxer. The bag should hang at about the height of the chin, so that its highest part is opposite the eyes and its lowest part opposite the chest. Pound away at this as if it were the head and shoulders of a living opponent. Hit out from the shoulder so that it flies up to the ceiling; catch it "a good one" as it flies back towards you; advance a step, and hit it so that at the next rebound it flies over your head; spring sharply round, and meet it on that side: hit it upwards till the cord loops; hit it round arm, so that if you are not quick enough, it catches you on the back of the head. In five minutes' time, (which, later, you may extend to ten), you will be puffing and panting like the conventional grampus. You can then rest, or turn to some other less active exercise among those to be hereafter described.

But there is an excellent and too much neglected exercise for the chest which requires no apparatus at all, and can be taken without leaving your room, or even your seat. It is simply the steady inhaling of air (at the nostrils) until the lungs are fully distended, holding the air there for a while, and then slowly expelling it. A time-keeper is useful with this exercise, so that its effect in improving the capacity of the lungs and increasing the power of the breathing apparatus generally, may be tested. In a capital little book, by Mr. W. Blackie, bearing the same title as this series of papers, the following case, illustrating the good effects of a practice in effect identical with this, is cited:—

"Some years ago, Dr. G., of Boston, showed us a photograph of himself taken several years previously. The shoulders were warped forward, the chest looked flat, almost hollow, and the face and general appearance suggested a delicate man. He was inclined, he said, to be consumptive. Well, by practising breathing (not in an ordinary 'blowing machine,' where you empty your lungs of about all that is in them, but an inspirometer, from which, instead, you inhale every inch of air you can), and by practising vigorous working of his diaphragm, he had so expanded his lungs that he could inhale three hundred and eighty cubic inches of air at one breath! Certainly, the depth of his chest at the later period was something astounding, it being, as nearly as we could judge without calipers, fully fourteen inches through, directly from breast-bone to spine, while it was a strikingly broad chest as well. An even more astonishing feature was the tremendous power of his voice. He said he could run two blocks (nearly a tenth of a mile) at one breath."

This case may, of course, be exceptional, still it is extremely significant.

(To be continued.)

A STUDY OF MINUTE LIFE.

By Henry J. Slack, F.G.S., F.R.M.S.

GREAT interest is felt in the history of minute living organisms, called microferments, on account of the discoveries by Pasteur, and others, showing their action in the production of various diseases afflicting domestic animals and mankind, and in many cases indicating how the mischief may be prevented. These bodies are related to the lower fungi—moulds, and so forth—and as they feed upon moist organic compounds, they assimilate certain of their elements for their own use and growth, and cause, or leave, the rest to reconstitute themselves in simpler forms. If this sounds too complicated to be easily intelligible, a few instances will make the principle clear, chemical formulæ and figures being avoided, because, although they are extremely useful to those accustomed to their appearance, they perplex beginners.

All living creatures are composed of highly complex materials, and life processes are only carried on in the presence of sufficient moisture to give mobility to their particles. Sugars, fats, and starches are examples of one group of these substances, and white of egg or albumen represents another group. Chemists find cane sugar to be made up of a great number of particles—atoms—of carbon, hydrogen, and oxygen; and it is never quite free from other matters. Carbon, hydrogen, and oxygen are ranged amongst the simple substances, or "elements;" but this means no more than that no one has succeeded in resolving them into simpler constituents. However this may ultimately be settled, they, like other bodies in the "simple" list, combine in definite proportions, and the smallest portion capable of so doing is commonly called an atom, and has a definite weight distinguishing it from an atom of anything else. Hydrogen being the lightest known substance, is taken by chemists as their standard, and the atomic weight of a body is stated in comparison with that of hydrogen. Thus, reckoning an hydrogen atom as weighing 1, an atom of oxygen weighs 16, and one of carbon 6. The reader will exclaim, "What has this to do with microferments and yeast? Wait a bit and see.

Sugar is built up of a multitude of the combining particles of carbon, hydrogen, and oxygen; twelve of the first, twenty-two of the second, and eleven of the third go to make the smallest possible piece of cane sugar. Now, just imagine what a complicated pattern can be made with forty-five balls, and when one pattern containing all of them is broken up, how many simpler patterns may be made by unions of balls in twos, threes, and all sorts of numbers.

When cane sugar is dissolved in water, besides its own forty-five particles, there are its water particles, two of hydrogen and one of oxygen. The minutest drop of the solution, therefore, consists of forty-eight particles, and when living yeast is put into it and feeds upon it, a great disturbance takes place amongst them.

If a small portion of brewers' yeast, or the so-called German yeast so much used by bakers, and which comes over from Dutch distilleries in a putty-like mass—is placed on a glass slide in a drop of water and viewed with the microscope and a power of about 400 linear magnification, it is seen to be composed of little tiny bladders, more or less round. It would take from two and a half to three thousand of these little cells placed in a row to make up one inch in length. Each one is, however, a minute plant, capable of carrying out a complete cycle of vital processes if the appropriate conditions are provided. Brewers' yeast is the best to experiment with, as the cells are rather larger, and at a summer temperature grow very quickly. The common brewers' yeast rises to the top of the fluid it causes to ferment, in consequence of the rapid formation of carbonic acid gas bubbles which buoy it up. In German breweries, a slower process, at a lower temperature, is carried on, and the yeast falls to the bottom of the fermenting vessels.

Supposing the reader takes up as much yeast as equals a pin's head in size, puts it in a small cell with sugar and water under the microscope, and keeps it in a warm room; some of the little bubbles will soon swell, smaller bladders will grow out from them, and finally separate. Under favourable conditions, this process goes on so fast that scores of the little plants soon become thousands, and the thousands millions and billions by this simple method of rapid budding. Many of the higher plants, besides propagating by seeds, which result from the co-operation of male and female organs, also multiply by buds. Some of the begonias exemplify this in a striking way, and there is a lily, common in gardens (*bulbiferum*), which produces black bulbils all up its stem. The yeast plants are not, therefore, exceptional in the budding process, and their mode of nutrition is found to be the same in principle as that of the higher vegetation. The yeast plants are capable of taking oxygen from the air, if in contact with it, or, as fish do, from air dissolved in water; but when they cannot get enough this way, they supply themselves by decomposing the sugar in the solutions of malt or other saccharine materials they are employed to ferment. M. Pasteur says: "Fermentation by yeast, the type of all ferments properly so called, presents to us the direct consequence of the work of nutrition, assimilation — in one word, of life — effectuated without free oxygen. The heat consumed in this work must necessarily be obtained in the decomposition of the fermentable matter, that is to say of the sugar, which, after the manner of explosive substances, disengages heat in its decomposition. Fermentation by yeast appears thus essentially allied with the power of this small cellular plant to perform a kind of breathing with the oxygen combined in sugar." Other plant-cells induced to live under similar conditions are found to be provocative of fermentation.

In alcoholic fermentations of either wine or beer, there are other matters present besides the saccharine ones. Some of these belong to the albuminous class, and besides carbon, hydrogen, nitrogen, and oxygen, they contain sulphur and phosphorus, and these, though in small proportions, contribute to the mobility and instability of the wine-must or sweet-wort of the beer. The fermentable fluids also contain some mineral matters which the great plants require, as do the higher kinds of vegetation, for their perfect growth.

The respiratory acts of plants consume oxygen and lead to the evolution of carbonic acid. Their nutritive acts include the digestion of carbonic acid and the evolution of oxygen, which produces a slow combustion, and when this process is carried on by the microferments, fungi, &c., it may completely destroy organic substances, as in cases of putrefaction and decay. If yeast alone operates in wine or beer fermentation, the chief result is the resolution of the sugar into alcoholic and carbonic acid, with small quantities of succinic acid and glycerine.

Schutzenberger states that 95·9 parts of cane sugar contain 44·4 carbon, 6·4 hydrogen, and 49·4 oxygen; and give 51·6 of alcohol, containing 26·9 carbon, 6·7 hydrogen, and 18·0 oxygen + 13·5 carbon and oxygen combined into carbonic acid, or, as chemists would call it, carbon dioxide. Dumas estimated that to decompose one gramme (15·4 grains) of sugar in one hour, about 400 milliards (400,000,000,000) yeast cells must be at work.

The yeast plant might have been described without so much reference to chemistry, but the general nature of fermentations cannot be understood without such explanations; and if the student beginning these inquiries will take the trouble to understand what a commotion the growth of yeast makes in saccharine solutions, the work done by other ferments will be more intelligible. In our next paper some of those which are often associated with yeast, to the detriment of beer and wine, will be described. This action throws light upon the production of diseases by special organisms.

CONDUCT AND DUTY.*

IN all ages of which any record has reached us, men of advanced mind (in their own age) have analysed the principles which regulate conduct, and have discussed those which should do so. In our own time the analysis of ethical considerations has been more fully developed than in any preceding age, — partly, perhaps, because a wider experience is open to us, but chiefly because the progress of the doctrine of evolution has thrown new light on the subject. No one who has thoughtfully studied the doctrine of biological evolution can fail to see how important is its bearing on the principles which determine duty and should rule conduct. If the investigation of the laws of evolution in their merely scientific aspect has not shown this, the study of sociological works, such as those of Herbert Spencer, must have forced even those who do not accept the general doctrine of evolution, to perceive that among those who do, the doctrine cannot but have a most important ethical influence. For this reason, then, chiefly, the subject of the book before us largely occupies men's thoughts in our time.

Mr. Leslie Stephen has long been known as among the foremost and ablest of those who have dealt with the science of ethics during the last quarter of a century. His views on points of detail have been presented in essays which have appeared from time to time in the *Fortnightly Review* and elsewhere. In the present volume, he has not collected such essays together, but has dealt with the general subject *de novo*; and he has here "attempted to lay down an ethical doctrine in harmony with the doctrine of evolution, so widely accepted by modern men of science." He remarks well that "problems of this kind require to be discussed in every generation with a change of dialect, if not with a corresponding change of the first principles." The standpoint from which he views the general subject differs from Mr. Spencer's. The great teacher of the modern doctrines of sociology has worked out an encyclopædic system, of which his principles of ethics are the outcome. Mr. Stephen, starting from the old ethical theories, has endeavoured to bring them into harmony with scientific principles, which he takes for granted. It is well that the subject should be examined from both points of view, that it may be seen how far the results coincide,—as, of course, they should do, if the general principle underlying both lines of argument is sound.

We recommend this work to all who have examined the subject from Mr. Spencer's point of view, to all who prefer to examine it from Mr. Stephen's, and to all who, eschewing the modern doctrines of evolution, and decrying the supposed moral consequences of those doctrines, may wish to know what, according to scientific reasoning, these consequences are. These last, in particular, will be interested, we take it, to see how the moral laws which they have been in the habit of regarding as imparted from without, are regarded by science as springing from within the body social.

It would be impossible to describe in detail the various sections of this interesting work. Each chapter might well form the subject of a complete essay, or of a volume of discussion. The criterion which Mr. Stephen establishes in the progress of his work as the general principle of conduct is simply this, that a man is virtuous or the reverse, a worthy or an unworthy member of the community, in so far as he does or does not conform to the type defined by the healthy condition of the social organism of which he forms part. This must not be confounded

* *The Science of Ethics*, by LESLIE STEPHEN. (Messrs. Smith, Elder, & Co., London.)

with the doctrine, *Soyez de votre siècle*, for the characteristics of an age may be chiefly characteristics of disease, and conformity with them may, therefore, be not virtue, but the reverse. The type defined by the healthy condition of the body social, not that defined by its actual condition, is that with which conformity is desirable.

It will be seen that this doctrine limits conduct in two directions. As the good soldier neither lags behind nor goes unduly in advance of the main body (not even if he be the captain), so the man who best fulfils his duties to the social body of which he forms part, must neither fall short of the standard necessary for the healthy condition of the social organism, nor go unduly in advance. Take, for instance, such a quality as loyalty, in its ordinary but rather degraded sense. In former days it was essential to the social well-being that personal loyalty should amount to something like devotion. And that quality, being essential to the very existence of a community, underwent development until, and even long after, this state of things ceased. It remains, then, a characteristic of many of the best men of a time when personal loyalty no longer has the specific value which it had in former times. Men who analyse the sentiment find, perhaps, in devotion to the King of Brentford, nothing specially virtuous; or, tracing his descent from those who first founded his family, they find small reason, perhaps, for regarding with respect the ground of the family's claim to loyal devotion. Men whose views of this particular duty have thus progressed, may be divided between two duties:—one, that of teaching those around them the avoidance of certain actions which appear to themselves derogatory to the dignity of manhood; the other, that of avoiding such offences as must arise from their not conforming to the type defined by the healthy condition of the social organism. They may do more harm by inculcating what they hold to be truth, and still more by doing what they consider theoretically just, than by conforming outwardly to the conditions of society as it exists around them. An officer, again, who ridicules that devotion to the colours which has led many a brave soldier to die rather than let the enemy take them, may in principle be very right, for a brave soldier is worth more than a blood-stained, shot riddled rag; and he who, in trying to save one, loses the other to his country or army, has not in that served his country well; but if that devotion, unreasonable though it is in principle, is absolutely essential to the efficiency of an army composed of not altogether well-reasoning elements, then the man who has ridiculed it, however reasonably, has done his country or its army an ill-service.

These cases are, of course, in themselves trivial—the reader will hardly need to be told that much more important matters are illustrated by them. If a citizen may be loyal to the community without any trace of loyalty to person or family; if a man may be a good and faithful soldier without the feeling (or having mastered as a weakness the feeling) of devotion to a standard or an ensign, so may there be many who are faithful to what they hold to be their duties without any of those feelings commonly spoken of as religious—though erroneously, for the word "religion" applies equally in reality to any influence or principle restraining men's actions. Men who have learned that certain fears, hopes, and emotions are no more necessary to virtuous conduct than devotion to a standard is necessary to soldiers already devoted to a cause, must remember that this is not at present true of the social organism to which they belong. It is not only not their duty, but the reverse of their duty, to ridicule feelings or beliefs essential to the well-being of the body social as it at present exists. The code we set up must be such as is good for the community, not that which is sufficient for ourselves. As our author well remarks, "we must admit that the ends which men pursue vary indefinitely, and that some men, possibly the mass of men, are fitted for those positions in the social organism which do not demand any great activity of the higher faculties, or make any strain upon a man's devotion to the race or to truth. . . . When we speak of the morality of the lower type, we must mean that the habit of obedience to the moral law may be impressed upon it, although the moral instincts which make such obedience the spontaneous fruit of his character may be very imperfectly developed; and therefore, as a general rule, that to some extent other instincts, such as the fear of punishment [the hope of reward], the contempt [or the praise] of his fellows, have to be called into play, so as to make, as it were, a substitute for genuine morality."

The wise moralist, on Mr. Stephen's theory, "assigns no new motives; he accepts human nature as it is, and he tries to show how it may maintain and improve the advantages already acquired. His influence is little enough, but, such as it is, it depends upon the fact that a certain harmony has already come into existence, and that men are therefore so constituted that they desire a more thorough solution of existing discords. A sound moral system is desirable in order to give greater definiteness to aims and methods; and it is doubtless important to obtain one in a period of rapid decay of old systems. But it is happy for the world that moral progress has not to wait till an unimpeachable system of ethics has been elaborated."

ENGLISH SEASIDE HEALTH-RESORTS.

By Alfred Haviland.

CLASSIFICATION (*Continued from page 18*).

The Mean Temperature of the Air in Relation to Latitude in England and Wales.

When the sun's rays fall perpendicularly on the earth's surface, as between the tropics, the greatest amount of heat is received from them; on the other hand, the more obliquely they do so, as between the tropics and the poles, the more is the amount of heat diminished. A ray from the sun falling perpendicularly on an object covers the least surface, and imparts the most heat; whilst a ray falling obliquely covers a larger surface, and gives less heat in proportion to its obliquity. Moreover, a sun-ray that falls perpendicularly on the earth passes through a lesser thickness of atmosphere, is shorter, in fact, than one which falls obliquely, and therefore loses less heat in passing through the atmosphere.

In using a magnifying glass for lighting a match we make use of this knowledge, and incline the glass at such an angle as to receive the sun's rays, as it were, perpendicularly to its surface, and then focus them. Again, if a ray of sunlight be admitted through a hole in a shutter, and a piece of white cardboard be held at such an angle as to receive it perpendicularly, it will be found that the space occupied by the light spot will have as small an area as possible according to the distance; whereas when the paper is held so as to receive this sun ray obliquely, the area covered by the light is increased in proportion to the obliquity with which the ray falls on the surface. The diagrams showing the apparent path of the sun during April and May, published in Vol. I. of Knowledge, pp. 169, 557, are not only interesting and instructive, but will help the student to understand how in our latitudes the obliquity of the sun's rays is increased or diminished according to the seasons. The effect of this obliquity on the mean temperature of the air will be seen by comparing the following mean temperatures within the different latitudes which cross England. We have taken the observations made in 1881 as illustrations. Between the parallels of latitude 50° and 51° N. there was no large town included, so that the figures really represent the mean air temperature of the South coast :—

Latitude N.	Mean Air Temperature. Fahrenheit.	Seaside Towns.	Mean Air Temperature. Fahrenheit.
Between 50 and 51	49 1′	South Coast......	49° 1′
„ 51 „ 52	48 1′	Barnstaple	50° 5′
„ 52 „ 53	46 9′	Lowestoft	47° 6′
„ 53 „ 54	46 1′	Llandudno	48° 6′
„ 54 „ 55	45° 4′	Scarborough......	47° 2′

We have selected the above sea-side health resorts as good representatives of each of the interlatitudinal belts given above for the sake of comparing their mean air temperatures with those derived from the forty three inland and coast stations where the observations were made which form the basis of the above results. A glance at the above figures will at once demonstrate how much higher the mean temperature of the air is for each latitude along the coast than the mean of England and Wales, which, of course, includes the mean temperatures of both inland and coast stations.

Another fact connected with the obliquity of the sun's rays according to latitude is the *postponement* of the time at which the hottest and coldest periods of the days and the seasons take place.

In all latitudes the hour of greatest daily warmth follows at certain intervals that of the greatest solar elevation, viz., noon; for instance, at Plymouth (about 50° 23′ N.) the warmest hour of the day in the shade is at one p.m., or rather a little after that hour;* at York (about 53° 52′ N.) it is about two p.m.; and at Leith† (a little south of 56° N.) it is 2.40 p.m.; so that the hour of greatest heat takes place nearly 1 hour and 10 minutes later in lat. 56 N. than it does at 50° 23′ N. We shall find in the sequel that large masses of elevated land and the sea operate powerfully in modifying the effect of latitude on the mean temperature. This, to a certain extent, has already been shown in the table above.

To illustrate the postponement of the effect of summer and winter on large masses of elevated matter we may instance the experiments made at York Minster, and recorded by John Phillips, F.R.S., in his charming and interesting work on the rivers, mountains, and sea-coast of Yorkshire. He tells us that a series of daily observations were made and continued for three years within the interior of the cathedral, and showed that the hottest day is about *five weeks* after the summer solstice, or a *fortnight* after the hottest day in the open air; and the coldest day *five weeks* after the winter solstice, or a *fortnight* after the coldest day in the open air.

We shall have to refer to the storage of heat by elevated masses, such as isolated hills, and hill ranges in the neighbourhood of certain seaside health resorts, and the effect, in postponing seasons, the giving up of this heat produces, later on; but a fact which bears on this subject should be recorded and remembered.

Messrs. Quetelet and Forbes made a series of experiments in Scotland, France, Belgium, and Germany on the postponement of the effect of summer and winter below the surface of the ground. It was found that the middle of summer and winter, or the extremes of heat and cold occur:—At the surface, in July and January; 3 ft. deep in August and February; 12 ft. deep in October and April; 24 ft. deep in December and June, and at less than 100 ft. in July and January of the following year. So that within 100 ft. from the surface, the seasons are as much reversed as at the antipodes. These facts relative to the postponement of the hot and cold periods agree with the old doggerel proverbs, "As the day lengthens the cold strengthens," and "The days grow hotter as they grow shorter." We shall refer to this subject again when discussing the causes of the local climates of the several health-resorts. In our next we shall discuss the effect of latitude on the *daily range of temperature*.

* Sir W. Harris, "Rep. of Brit. Assoc., 1839."
† Sir D. Brewster in "Edin. Phil. Transactions."

HOME CURES FOR POISONS.

COPPER.

THE use of copper vessels for preparing food has led to many cases of poisoning, though, as a matter of fact, if copper utensils are carefully cleaned, and food which has been cooked in them is not allowed to stand in them till cooled, they may be used safely enough. This, however, ought not to be left to the care of servants, who, not taking scientific views of such matters, find it difficult to understand how the utensil which was clean when food was put into it to be cooked, may be (chemically) unclean when the food is taken out of it. To this must be added that copper vessels, however clean, are not fit utensils for cooking or keeping any food of an acid nature. The practice of putting copper coins into pickles to give them a pretty green colour used to be considered by some housekeepers of former times a rather clever thing. This colour was derived from the verdigris (or subacetate of copper), formed by the combination of acetic acid and the oxide of copper—and it is hardly necessary to say that verdigris is a poison; but the green of the pickles was very pleasant to look at. Probably, now that copper coins are scarce, the practice of adding copper in this cheerful manner, to poison our pickles, is not so common as it used to be. It should be added that tinning the interior of coppers is only a protection so long as the tinning remains entire.

Arseniate of copper (Scheele's green, or mineral green), is formed from the combination of arsenious acid with oxide of copper. Sulphate of copper (blue vitriol, blue copperas, or blue-stone) is made in large quantities for dyeing and colouring purposes. It is not very likely to be taken by accident, as it has a most unpleasant metallic taste.

SYMPTOMS.

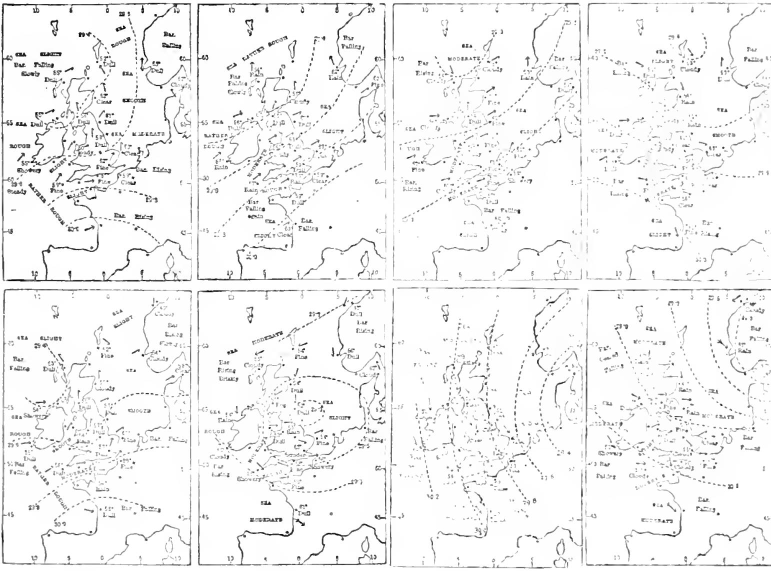
The symptoms of poisoning by any of the salts of copper are vomiting, violent colic, convulsive movement of head, metallic taste in the mouth, pains in the thighs, leg cramps, laboured breathing, followed by lethargy. But sometimes lethargy and partial insensibility are among the first symptoms noted, the symptoms of irritation coming later. Yellowness of the skin, as in jaundice, is a characteristic feature of poisoning by copper, at least so far as metallic poisons are concerned. In some cases, slow poisoning by copper occurs, where copper vessels, for instance, are used daily with insufficient precautions. In these cases death often follows; and it is then found, in *post-mortem* examination, that copper has accumulated in the liver.

HOME REMEDIES.

In cases of copper poisoning, the vomiting caused by the poison should be encouraged by copious draughts of tepid

WEATHER CHARTS FOR WEEK ENDING SUNDAY, JUNE 11.

Sunday, 4th. Monday, 5th. Tuesday, 6th. Wednesday, 7th.



Thursday, 8th. Friday, 9th. Saturday, 10th. Sunday, 11th.

In the above charts the dotted lines are "isobars," or lines of equal barometrical pressure, the values which they indicate being given in figures at the end, thus—30·4. The shade temperature is given in figures for several places on the coast, and the weather is recorded in words. The arrows fly with the wind, the force of which is shown by the number of barbs and feathers, thus:— ⟶, light; ⟶, fresh or strong; ⟶, a gale; ⟶, a violent gale; ⊙ signifies calm. The state of the sea is noted in capital letters. The * denotes the various stations. The hour for which each chart is drawn is 6 p.m.

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water, in which much sugar has been dissolved. Afterwards whites of eggs dissolved in water, six to the half-pint, should be freely administered. Milk or wheat flour may be put in the water if there are no eggs in the house. Sugar may be added to whatever draughts are thus taken, and everything acid, especially vinegar, is to be avoided. The time between sending for a doctor (which should be done at once) and awaiting his arrival, can hardly be better employed than in following the above instructions.

JUNE FLOWERS.

By Grant Allen.

JUNE is the botanist's despair: there are so many beautiful plants in blossom, that he can never hope to examine them all at once. The only possible plan for him is to specialise himself, and take a few families at a time each year. The pea flowers are a good group to study in June; they are recognisable at once by their peculiar blossoms, which even the unlearned know at sight and they are full of varied interest from every point of view. Among smaller herbs of this class, the simplest division is into those with trefoil foliage, like the clovers, and those with leaves of various other types. The medicks (*Medicago*) belong to the first-named group. The only common kinds in England have small yellow flowers, and all may readily be known by their curved spiral pods. *M. lupulina*, nonsuch, has but one twist to the pod, and a single seed; it grows abundantly in meadows. In *M. maculata* the pod has three or four tight whorls, and becomes almost globular as it ripens; its edge is furrowed, and lined with close prickles. *M. denticulata* is a rarer plant, found chiefly in the eastern counties and on the south coast; its pod has also prickles, but is not furrowed, and the whorls are loose, like a corkscrew, instead of being tightly curled together, like a snail. *Melilotus* has also trefoil leaves, peculiarly thick and jointed at the point of union; its long and handsome loose bunch of bright yellow flowers at once distinguishes it from the clovers, while its small straight pod separates it immediately from the medicks. Only one species is likely to be found by beginners, and that is *M. officinalis*, with a net-veined pod. *M. Arvensis*, almost confined to eastern England, has the pod simply wrinkled, while the rare *M. alba* may be clearly known by its white blossoms. The clovers (*Trifolium*) are a more difficult set of pea-flowers. They are distinguished by their clustered roundish heads, straight, small pods, and often tubular flowers; but, among themselves, the differences are very minute. Everybody knows common red or purple clover, however (*T. pratense*), as well as the little cream-coloured Dutch clover (*T. repens*), and these must be taken as fixed points for determining the others. The beautiful crimson clover (*T. incarnatum*), grown in great fields of brilliant colour, is also familiar to almost all of us. Very near purple clover come three other rarer sorts: *T. maritimum*, with heads of the same type but much smaller flowers, and rigid, stiff calyx teeth (the lowest larger than the others) enlarged after flowering; *T. striatum*, a little shabby creeping plant, with calyx-teeth shaped like a pin's point; and *T. scabrum*, which is *T. striatum* much dwarfed, and trailing along the ground. Nearer to Dutch clover are *T. hybridum*, with rather pinker blossoms, and no rootlets on the stem, as well as the curious *T. subterraneum*, which buries its own seed in the ground, and which may be known by its reduced number of flowers—seldom more than three in the head—as well as by its abortive central blossoms, which only grow out after the pods begin to swell, looking then like little hard-pointed knobs in the middle of the cluster. A totally different modification of the clover type is represented by hop-clover (*T. procumbens*), which may at once be discriminated by its likeness to a hop: it has numerous small yellow flowers, turned back upon the stalk as it fades, and forming a sort of brown ball. *T. minus* is the same type dwarfed, with only some twenty flowers in each head, instead of fifty, or thereabouts, as in the larger form.

The only other clovers you are likely to find at present are *T. arvense*, easily known by its fluffy, downy, purplish-grey head, made soft as wool by the feathery teeth of the calyx, and *T. fragiferum*, a close relative of Dutch clover, but looking rather like a strawberry as it fades. The remaining species are very local. *Lotus corniculatus* belongs to a falsely trifoliate genus, for though its leaves look like trefoils, there are really two more leaflets at the base of each footstalk, easily overlooked unless you are warned about them. Its bright yellow flowers, with a sharp, pointed keel, are known to everybody everywhere. Rest-harrow (*Ononis arvensis*) has usually trefoil leaves, but sometimes the side leaflets don't grow; it may be recognised by its pink, sweet-pea flower and its pointed keel. The other herbs of the pea tribe have several leaflets, or at least have not trefoil foliage. Lady's fingers (*Anthyllis vulneraria*) may readily be known by their woolly, fluffy, woolly-looking heads of yellow blossoms, with a leaf under each head. Saintfoin (*Onobrychis sativa*) has a long and handsome spike of pink and white-streaked flowers, and no tendrils to the leaves. In the vetches and peas there are almost always tendrils at the end of the leaf-stalks, though sometimes they are reduced to a fine point like the end of a needle. Only three vetches are now common—*Vicia sepium*, with a bunch of purple flowers, each without a separate stalk; *V. sativa*, with its hairy red flowers; and *V. cracca*, with a handsome spike of variegated blossoms on long stems. They may all be discriminated from the peas by their numerous small leaflets. In the true peas (*Lathyrus*), on the other hand, the leaflets are usually few and large, as in *L. pratensis*, with its short bunch of pale yellow flowers. In two rarer instances, however, there are no leaflets at all; *L. Nissolia*, the grass pea, has the leaf-stalk flattened out exactly like a blade of grass, and bears pretty red flowers; while *L. aphaca* has the stipules (or wings at the base of the leaf-stalk) expanded into a pair of large green leaves. The only shrubby pea-plants likely to be at present at flowering are the dwarf gorse (true furze has now past bloom), and the last stragglers of the broom, both of which are too familiar to need description. Thus a single family has run away with all our space; but it is better to learn this one well the present year, and take up another hereafter, than to overburden the mind with a lot of petty distinctions at once, few of which will be accurately remembered. Study the plants of this single tribe, study their leaves, their flowers, their pods, their seeds; compare them all carefully with one another, and you will have done more good work in one month than if you learnt off, parrot-fashion, a hundred lists of half known and half-understood species.

THE HISTORY OF TUBERCLE.

In pursuing his investigations, Koch made use of material derived from both human and animal sources. Examination of the tuberculous material deposited in the lungs and other organs, invariably led to the discovery of minute organisms possessing all the bacterial characteristics of bacilli, and necessitated the conclusion that these forms of life are invariably present in such deposits. In young tubercle, the bacilli were naturally more easily recognised; but in older material, especially in such as was distinctly caseous, their presence could not always be demonstrated, although abundant evidence of their existence was found at the edges of such accumulations. In a multitude of cases of general miliary tuberculosis, bacilli in incalculable numbers were encountered in every affected situation; and in effect it may be taken as a warrantable conclusion that they inevitably accompany the development at least of the disease. From this point, however, to a demonstration that they are also the *cause* of the degenerations which accompany their presence, is a considerable leap, the taking of which could be justified only on the accumulation of sufficient actual proof of the fact. It is the production of this proof that constitutes Koch's principal claim to the gratitude of the scientific world; and the manner in which it has been accomplished must win for its author an amount of praise such as few recent performances of a similar kind have merited.

Naturally, but one means of supplying the needed demonstration presented itself—viz., the adoption of experiments on living animals. For the purpose, therefore, numbers of guinea-pigs, rabbits, and cats were operated on, with the result, in every case, of verifying the assumptions of the experimenter. By directly transferring the tuberculous matter from diseased animals to healthy ones, through inoculation, he succeeded in all cases in reproducing the disease; but inasmuch as this proceeding was open to the objection that the transferred material might possibly contain a virus to which contamination was due, rather than to the presence in it of microscopic organisms, it was modified by the introduction of "cultivation" experiments conducted on a very exhaustive scale. In this connection, perhaps, more than any other, must we especially admire the unceasing perseverance of Koch's proceedings, and also unhesitatingly accept the results obtained from them. After lengthy trials, he succeeded in devising a pabulum in which bacilli grew and reproduced with the utmost freedom. At the same time he was enabled to determine the conditions which were favourable and essential to their development, thus arriving at the important discovery that they grow only within a narrow temperature range of 30° to 41° C.; below the former, and above 42°, no increase took place even after the lapse of so long a period as three weeks; thus a most important distinction is to be drawn between the bacilli of tubercle and the bacilli of anthrax, the latter readily continuing the processes of active life down to a temperature as low as 20° C.

Preserving, then, his cultivation fluid at the appropriate temperature, Koch sowed a speck of tuberculous matter, and from the generation of bacilli thus produced he infected a second quantity of nutritive matter, and so on, until in some cases the cultivation process was extended over as long as six months. The purified bacilli so obtained could not, by any possibility, be accused of communicating any foreign virus; and yet, when introduced into healthy animals, they never failed to reproduce themselves in incalculable numbers, and to set up all the symptoms of tuberculous infection. To quote definite examples of the experiments made in this direction, it may be mentioned that four guinea-pigs were inoculated with bacilli of the fifth generation produced in fifty-four days from tuberculous matter originally derived from a human being. In each case, the infected animal sickened and lost flesh, and being killed at the end of thirty-two or thirty-five days, strongly pronounced tuberculosis was found in every instance. The situation chosen for the injection of infective material was found to exert no influence on the result. The abdomen, the anterior chamber of the eye, and other places were selected, with always the same ultimate consequences ensuing; and in cases where check experiments were made by injecting natural, healthy blood serum into animals at the same time as others were infected with cultivated bacilli, it was found that while the latter sickened and became tuberculous, the former remained unaffected.

In another series of experiments the sputum of phthisical patients was obtained and dried thoroughly for six or eight weeks. At the end of this time, being suspended again in solution and injected into guinea-pigs, the latter became rapidly emaciated, and in every respect similarly diseased to those animals directly infected with bacilli obtained at once from tuberculous masses, or through successive cultivations. The importance of this particular observation will be at once apparent. It proves that hitherto unsuspected danger lurks in the neighbourhood of every consumptive individual, and that ordinary precautions are insufficient to protect susceptible persons from the influence of such producing agents of a dire and rapidly destructive disease. At the same time it must be assumed that it is essential for the infective bacilli to find their way into the body under certain definite conditions in order for their development and the production of tuberculous deposits to follow as a matter of course; and it is on these by no means insignificant points that further information must be obtained by means of further experimentation. Were it otherwise it would be difficult to explain the immunity, such as it is, enjoyed from a disease so prevalent as tubercle, for it is estimated that *one-seventh* of the total mortality arises from it. And further than this, there is a stern necessity now shown to us to admit and attempt the discovery of a means of alleviating the disastrous consequences that follow on the general distribution of tuberculous disease.

In this respect there must henceforth be no unwise or careless compromise with sentimentalism. Koch has contributed to our knowledge of the history of disease a discovery which bids fair to rank second in importance only to Jenner's; and on the use we may be able to make of the facts already demonstrated must largely depend the influence it may exert on the destinies of the human race.—*Medical Press.*

ON SOME CRITICS.

IN a magazine like this, in which correspondence has been freely admitted, articles by those who have been invited to treat of a special subject because of their special study of it, are exposed to criticism, and, in some cases, to useful correction. We cannot always find room for letters conveying such criticisms, although the effect of the criticisms, sent as they are to the writer criticised, may be fully felt in our pages. Some writers of letters complain of this as unfair, apparently imagining that these pages are intended to be an arena for controversies, and our chief editorial duty to be the regulation of such encounters. Then many of the criticisms which thus reach us are so worded that, even if our object were to make KNOWLEDGE a fighting field, the real unfairness would be in inserting them in full. For instance, instead of pointing out that some word or expression, used perhaps by one of our ablest contributors, is open to misconception, a critic will calmly take it for granted that it was used under a misconception, and carefully explain (for instance) to Mr. Grant Allen some elementary botanical matter, or tell F.R.A.S. that a planet must be carefully distinguished from a fixed star, or Dr. Wilson that a whale does not, as he mistakenly imagines, walk on four legs. Now, in such cases as these, it would not be fair, either to our contributors or to KNOWLEDGE, to insert letters in full; or, in fact, to do other than send them to the writer criticised, so that whatever germ of useful suggestions they may contain may bear fruit.

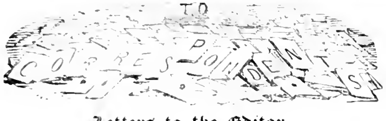
For my own part, a long experience in such matters has made me tolerably indifferent to criticisms of this sort, where I know that the paper criticised represents the result of honest work and thought, while the error corrected (or imagined) is in reality trifling. But writers of such criticisms must not be surprised if at times a recognised authority on some subject is not particularly well pleased to receive a letter telling him gravely about the most elementary matters in his own special branch of research. Still less must they be surprised, if, without expressing any annoyance, a writer thus absurdly criticised employs a little sarcasm, more or less humorous, or tries whether his "friendly critic" likes a little of the same sort of criticism himself. I fancy, for instance, that in answering recently a criticism relating to his remarks on "Blood Corpuscles," Dr. Wilson by no means supposed his critic did not know how to spell the word "inaccuracy"; but, as that critic had explained that certain corpuscles are not round (that is, not globular), but circular, Dr. Wilson thought it as much to the point to explain to his critic that a certain word (misspelt, no doubt, through hurry, not of *malice prepense*) should be spelt in a particular way. The critic writes very angrily to me, as the supposed corrector of his spelling, on this point. He does not at all like it to be supposed that he cannot spell; but he does not seem to have thought that perhaps Dr. Wilson might not much like to be addressed as though he did not know the ABC of his own special subject.

So with the quadruped and mammal question raised by Dr. Fisher, and touched on by a number of correspondents. It is one thing to suggest that some reader might be misled by the word quadruped being used as synonymous with mammalian; another to write in a tone implying that Dr. Wilson has yet to learn that men have not four legs, and that frogs have (except sometimes when "fiends, in form of boys, have hunted them from marshy joys"). Nor can I see why his statement that ordinary quadrupeds possess a collar-bone (especially in a passage specially intended to show how two distinct collar-bones have been developed from the *furculum*, the *interclavicle* being the "found link") should expose a Professor of Biology to the rudeness (for such it really is, however innocently intended) of being told that certain quadrupeds have no collar-bones. If critics who write thus would ask themselves how they would like some casual, and, perhaps, too general expression of their own, to be interpreted as implying gross ignorance in a subject about which, perhaps, they are exceptionally well informed, they will see how unfair it would be to suffer their letters to appear in full, though the suggestion that such and such an expression may be misunderstood might by itself be a very useful one.

Allowance should also be made for printing errors, especially where every facility is given for their correction. It should be remembered that whereas in the case of a book every page is usually corrected twice at least by the author, in a weekly magazine the author has only one opportunity of correcting proofs, and in the case of papers published under pressure of time, not even that. Some errors creep into daily and weekly papers, through accidents, the result of necessary haste, even when extreme care has been taken to correct them. For instance, Dr. Haviland's introductory paper, No. 30, was read neither by the author nor myself, because when the printer's foreman told me "it had not been seen by the author," I unfortunately misunderstood him (there was some noise of machinery at the time) to say "it *had* been seen by the author." Again, at p. 11 I added to the paragraph about Wells' Comet, a remark relating to "the comet which is now near the sun in the skies," meaning the one seen during the recent eclipse. In the proof of this, a comma followed the word "comet," by which the sense was entirely altered, my remark seeming to apply to Comet Wells. This was altered, and because such alterations are not always made, special attention was called to the point, and the matter reached the printing-machine correctly set up. But here, unfortunately, the sentence caught the eye of the machine-reviser, who, in his friendly anxiety to see everything right, restored the obnoxious comma, and made me seem to talk nonsense (for which I have been taken to task by no less than eleven correspondents). This, of course, was simply *excès de zèle*, and I could only feel grateful, annoying though the mistake was in itself. It is not always so; for instance, I was not altogether grateful when, a few years back, I found that a compositor had altered the words "lines, bands, and striæ near the violet end of spectrum," into "links, bonds, and stripes for the violent kind of spectres." RICHARD A. PROCTOR.

VERBAL CARPING.—"However, it is not for me to talk. I have made mistakes enough in conversation and in print. I never find them out until they are stereotyped, and then I think they rarely escape me. How one does tremble with rage at his own intense momentary stupidity about things he knows perfectly well, and to think how he lays himself open to the impertinences of the *captatores verborum*, those useful but humble scavengers, whose business it is to pick up what might offend or injure, and remove it, hugging and feeding on it as they go."—Wendell Holmes, in "The Autocrat of the Breakfast Table."

RECOVERY FROM A BROKEN NECK.—John Collery, a San Francisco teamster, about five months ago, tried to drive his team through a barn-door, and in so doing had his head forced down on his breast until his neck was broken. Police Surgeon Stambaugh found that the seventh cervical vertebra was fractured, and that the spinal cord had been stretched nearly two inches. As the fatality in such cases is estimated at nine hundred and ninety-nine in one thousand, everybody gave up hope of his recovery. Recently, however, a reporter met Collery on the street, who stated that he was almost as well as before the accident, except for a slight stiffness in his right side. After his removal to his home he was laid flat on his back, with a sort of fence about his head and neck which kept him immovable for over two months. Both the body of the vertebra and the arching *laminæ* were discovered to be broken, and the operation of joining them together without pinching the spinal cord where it had sagged between the ragged edges is described as one of the most difficult ever performed. For a month the patient lay on his back, completely paralysed in one-half of his body, and with but little feeling in the other. If he moved in the slightest degree during the first fortnight, he could plainly feel the jagged edges of the bone grate together, and for hours after such an attempt he was content to lie on his hard bed without attempting to move a muscle for fear that the spinal cord should be crushed, and his existence ended in a twinkling. The straightest position attainable was required, and Dr. Stambaugh was compelled to refuse the patient a mattress, forcing him to lie on a wide plank. Collery says that before his eight weeks of enforced quietness were ended, he thought that board was made of adamant, from its hardness. The most dangerous time he experienced, he says, was one day when an attendant told him that a man whose neck could stand breaking as his had, was not born to be hanged. His desire to laugh was irresistible, and the shaking up his merriment gave him caused his fastenings to burst, and the fracture came near being ruptured afresh. The paralysis has now almost entirely disappeared, and Dr. Stambaugh says that Collery will be able to go to work within six months.—*Frank Leslie's Illustrated.*



Letters to the Editor.

[*The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.*]

All Editorial communications should be addressed to the Editor of KNOWLEDGE; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

*** *All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

All Letters or Queries to the Editor which require attention in the current issue of KNOWLEDGE, *should reach the Publishing Office not later than the Saturday preceding the day of publication.*

(I.) Letters to have a chance of appearing must be concise; they must be drawn up in the form adopted for letters here, so that they may go untouched to the printers; private communications, therefore, as well as queries, or replies to queries (intended to appear as such) should be written on separate leaves.

(II.) Letters which (either because too long, or unsuitable, or dealing with matters which others have discussed, or for any other reason) cannot find place here, will either be briefly referred to in answers to correspondents, or acknowledged in a column reserved for the purpose.

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"There is no harm in making a mistake, but great harm in making none. Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

"God's Orthodoxy is Truth."—*Charles Kingsley.*

Our Correspondence Columns.

METACHROMATISM.

[427] There are a few mistakes in Colonel Ross's latest communication to you (KNOWLEDGE, June 9, p. 25), which, since they involve aspersions on my character, I trust you will allow me to set right.

These are the true facts of my intercourse with Colonel Ross. In April, 1874, I laid the MS. of a projected research on inorganic colour change before Professor Frankland, of the Royal College of Chemistry, South Kensington. I commenced the experimental work of the research as soon as ever my duties would allow me, viz. in the first week of October, 1875. When my work was completed (one day in December), the late Mr. Valentin brought Colonel (then Major) Ross, and introduced him to me at my table in the laboratory. I was then given to understand that Major Ross's book on Pyrology was in the press. He promised to send Mr. Valentin a copy, which that gentleman never received, as it afterwards transpired that either Major Ross or his agent sent the book to the Museum authorities, and they quietly deposited it on one of the library shelves. I had no knowledge whatever of Colonel Ross's colour speculations, which, by the way, I now hold, and can prove experimentally, to be erroneous. Colonel Ross's statements on these matters have been denied before, many years ago, and I beg to refer your readers to a letter from Mr. Wm. Valentin, in the *Chemical News* of Sept. 22, 1876.

But to return to the fortunes of my paper. There was certainly great delay in the printing of it. In the first place, it was not read until a month after being announced, because of my having to go on an expedition in connection with the Loan Exhibition of Scientific Apparatus, which was then being organised. It was read in February. After months of delay I was requested to cut it down for reconsideration by the publication committee. This was done; but for some reason, best known to themselves, they decided the subject was not suitable for their journal. Here Colonel Ross comes in with a glaring error, to call it by no worse a name. The article in the *Chemical News*, to which he refers as having influenced the Chemical Society's Committee, did not appear in print while they were considering the matter, but a while after, and it was from Colonel Ross's own pen. It is a communication he must have often regretted, as it stands there in the *Chemical News* for Sept. 8, 1876, a monument against him. When the Chemical Society refused my paper, I sent it at once to Mr. William Crookes, who very kindly had it printed at once.

WM. ACKROYD,
Fellow of the Inst. of Chemistry.

[We hasten to insert Mr. Ackroyd's correction of Colonel Ross's statements. It is evident there must have been some misapprehension on the part of the latter as to the order in which events happened. Space is too limited to enable us to find further room for matters rather personal than scientific; so that unless Colonel Ross is able to show that the dates mentioned by Mr. Ackroyd are incorrect, or to make other corrections susceptible of definite verification, our readers will not hear more about these matters. But we are sure they would gladly welcome Mr. Ackroyd's account of any experiments bearing on the scientific questions at issue.—ED.]

THE HIGHLAND CELT.

[428] In a recent number of KNOWLEDGE, Mr. Grant Allen makes the following statement (p. 550):—"The so-called Celts of . . . . the Highlands are, for the most part, dark-haired and dark-skinned people." This is totally opposed both to history and fact. I do not speak of the Islanders, who are a very mixed race, but the Highlanders of the mainland, who have always been a brown-haired race. Their very name of Caledonians, which is Gaidhill-dhonna, or brown-haired Gaels, implies this. Caledonii, in the mouth of a Roman, and Gaidhill-dhonna in the mouth of a Scottish Highlander, are almost, if not entirely, identical. Then we have the evidence of Tacitus and of our ancient genuine Gaelic poetry. Amongst many others, refer to Tacitus's "Life of Agricola," c. xi.; Alexander and Donald Stewart's "Highland Bards," pp. 474–75; and Mr. Firbis's genealogies quoted in "Cloncurry's Lectures," p. 223. Turning to fact, I asked a schoolmaster in Breadalbane, and out of 120 children in his school, 118 had brown hair of a darker or lighter hue. I also asked a drill-instructor, and in a company of 86, above 80 had the same character.

It is true that in some parts, chiefly in Cowal, in Argyllshire, there are a very few black-haired Gaels. These, however, are not genuine Gaels, but descendants of the Fir-bolg, who were in Ireland before the Gaels, but being conquered, and having submitted, were incorporated with the true Gaels. To distinguish them from these, they were named *Tion-gall*. From Ireland they passed to the Isle of Man and Cowal. CHARLES STEWART.

THE FEVER TREE.

[429]—Allow me to call your attention to errors in the note on the "Fever Tree," page 608 [which was inserted by mistake—having been scored out from a column of other matter, but in pencil only.—ED.] "The bark yields a febrifuge second only in efficiency to quinine, but superior in all medical qualities to cinchona." Quinine is an alkaloid, cinchona the genuine name of the various species of cinchona. There is an alkaloid called *cinchonine*, about the sixth part of the price of quinine, but as the only product of Eucalyptus at all know in this country is the essential oil, and the decoction of the leaves has proved a failure, I cannot understand the comparison. A febrifuge is said to reside in the bark, you will see, but I have not heard that it has been extracted.

Whether the tree will grow in "the eastern and middle states" does not much interest us, but as it is extremely impatient of frost (perhaps I should say patient, for it dies off quietly), I do not suppose it will. There were a fair number of trees in the south of England and Ireland that had gratified the hopes of the planters until the recent winters swept them all, I believe, away. I do not think it is acclimatised as yet in Italy, where a number have been planted in the Campagna; but I believe it has answered in Algeria better than in Europe. It is, of course, incorrect that the tree "produces no fruit or nut." W. SOUTHALL,
Pharmaceutical Chemist.

SIDEREAL TIME.

[430]—Amateur astronomers will thank "Ocean" for his communication of a "neat method" of ascertaining the approximate sidereal time at noon for any day in the year.

Will you permit me to send his "neat method" *reversed*, by which any one may be enabled, without an ephemeris, to calculate from the sidereal time at noon *any day* in the year.

For instance, to the constant 3·22 add the hours of sidereal time divided by 2, and also the minutes divided by 4. Taking his own example, we find that to the constant .... 3·22

Sidereal hours	+	1·
Minutes	+	0·13
		5·5

The result will be the fifth day of the fifth month, or May 5.

This "reversed method" is useful for finding the day on which a given star, whose R. A. is known, will transit the meridian at any given time. For instance :—

Required to know on what day Arcturus will cross the meridian at three o'clock.

	h. m
Arcturus, R. A.	14 10
3 p.m.	3
	17 10
Then to the constant	3 22
Add 17 h. divided by 2	8 0
70 m. „ 4	0 17
	12 9

which is the 9th day of the 12th month, or Dec. 9th.

In the N. A. the sid. time at noon on Dec. 9th is 17h. 12m.

B.

Answers to Correspondents.

*** *All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded; nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

JNO. T. SECCOMBE. I fear it would be difficult to prove that diamonds are condensed comets.—E. H. B. STEPHENSON. The objection to Tyndall's explanation of sound heard in shell, as a case of mere resonance, is that a much larger and more perfect sound-gatherer, applied more suitably to aid the hearing, does not produce the same degree or kind of noise; as regards pressure of the shell against the ear, the sound is heard when the shell does not touch the ear.—W. BENSON. The idea has been suggested before that a comet's tail is an electrical phenomenon. As presented by you, the theory is open to the objection that in the case of a retreating comet the tail occupies the part of space towards which the comet is moving.—G. W. I think you have misunderstood the object of the articles on "Science at the Royal Academy." Their author is discussing the effect of *quasi* scientific errors on the artistic qualities of pictures and sculptures. Truth is as essential in art as in science. It so chances that being at the Royal Academy a day or two since, I heard two ladies, who certainly had not read KNOWLEDGE, remarking on the odd-looking wrists in "Day Dreams." Anatomy recognises as the cause of that odd look, an incorrectly drawn or else malformed carpal bone. You consider his criticisms should first be applied to the illustrations in scientific works. Where errors in these escape the eye of a scientific author, or where there is a want of artistic ability in those employed to illustrate such works, the defect is a matter to be regretted. But two wrongs do not make a right. You say "before we sit in judgment as to the scientific correctness of art, let us try to improve the want of artistic correctness perpetuated on behalf of science." Why should not the other come first, especially just now when the Academy is open. Thanks, however, for your suggestive letter, which should appear in full if there were space.—F. YELWOC. The only one of your long string of questions which comes fairly within our scope is the one relating to cycloidal geometry, and we can only say that the subject is difficult, and not particularly useful, except to mathematicians, to whom it is very interesting. You really are unreasonable in asking so many questions.—JAS. DISNEY. The instrument you name is an excellent one W. RIDD. We hope shortly to give a short article on the new crater. W. CORNWELL. We are now publishing papers on Botany, such as you describe, under the able superintendence of Mr. Grant Allen.—T. H. COVE says publishers of J. R. Young's "Solution of Cubic and Biquadratic Equations" are Souter & Law, Fleet-street. TARANAKI. The experiment you explain can prove nothing. The green you get is the green of an impure spectrum.—G. C. D. M. Your questions cannot possibly be answered, except in set articles, and just now we have not space for articles on gravitation. When and where did we ever say that the moon's axis points earthwards?—H. LANCASTER. Thanks for picture of Comte Wells; but as it presents no features of interest, we must wait until larger views are to hand.—SATELLITE. Your description of the lunar phenomena insufficient. If it was around the moon, it was not a bow.—L. LUCAS. Have not space for your papers on Cats and Dogs and Climbing Perches.—A. H. You are quite right, we dropped the 10 accidentally in the closing calculation, p. 585. It does not greatly affect the result, but, as you say, r=·4717, or is rather less, not rather more, than ½ (per cent.). Thanks. W. B. Thanks for your kindly letter; such letters do us good. We were beginning to think ourselves quite ogreish where we had meant to be good-natured.—W. H. FASSETT. Fifty or sixty it should have been. See answer to W. Southall below.—J. M. CRAVEN. You would find very interesting information on the subject you mention in Dr. Carpenter's "Mental Physiology."—E. M. O. Thanks, but no space.—J. A. MILES. Many thanks for your capital sonnets, but we are obliged to make it a rule to have no poetry in KNOWLEDGE, lest we should offend many whose poetry we should be compelled to return.—J. GREENFIELD. We cannot well find room for your speculations, which are, after all, rather vague. We may note that Legrange never asserted, still less proved, that the universe was made to last for ever; nor is there anything to show that the solar rays can possibly work in circles. With regard to your other suggestion, we must ask you, on the score of great pressure on our time, to excuse us.—W. SOUTHALL. See reply to W. H. Fassett, above. Four square feet would be more than the average required for each person. One square foot (or say 16 × 9 in.) would do, remembering how many children and infants there would be.—ZIA. The statement that the deviation of projectile is always to the right in both hemispheres, apart from any effect due to the rifling, must be a misprint. Whether you are in the northern hemisphere firing a ball due north, or in the southern hemisphere firing a ball due south, the ball comes from a place where the easterly motion is greater to a place where the easterly motion is less, consequently it falls to the east, which is to the right in the northern, and to the left in the southern hemisphere.—H. KYD. The Greek name of Mercury was ὁ στίλβων, "the sparkling one."—W. FOLEY, M.D. We have forwarded your communication to the publishers, which is, unfortunately all we can do in the matter. F.C.S. We regret very much that your letter in answer to "FARMER" is altogether too long for insertion. We feel bound in justice to give you an opportunity for reply, but not for so long a reply as you have sent. —J. ROBERTS. I think I answered your question about Oliver Cromwell, saying that I did not know about his astrological ideas. *Ras Alhague* means the "serpent-charmers' head;" it is the bright star in the head of Ophiuchus; *Ras Algethi* is the star in the head of Hercules, the name means the "Kneeler's head.—J. A. L. ROBSON. According to every theory of the radiometer, the forces causing rotation are very slight. When air is present these forces are quite unable to generate rotation against the atmospheric resistance.—SOPRANO. Thanks, but our engraver can make nothing of your picture, and without it your description is difficult to understand. W. HOUGHTON. Your letter is rather too technical for our readers.—J. WHITEHEAD. Your theory that new stars may be explained by the solar system drawing nearer to them at times, will not bear analysis. The apparent fixity of a star in position proves that the sun has not just drawn nearer to or farther from that star.—F. W. CROSS. No planet or satellite has ever been appreciably disturbed in its course by a comet's attraction. Still, it would be unsafe to infer that a comet's mass is itself inappreciable. We know that comets are followed by many millions of millions of meteoric bodies, and these have mass.—C. A. BUSTON. The spots had not moved on the sun's disc as they seemed to have done, but the sun's disc had altered in position; that which had been its lowest point at the first observation was far to the left of the lowest point at the second observation.—J. T. S. S. I.—The ball let fall from the mouth of the gun will reach the ground somewhat sooner than the one fired horizontally from the same height. The difference, however, would be very slight. It is due to the curvature of the earth. possibly in practice a further slight difference may be caused by the difference in the atmospheric resistances. G. R. MYNNE. Very likely that is the way in which the "cold snap" arises, but until it is explained, it can hardly be considered an explanation. H. F. I am not aware that the late eclipse has taught us anything new in regard to metals in other worlds. We have not only known that there are metals in the sun, but even that some of the metals exist in stars so far away that their light takes years in reaching us.—R. S. STANLEY. What you saw was a range of lunar mountains, the tops of which had just come into sunlight.—W. MORGAN. You have certainly accepted the best of the three courses which were open to you. It would have pained me very much to have heard that a reader had to stand on his head to read one of [the weather charts, and we do not want KNOWLEDGE turned upside down. The fact is that "owing to circumstances over which none of us had any control," the engraver was very much hurried in preparing the weather charts, and in fixing the diagram for photographic reduction, he unluckily placed one upside down; fortunately those diagrams were simply experimental. We have now matured a plan we hope to carry on without any interruption for many years.

ELECTRICAL ANSWERS.

W. N. M. 1. Put a little less bichromate, say 2 oz. instead of 2½ oz. The crystallisation is probably due to super-saturation; I presume you made your solution in boiling water? 2. The use of porous pots would increase the internal resistance of the cell, but this is far more than compensated for by increasing the constancy. A simple bichromate cell runs down in a few minutes, while one with a porous pot (especially if a little mercury, about 3 oz., is put in the pot containing the zinc) will give a continuous current for several weeks—as long in fact as the constituents of the cell last. 3. The same current would be obtained from two zincs and one carbon, as from two carbons and one zinc, but in the former case there would be a larger, and therefore wasteful, consumption of zinc. GEORGE PENHILL. "Resistance in feet per ohm" is an extremely awkward and clumsy expression. It is intended to mean the number of feet of wire which offer a resistance of one ohm. Thus, in the case cited, a wire of 9,826 feet to the pound, having a resistance in feet per ohm of 3·3, means that 3·3 feet (about one mètre) of wire offer a resistance of one ohm. It is far better, more logical, and therefore scientific to speak of "Resistance in ohms per foot," or whatever length we may choose as a standard. In telegraphy the standard length is one mile, so that we should say a mile of copper wire, No. 16 b.w.g. offers a resistance of 25 ohms.

Our Mathematical Column.

THE LAWS OF PROBABILITY.

A FEW examples of the application of this rule to questions about hypotheses will serve to illustrate its real simplicity; for, as is the case with nearly all rules, the verbiage necessary to remove ambiguity has introduced complexity.

EX. 1. *A teetotum has four faces, and it is known that these are either marked 1, 2, 3, 4, or 1, 1, 2, 2, or 1, 1, 1, 1; but the chances of these several arrangements are, respectively, as 3, 2, and 1; the teetotum is spun twice, and each time 1 is the number turned up. What is now the probability of the several arrangements?*

If the first arrangement exists, the chance of the observed event is $\frac{1}{4} \times \frac{1}{4}$, or $\frac{1}{16}$; if the second is the actual arrangement, the chance of the observed event is $\frac{1}{2} \times \frac{1}{2}$, or $\frac{1}{4}$; and, lastly, if the third is the arrangement, the observed event is a certainty, or 1. Hence our formula informs us that *after* the event, the chance that the teetotum is marked 1, 2, 3, 4, is

$$\frac{3 \times \frac{1}{16}}{3 \times \frac{1}{16} + 2 \times \frac{1}{4} + 1 \times 1}$$

the chance that the teetotum is marked 1, 1, 2, 2, is $2 \times \frac{1}{4}$ over the same denominator; and the chance that the teetotum is marked 1, 1, 1, 1, is 1×1 over the same denominator. The denominator is $\frac{3}{16} + \frac{8}{16} + \frac{16}{16}$, or $\frac{27}{16}$. And the chances of the several arrangements are $\frac{3}{27}$, $\frac{8}{27}$, and $\frac{16}{27}$, respectively.

That arrangement which was antecedently the most likely is the most unlikely of all after the observed event; and the arrangement which was antecedently most unlikely is most likely of all after the observed event.

It is important to notice how the antecedent probabilities, or the *a priori* probabilities, as they are called, are modified after the observed event in such instances. For example, we may regard the spinning of the teetotum in this case as an observation or experiment, and the illustration shows us how theories antecedently more probable may become less likely as observation is extended. The just appreciation of this fact is the essence of sound theorising or, rather, of all science.

I give next two examples tending to illustrate this point.

EX. 2. *Suppose the antecedent probability of the theory that the earth on which we live is at rest and the centre of planetary motions, to be a million times greater than the probability that the earth is a planet circling round the sun. Then on the former theory, although a planet travelling round the earth might have a path so looped that the planet would appear to follow looped paths in the heavens, yet the chance of this occurring might fairly be regarded as small. But set it at $\frac{1}{2}$, or an even chance. On the second theory, the planets would be certain to travel on looped paths, or the probability of their so doing would be represented by unity. Now, there are 120 planets, all of which travel on looped paths. Supposing no other facts known, what is the probability that the earth is at rest in the centre of the planetary system?*

Here we have two hypotheses, the chances of which are respectively $\frac{1000000}{1000001}$ and $\frac{1}{1000001}$. The chance of the observed event on the former hypothesis is $\left(\frac{1}{2}\right)^{120}$, and on the latter is unity. Hence our formula gives as the probability that the earth is at rest at the centre of the planetary system—

$$\frac{\frac{1000000}{1000001} \times \left(\frac{1}{2}\right)^{120}}{\frac{1000000}{1000001} \times \left(\frac{1}{2}\right)^{120} + \frac{1}{1000001}}$$

which reduces to $\frac{1000000}{1000000 + 2^{120}}$

Now, the logarithm of 2 is 0·3010300, and multiplying this expression by 120, we get 36·1236000; so that 2^{120} is a number containing 37 digits, the first seven of which are 1328230 (because the logarithm of 1·328230 is 0·1236001). Putting this value in the above expression, and dividing numerator and denominator by 1000000, we obtain for the probability that the earth is the centre of the planetary system—

$$\frac{1}{1{,}328{,}230{,}000{,}000{,}000{,}000{,}000{,}000{,}000{,}000}$$

I may be permitted to select for my next example, a theory of my own.

EX. 3.—*Let it be regarded as antecedently a billion times more likely that the stars of our galaxy are spread with a certain general uniformity throughout the space around the sun, than that they are gathered into definite aggregations so marked in their character as to be recognisable in the statistical distribution of the stars. On the latter hypothesis, it may be regarded as an even chance that on comparing the number of stars visible to the naked eye in the northern and southern hemispheres, we should find as great a disparity as is represented by such a proportion as 7 to 5. But set the odds as 10 to 1 against such a result. Now it is observed that, as a matter of fact, out of 6,000 stars visible to the naked eye, 3,500 are in the southern hemisphere. Required the probability that stars are spread with a certain general uniformity throughout space.*

In a paper which I communicated a few years ago to the Royal Astronomical Society, I showed that if the stars are spread in this way, the chance of the observed arrangement is

$$\frac{1}{66{,}996{,}090{,}000{,}000{,}000{,}000{,}000} \quad \text{(A)}$$

On the hypothesis that there are definite stellar aggregations, the chance of the observed arrangement is

$$\frac{1}{11} \quad \text{(B)}$$

But the antecedent probability of the former supposition is set by our question at

$$\frac{1{,}000{,}000{,}000{,}000}{1{,}000{,}000{,}000{,}001} \quad \text{(C)}$$

that of the latter at only

$$\frac{1}{1{,}000{,}000{,}000{,}001} \quad \text{(D)}$$

Hence the probability of the former hypothesis in presence of the observed fact is obtained by multiplying (A) by (C) for a numerator, and adding that product to (C) × (D) for a denominator. It is (very approximately),

$$\frac{\frac{1}{66{,}996{,}090{,}000}}{\frac{1}{66{,}996{,}090{,}000} + \frac{1}{11}}, \text{ which reduces}$$

to $\frac{11}{66{,}996{,}090{,}011}$ or $\frac{1}{6{,}090{,}553{,}636}$;

that is, the odds are more than six thousand millions to one against the generally-accepted hypothesis. I do not think I have treated this hypothesis unfairly in setting the antecedent odds in its favour at only a billion to one.

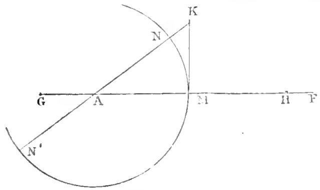
It would be easy to multiply examples of the application of the important general rule above stated; but what space is still available must be devoted to certain general considerations, to be carefully borne in mind by those who discuss the probabilities of different hypotheses.

(To be continued.)

A correspondent asks us how in Problem 33, p. 632. the point F can be determined so that the proposition—

$$GA : AF :: HF : AH$$

shall hold, GA and AH only being known. This is so readily done that it had not seemed worth while to indicate the method. Thus, from



M, the bisection of AH, draw MK perp. to AH, and equal to side of square equal to GA.AH. Join AK, and describe about A. as centre, the circular arc MN. Then if HF be taken equal to MK, F is the point required. For if KA produced meet the circle NM in N', we have NN' = AH; and, therefore,—

$$HF.FA = NK.KN' = \text{sq. on } MK = GA.AH$$
$$\therefore GA : AF :: HF : AH$$

Our Whist Column.

BY "FIVE OF CLUBS."

WE now give the method of play for the illustrative hand in No. 30. The young Whist player will carefully note that the line on which *Y* and *Z* play in order to save and win the game is not that which should be followed if the score were love all, and honours not all with *A B*. For, the position of the cards which causes *Y Z* to save the game by departing from rule, and leading from weak suits, is antecedently improbable. *Y Z* play as they do, because it is their only chance. Had the Knave of Trumps been either with *Y* or *Z*, falling first or second round to a higher honour, *Y*'s proper course would have been to play out his King and Ace of Clubs, then the Knave which *A*'s Queen would have taken; and whatever *A* led the game would be saved by *Y Z*. We note also that the play of the hands is given here in accordance with Clay's suggestions; according to the present system of discarding (to which Clay later gave in his adherence), *Z* instead of discarding a Club at round 3, would have discarded a Heart, thereby showing *Y* that Hearts were his best suit:—

THE HANDS.

A.
Spades—Q, Kn, 10, 4, 3, 2.
Hearts—5, 3.
Clubs—Q, 9, 8, 3.
Diamonds—9.

Y.
Spades—8, 7.
Hearts—9, 7, 6.
Clubs—A, K, Kn, 10.
Diamonds—10, 7, 6, 5.

B

Y Dealer Z

Trump Card, Five of Spades

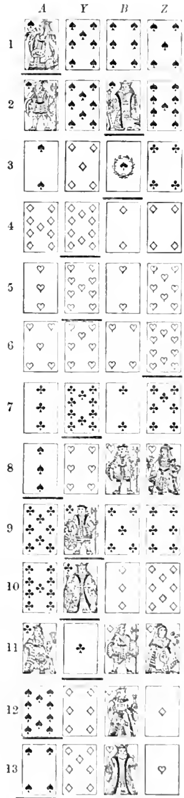
A

B.
Spades—A, K, 6.
Hearts—K, Kn, 2, 4.
Clubs—5, 2.
Diamonds—K, Kn, 3, 2.

Z.
Spades—9, 5.
Hearts—A, Q, 10, 8.
Clubs—7, 6, 4.
Diamonds—A, Q, 8, 4.

Score:—
A, *B*, = 0.
Y, *Z*, = 4.

THE PLAY.



REMARKS AND INFERENCES.

1. *A*, of course, leads Q of Trumps (see leads in former numbers). *Y*, *B*, and *Z* can all place Kn and ten in *A*'s hand, also two, three, and four of Spades from the play.

2. All the players should know where the remaining Trumps lie.

3. *B* not having noticed the fall of Trumps, only counting them, leads Ace to draw another round, though *Y* and *Z* have none, and he ought to know it. The discards are as Clay gives them. *Z*'s is made on the old-fashioned principle of discarding from shortest suits. *Y* sees, however, that it is better for him to retain the power of leading (as often as there may be occasion) to his partner. It was from such considerations that the modern principle of discarding from the longest suit when strength in trumps is declared against you, took its origin.

4. *B* leads from what he takes to be *Y*'s weakest suit, Hearts and Diamonds being equally strong in his own hand.

5. If *Y* leads Clubs in which suit his partner is weak—the game is obviously lost, for *A* has three more tricks in Trumps. If *Z* is not strong in Hearts the game is lost; therefore *Y* plays as if he knew *Z* to be strong in Hearts. *Z* finesses deeply.

6. *Y* continues the Heart lead.

7. *Z* leads a Club, and *Y* finesses the ten.

8. *Y* continues the Hearts, forcing *A*, who can only lead Clubs, in which suit *Y* is secure, and the game is won for *Y Z*, *Y* making three tricks in Clubs.

PLAYING TO THE CHANCES.—"When I was a youngster I was looking over Clay, and late in the hand he led Queen, from Queen, Knave, nine, and a small card. This was the old-fashioned lead, but a small card is now led from Queen, Knave, nine, &c. I afterwards asked Clay whether he considered the old lead, as given by Hoyle, preferable to the modern one. He said, 'No, I generally lead the small one; but when I had the lead the cards must be lucky for us, or we lose the odd trick.' By this he meant that unless the King lay to his left, or the ten to his right, and one of the finesses succeeded, the odd trick could not be won. I have won many an odd trick since by acting on a similar principle, and always think of Clay when it comes off."—Cavendish's "Card-Table Talk."

NOTICES.—The First Volume of KNOWLEDGE is now ready, bound in red cloth, gilt lettered. Price 10s. 6d. Vol. I. contains the numbers from the commencement (Nov. 4, 1881) to No 30 (May 26, 1882). As there is only a limited number of copies, the Publishers advise that orders should be sent in without delay, to prevent disappointment. The Title-page and Index to Volume I. is also ready, price 2d., post-free 2½d. Binding Cases for Volume I., price 1s. 6d. each. Complete copies bound (including Title, Index, and Case), for 2s. 6d. each.

Our Chess Column.

By Mephisto.

THE VIENNA TOURNAMENT.

WE have received this fine game too late for annotation. It was played in the twenty-fifth round on Saturday last, June 10th, between Herren Paulsen and Winawer. It was well contested throughout, both players voluntarily abandoning their Queens. By this victory Winawer has sustained a serious check, while Steinitz was thereby for the first time at the head of the list—viz., eighteen, while Winawer remained at seventeen.

On Monday morning, according to telegraphic information received in London, Steinitz stood at 19; Mason, 18; Winawer, 17½; Mackenzie, 16½; Zukertort, 16½; Blackburne, 15½; and Englisch, 15.

White. Paulsen.	Black. Winawer.
1. P to K4	P to K4
2. Kt to KB3	K to QB3
3. P to Q4	P takes P
4. Kt takes P	Q to R5
5. Kt to Kt5	B to Kt5(ch)
6. P to B3	B to B4
7. Q to K2	B to Kt3
8. B to K3	Q to Qsq
9. B takes B	RP takes B
10. P to KKt3	P to Q3
11. B to Kt2	KKt to K2
12. Kt to Q2	Castles
13. Kt to B3	B to Kt5
14. P to KR3	B takes Kt
15. B takes B	P to B4
16. P takes P	R takes P
17. B to K4	R to B3
18. Castles	Q to Q2
19. B to Kt2	QR to KBsq
20. QR to Qsq	K to Rsq
21. K to R2	R to K3
22. Q to Q2	Kt to K4
23. Kt to Q4	R to R3
24. P to B4	Kt to B5
25. Q to K2	P to Q4
26. KR to Ksq	R to Ksq
27. Kt to B3	Kt to Q3
28. Kt to K5	Q to B4
29. Kt to Kt4	R to R4
30. R takes P	Q takes R
31. B takes Q	R takes B
32. Kt to K3	R to QR4
33. Kt to B4	Kt to Ktsq
34. Q takes R	Kt takes Q
35. Kt takes R	Kt to Q3
36. Kt to Kt 3	P to Kt3
37. Kt to Q4	P to R3
38. Kt to K6	P to B4
39. R to Qsq	Kt to QB5
40. P to Kt3	Kt to K6
41. R to Q3	Kt to B4
42. R to Q7	Kt to B3
43. R takes P	Kt to K5
44. P to Kt4	Kt to K6
45. R takes P	Kt takes BP
46. Kt takes P	Kt takes RP
47. R takes P	K to R2
48. P to B4	Kt to Kt4
49. Kt to K4	Kt f Kt5 to Q4
50. Kt to B6(ch)	Kt takes Kt
51. R takes Kt	Kt to B8(ch)
52. K to Ktsq	Kt to Q7
53. P to Kt4	Kt to B6(ch)
54. K to Kt2	Kt to Q5
55. R to Q6	Kt to B7
56. P to QKt5	Kt to K6(ch)
57. K to B3	Kt to B5
58. R to K 6	P to R4
59. P to Kt6	P takes P(ch)
60. P takes P	Kt to R4
61. P to Kt5	K to Ktsq
62. R to K7	K to Bsq
63. P to B6	Kt to B3
64. R to QB7	Resigns

SCORE LIST OF THE VIENNA INTERNATIONAL TOURNAMENT.

Completed up to the 25th Round, played on Saturday last, June 10th.

No.	Rounds Nos.	1 & 18	2 & 19	3 & 20	4 & 21	5 & 22	6 & 23	7 & 24	8 & 25	9 & 26	10 & 27	11 & 28	12 & 29	13 & 30	14 & 31	15 & 32	16 & 33	17 & 34	Total.
1	Bird, paired against player No.	13	4	3	7	9	6	5	2	16	14	10	11	8	12	15	18	17	
	Score	0 0	0 1	0 0	1 ½	½ 1	0 1	1 0	0 1	0	1	½	0	1	0	1	0	½	11
2	Blackburne, paired agst player No.	12	16	5	17	8	4	11	1	13	10	18	14	6	9	7	3	15	
	Score	0 1	0 1	1 0	1 0	1 1	1 1	1 ½	1 0	1	0	1	1	0	0	½	½	0	11½
3	Englisch, paired against player No.	4	10	1	13	11	15	18	7	6	5	17	9	14	16	8	2	12	
	Score	½ 1	1 1	1 1	0 ½	½ ½	½ ½	1 ½	½ ½	½	½	½	1	1	0	0	½	½	15
4	Fleissig, paired against player No.	3	1	13	11	15	2	12	6	18	9	8	7	10	27	16	5	14	
	Score	½	1	1	0	0	0	0	0	1	½	0	½	½	0	1	0	0	re-signed.
5	Hruby, paired against player No.	18	15	2	16	12	17	1	14	10	3	7	8	11	6	9	4	13	
	Score	0 0	1 ½	0 1	0 0	1 0	1 0	0 1	1 0	½	½	1	1	½	0	0	1	1	12
6	Mackenzie, paired agst player No.	16	18	12	14	10	1	7	4	3	15	11	13	2	5	17	8	0	
	Score	1 ½	½ ½	½ 0	1 ½	1 ½	1 0	½ 0	1 1	½	1	0	0	1	1	½	1	1	15½
7	Mason, paired against player No.	17	14	10	1	13	11	6	3	9	16	5	4	12	8	2	15	18	
	Score	1 1	1 1	1 1	0 ½	1 1	½ 1	½ 1	½ ½	0	1	0	½	½	1	½	1	0	17
8	Meitner, paired against player No.	9	13	11	15	2	16	14	18	12	17	4	5	1	7	3	6	10	
	Score	0 1	1 1	½ 1	1 ½	0 0	0 0	0 1	0 0	0	½	1	0	0	0	1	0	½	10
9	Noa, paired against player No.	8	12	14	10	1	13	15	11	7	4	16	3	18	2	5	17	6	
	Score	1	0	1	½	½	1	0	1	1	½	0	0	0	1	1	½	0	re-signed.
10	Paulsen, paired against player No.	11	3	7	9	6	18	17	16	5	2	1	15	4	14	12	13	8	
	Score	½ 1	0 0	0 0	½ 1	0 ½	0 0	½ ½	0 1	½	1	½	½	½	1	0	1	½	11
11	Schwarz, paired against player No.	10	17	8	4	3	7	2	9	15	18	6	1	5	13	14	12	10	
	Score	½ 0	½ ½	½ 0	1 1	½ ½	½ 0	0 ½	0 1	1	1	1	1	½	0	½	0	0	12
12	Steinitz, paired against player No.	2	9	6	18	5	14	4	17	8	13	15	16	7	1	10	11	3	
	Score	1 0	1 1	½ 1	0 ½	0 1	0 1	1 1	0 1	1	1	1	1	½	1	1	1	½	18
13	Tschigorin, paired agst player No.	1	8	4	3	7	9	16	15	2	12	14	6	17	11	18	10	5	
	Score	1 1	0 0	0 1	1 ½	0 0	1	0 0	0 0	0	0	1	1	0	1	1	0	0	9½
14	Ware, paired against player No.	15	7	9	6	18	12	8	5	17	1	13	2	3	10	11	16	4	
	Score	1 1	0 0	0 1	0 ½	0 0	1 0	1 0	0 1	0	0	0	0	0	0	½	0	1	8
15	Weiss, paired against player No.	14	5	17	8	4	3	9	13	11	6	12	10	16	18	1	7	2	
	Score	0 0	0 ½	½ 1	0 ½	1 1	½ ½	1 1	1 1	0	0	0	½	0	1	0	0	1	12
16	Winawer, paired agst player No.	6	2	18	5	17	8	13	10	1	7	9	12	15	3	4	14	11	
	Score	0 ½	1 0	1 ½	1 1	0 1	1 1	1 1	1 0	1	0	1	0	1	1	0	1	1	17
17	Wittek, paired against player No.	7	11	15	2	16	5	10	12	14	8	3	18	13	4	6	9	1	
	Score	0 0	½ ½	½ 0	0 1	1 0	0 1	½ ½	1 0	1	½	½	0	1	1	½	½	½	12
18	Zukertort, paired agst player No.	5	6	16	12	14	10	3	8	4	11	2	17	9	15	13	1	7	
	Score	1 1	½ ½	0 ½	1 ½	1 1	1 1	0 ½	1 1	0	0	0	1	1	0	0	1	1	15

REMARKS.

There are eighteen players at Vienna, each one playing two games with each other. They play first one game all round, which gives seventeen rounds, and then another game in the same order in which the first was played, making altogether thirty-four rounds. Won games count one, drawn games count half. If, for instance, we wish to find out how Blackburne fared with Steinitz, we turn to No. 2, Blackburne, and find that he is paired against No. 12, Steinitz, for the first and eighteenth round, and that he lost the first game and won the second. We also see that his total score is 11½.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, JUNE 23, 1882.

Contents of No. 34.

LADIES' DRESS SOCIETY.

EVERY one interested in the question of rational dress for women (and which of us—man, woman, or child—is not, directly or indirectly?) should know of the Rational Dress Society, the objects of which are:—

To promote the adoption, according to individual taste and convenience, of a style of dress based upon considerations of health, comfort, and beauty, and

To deprecate constant changes of fashion which cannot be recommended on any of these grounds.

The society seeks to promote its objects by means of drawing-room meetings, advertisements, circulating pamphlets, leaflets, &c., and also by issuing patterns which meet the approval of the committee. An annual subscription of half-a-crown constitutes membership. Mrs. E. M. King, 34, Cornwall-road, Bayswater, is the honorary secretary of the society, and those interested in the objects of the society are requested to write to her. The president of the society is Viscountess Harberton, an important letter from whom appears in our correspondence columns.

It is impossible to over-estimate the importance to all of us, of this question of rational dress for women (we use the more general and nobler word, for the movement is not intended to be limited to ladies). Men talk about it too frequently as if they were not personally concerned in the matter, yet there is not a man in civilised communities whose own individual health and constitution have not been affected by the fashions of feminine attire. But if this were not the case, all men are interested in the well-being of the women of their family,—mother, wife, sisters, daughters. If for unselfish reasons they are not (as they ought to be), there are multitudes of selfish reasons why they should be interested. What dress reform means to women, we leave women to show. As Mrs. King well remarks in her little pamphlet on "Rational Dress" (published by Messrs. Kegan Paul & Co., price sixpence), it may be questioned "whether men are quite in a position to talk about reforming the dress of women, still less to blame them for its follies; for it is chiefly they themselves who have bound this burden upon women's shoulders." Whenever an attempt has been made at rational reform, the sneers and ridicule which have prevented women from accepting the reform have come almost wholly from men. They have not contented themselves, as they well might, by ridiculing extravagancies, they have ridiculed the essential principles of rational reform. And it is to be observed that they adopt a manner in ridiculing reforms, quite different from that which they employ in laughing at the follies of fashion. The laughter at these amounts almost to encouragement; the sneers at those are generally as coarse and offensive as they are foolish.

It is comforting to find that "women reformers have no such feeling of despair as that expressed by men," but, on the contrary, have perfect faith in the remedy they offer. "We know," says Mrs. King hopefully, "that we are working on the natural lines, and upon true principles, and that these will of themselves achieve the moral, mental, and physical cure we need. We know that we are allied with the rising spirit of the age—that which manifests itself in the growing mental and physical activity of woman. We are ready to accept, appreciate, and profit by the greater generosity of [those] men who encourage and help us to obtain a like advantage with themselves in education: and to join them in their sports and healthy pleasures."

FOUND LINKS.

By Dr. Andrew Wilson, F.R.S.E., F.L.S.

PART VIII.

PASSING now to a very different group of animals we find the *Tunicates*, *Ascidians*, or "Sea Squirts" (Fig. 1), to present us with certain highly interesting features for remark. These animals are usually regarded as poor relations of the shell-fish or *Molluscs*; and they exist both in a fixed and free state. The fixed "sea squirts" are tolerably common, and are found attached to shells and other objects dredged from deep water. Each "sea squirt" is a clear leathery bag, an inch or two in length. Like the old "wine-skin," it has two necks or openings (*d*, *i*). One leads into a wide throat or *pharynx* (A), the walls of which are richly ciliated, and which are perforated by numerous openings, whilst the whole throat, like that of the lancelet, is richly supplied with bloodvessels. The other opening is a door of exit. It leads from a sac or bag, called the *atrium*, into which the water used in breathing is wafted from the throat. Thus, when a "sea squirt" breathes, the water is inhaled by the mouth-opening, aerates the blood contained in the vessels of the throat, and is then sent into the atrium, whence it is discharged into the outer world. The "sea squirt's" stomach (B) opens from the throat, and its intestine in turn opens into the atrium. A heart (*l*) exists in the shape of a curious tube, which propels the blood for so many beats in one direction, and then, reversing its action, sends that fluid for so many pulsations in the opposite direction. A single nervous mass lies between the two openings of the body, and the other wall of the body itself consists largely of a material called *cellulose*, which is a

Fig. 1. *A*[illegible], a Sea-Squirt.
(A, Pharynx, or respiratory portion of the body; B, stomach; C, egg-producing organ.)

[illegible] plant compound. The animal in such a case [illegible] the substance of the plant, and imitates the [illegible] of the latter organism.

[illegible] is an outline of the rooted and fixed "sea squirt." Its [illegible] history, however, is still more interesting. It [illegible] from the egg in exactly the same fashion as the [illegible]. The early stages of the sea squirt run parallel [illegible] of the fish. Finally, at a certain stage, the [illegible] squirt [illegible] its appearance as a free swimming [illegible] resembling a tadpole, and possessing [illegible]. More wonderful still, the resemblance to the [illegible] of a closer character. A *notochord* [illegible] as in the lancelet and young of other [illegible] a nervous system appears above the [illegible] as in the lowest fish. So, also, the charac[illegible] throat with its clefts, is formed. Now, whilst [illegible] squirts appear to remain in this tadpole [illegible] most of the species begin sooner or later to retro[illegible] and to back [illegible] in development. The young sea [illegible] fixes itself to some object by the suckers with which [illegible] extremity is provided. The tail begins to shrivel, [illegible] the body enlarges and the throat increases in size. [illegible] and the leathery skin are formed, and finally [illegible] becomes the bag-like organism with which we [illegible]. As a sea squirt, pure and simple, the animal loses [illegible] nearly all the characters by which it was related to [illegible], and but for the knowledge of what it *was*, [illegible] therefore hardly know what a sea squirt (or [illegible] other animal) really *is*.

What, now, are the legitimate inferences to be drawn [illegible] the facts above detailed, and which, it may be re[illegible], are the common details of modern zoological in[illegible]. Firstly, that, whilst the lancelet is the lowest [illegible], it shows its affinities to other vertebrates clearly [illegible] in the possession of a *notochord* and of the other [illegible] already detailed. Secondly, that the sea squirts [illegible] the only animals which present any likeness to the [illegible], and through it to other vertebrates—man included. [illegible], that this likeness is so real and so close in all [illegible] that the affinities of the two groups cannot be [illegible]. The likeness is seen not only in the posses[illegible] *notochord* found in no other Invertebrated [illegible] but in the curious throat with its gill-slits, [illegible] in the nervous axis placed above the noto[illegible]. Again, the likeness in the earliest stages of [illegible] is still more startling; the egg of the [illegible] and that of the sea squirt develope in precisely [illegible] fashion. Fourthly, if these likenesses be admitted, [illegible] logically follows that they must be susceptible of ex[illegible]. The only feasible and rational account of the [illegible] in question, is that which, through the aid of [illegible] theory of evolution, attributes the likeness to a common [illegible] or descent, as it attributes the differences to modi[illegible] and adaptation to special ways of life. If this [illegible] admitted, it follows, fifthly, that the entire [illegible], from the lancelet to man, has been [illegible] root to be represented to-day by the sea [illegible]. The Tunicata, in this view, are the far back [illegible] of the vertebrate tribes.

[illegible] has heard frequent allusion to the so-called "base [illegible] of man as attributed by evolution to the sea squirt [illegible] and this usually from persons unacquainted with the [illegible] details of parallel development in sea squirts [illegible] the lancelet. But such persons forget that, traced [illegible] to its ultimate beginnings, the human germ itself is a [illegible] speck of protoplasm about the [illegible]th of an inch in [illegible], and indistinguishable in any fashion from the [illegible] of lancelet or of sea squirt. Moreover, at a certain [illegible] stage in man's early history, the developing germ resembles tolerably closely that of sea squirt and lancelet, as, later on, it has characters common to all quadrupeds, and only as an ultimate phase exhibits the special features of the human type. In a word, the hard facts of development exist, whether we like them or no; and they alone are wise who can reflect, calmly and placidly and philosophically, that these facts in no wise detract from man's place in nature; but, rightly viewed, only the more ennoble the humanity that, from such humble beginnings, has attained to the highest twig on the tree of life. Mr. Darwin's own words will bear quoting here:—"The most ancient progenitors in the kingdom of the Vertebrata at which we are able to obtain an obscure glance, apparently consisted of a group of marine animals, resembling the larvæ of existing Ascidians. These animals probably gave rise to a group of fishes as lowly organised as the lancelet; and from these the Ganoids, and other fishes, like the Lepidosiren, must have been developed. From such fish, a very small advance would carry us on to the Amphibians." Mr. Darwin's words are again worth quoting, when, in speaking of the origin of man, he remarks that "it is only our natural prejudice, and that arrogance which made our forefathers declare that they were descended from demi-gods, which leads us to demur to this conclusion (that of man's descent from lower forms). But the time will before long come, when it will be thought wonderful that naturalists, who were well acquainted with the comparative structure and development of man, and other mammals, should have believed that each was the work of a separate act of creation." And, finally, concerning the often-assumed degradation of vertebrate ancestry, the late distinguished author of the "Origin of Species" has a noble passage wherein he gives the death-blow to all arrogance of heart and mind respecting the origin of the highest forms:—"Thus we have given to man a pedigree of prodigious length, but not, it may be said, of noble quality. The world, it has often been remarked, appears as if it had long been preparing for the advent of man; and this, in one sense, is strictly true, for he owes his birth to a long line of progenitors. If any single link in this chain had never existed, man would not have been exactly what he now is. Unless we wilfully close our eyes, we may, with our present knowledge, approximately recognise our parentage; nor need we feel ashamed of it. The most humble organism is something higher than the inorganic dust under our feet; and no one with an unbiassed mind can study any living creature, however humble, without being struck with enthusiasm at its marvellous structure and properties."

In a concluding paper I shall deal with the evidence for "Found Links," furnished by a study of fossil and extinct mammals and quadrupeds.

Speculation in electrical companies' shares is becoming very dangerous for the uninitiated. Our spirited contemporary, the *Electrical Review*, severely comments on one of these companies, namely, the "Self-Generating Electric Light and Power Company, Limited." A representative of the journal called at the office for information, and was shown a Bunsen cell and a Swan lamp. These constituted the stock. He was informed that Mr. Simon (the inventor of the company's embryo speciality) had not yet completed his lamp. Mr. Simon is, nevertheless, to receive out of a nominal capital of £300,000, the sum of £120,000. This speaks volumes. Amongst the works modestly contemplated by the company is "To manufacture bricks, quarry stone, manufacture cement and concrete, and to construct tunnels or subways for carrying wires or conductors of electricity, and to construct railways, tramways, or waterways." It is also contemplated to carry on, or at any time to cease to carry on (!!!) the business of manufacturers of electrical generators or accumulators, lamps of all kinds, &c. It is to be feared that we shall hear a deal of such companies before the year is out.

THOUGHT-READING.

By the Editor.

We have received from several correspondents communications on the subject of Thought-Reading, and the Willing Game as now practised in parlours and drawing-rooms. Several very remarkable narratives have been sent to us, which we have been invited to publish, along with the various theories suggested by the narrators, these theories usually resolving themselves into a vague impression that the observed results are due either to electricity or to animal magnetism.

Now, there can be no question that among the phenomena observed during these experiments there are many which are well worth scientific investigation. Even in cases where there is wilful trickery, a degree of sensibility is manifested by some among the "subjects" which is far greater than had been previously imagined, at least by those unacquainted with such remarkable instances as Dr. Carpenter and others have described in treatises on mental physiology. Take, for instance, such a case as the following, described by Prof. Barrett in the current number of the *Nineteenth Century*:—"A young lady could write words, or even rudely copy sketches which had been shown to her mother and not to herself, the mother sitting behind her and placing a finger on the girl's bare arm, even above the flexed elbow." In this case careful experiments proved that indiscernible and probably unconscious movements of the touching finger served to convey a sufficient guidance to the girl's delicate skin and quick intelligence. But no one who has examined such cases as this, and recognised the wide range of difference between one person and another in sensibility to slight muscular impressions, can attach any weight to the customary protestations in drawing-room experiments. On the one hand, the person guiding asserts that there has been no guiding, and probably often believes that there has been none; on the other, the person guided is as ready to asseverate that there has been no guiding influence whatever (and possibly may have recognised none). But experiment shows that there has been.

Thus, we must not be expected to find space for accounts of remarkable cases of apparent mind reading or mind-guiding,—generally sent without any of the details that have scientific value, and without any attestation more satisfactory than some remark that the writer *knows* there was no trickery. Nor can we admit, as a scientific explanation, the expression of a belief that there must have been magnetism. As Professor Barrett remarks, the explanation "It is magnetism,' seems perfectly sufficient "to many who, for a thousand pounds, could not write down a single true sentence on the ascertained laws of magnetic attraction;" while, "if one ventures euphemistically to suggest this, they usually take refuge in 'animal magnetism,' a phrase so obviously ordained by Providence as a safe retreat, that it would be brutal to drive them to lay on it."

But there is room for scientific research into this matter. Some of the experiments already made under suitable test conditions have led to results so remarkable, as to show that the subject is well worth examining closely. Professor Barrett, Mr. Edmund Gurney, and Mr. Frederic W. H. Myers have been at some pains to collect evidence which is, indeed, as yet incomplete, but still seems to indicate a real power of mind on mind which, to say the least, has not yet been explained. They attach somewhat more weight, relatively, to the mind-reading side of the question than I am disposed to do. It seems to me the real point to be attended to is the power of mind in guiding mind, not the aptitude of some minds to be guided—though, of course, both are parts of the same subject of inquiry. There are cases in which mind-guiding seems the prominent feature; others, in which mind-reading seems chiefly in question; others, in which it is doubtful whether one or the other has been principally at work.

Take, for instance, the following case described by Dickens in a letter to Forster. Dickens is here speaking of a professional conjurer, and therefore trickery may have, or rather must have, the fullest possible influence assigned to it; but trickery will not explain the mental phenomena. Dickens speaks of the man as "a perfectly original genius, putting any sort of knowledge of legerdemain such as I supposed that I possessed at utter defiance":—

"You are to observe," says Dickens, "that he was *with the company*, not in the least removed from them, and that we occupied the front row. He brought in some writing-paper with him as he entered, and a black-lead pencil; and he wrote some words on half-sheets of paper. One of these half sheets he folded into two, and gave to Catherine [Mrs. Dickens] to hold. 'Madame,' he says aloud, 'will you think of any class of objects?' 'I have done so.' 'Of what class, madam?' 'Animals.' 'Will you think of a particular animal, madam?' 'I have done so.' 'Of what animal?' 'The lion.' 'Will you think of another class of objects, madam?' 'I have done so.' 'Of what class?' 'Flowers.' 'The particular flower?' 'The rose.' 'Will you open the paper you hold in your hand?' She opened it, and there was neatly and plainly written in pencil: *The Lion. The Rose.* Nothing whatever had led up to these words, and they were the most distant conceivable from Catherine's thoughts when she entered the room."

Unless we suppose that by some amazing feat of legerdemain the conjuror, after Mrs. Dickens had named the rose and the lion, substituted for the paper in her hand one on which he had written these two words, doing this in the momentary interval between her naming the rose, and opening the paper in her hand, we must suppose that he influenced her mind in some way (the determination of which is what science yet has to seek) to think first of a lion, then of a rose. The interpretation of the trick as a feat of *legerdemain* is, of course, quite out of the question. There were thousands of objects of which Mrs. Dickens might have thought first, thousands of which she might have thought next: therefore millions of combinations of two objects of which she might have thought. The conjuror could not possibly, then, have had ready to hand, among a multitude of papers, one containing in right order the two Mrs. Dickens had selected. He could not possibly have written those two names on a piece of paper in the moment between her answering "the Rose" and opening the paper in her hand at his request. Still less could he have combined (in this momentary interval of time) the accomplishment of this feat, with the extraction of one paper from her hand and the substitution of another, without any knowledge of the change either on her part or on that of the audience, including such a keen observer as her husband. It seems certain then that the conjuror guided her mind by will power to think of the objects whose names he had already written on the paper.

(*To be continued.*)

Terrific Thunderstorm at Berlin.—A terrific thunderstorm visited Berlin on Monday, the 29th ult. From half-past two to half-past three the fire brigade were summoned no fewer than twenty-eight times to extinguish fires caused by lightning, but there were no serious conflagrations. The storm was confined to Berlin and its immediate neighbourhood.

CRYSTALS.

By William Jago, F.C.S., Assoc. Inst. Chem.

No. IV.

ANOTHER group of rocks is that in which the structure is wholly crystalline; they contain no glassy base, and often the crystals are sufficiently large to be readily discerned by the naked eye. From the very fact that the crystals are so packed and crowded, it often follows that their shape is not perfect: those last formed must of necessity fit themselves into the spaces left for them. Fig. 1 is a microscopic study of a rock of this description. This particular specimen at one time formed a part of Cleopatra's Needle, and thus possesses some little interest additional to that it derives from its geological character. This rock, usually termed "Syenite," is essentially composed of the minerals felspar and hornblende: the specimen before us also contains quartz.

Fig. 1.

Hornblende is a mineral of a very dark colour; and even in thin sections is almost opaque; but little of it is shown in the figure. There is, however, a small piece in the upper part of the field, represented by very dark cross shading. To the left is seen a space which, save a few straight lines, is almost free from markings; this portion of the rock is quartz. Starting from the bottom of the figure, and occupying the whole of the centre, is a portion of a crystal of felspar, approximately square in section. The felspar of Cleopatra's Needle is of special interest to the geologist from some peculiar markings it shows when viewed by polarised light. These consist of a series of striations, across the crystal (from left to right of the figure), but as they are most brilliantly coloured, it is impossible to represent them in a plain black-and-white sketch. To us, who are at present engaged in the study of crystal life and growth, there is one lesson in particular the felspar crystal teaches us. It may be noticed that the crystal is cloudy, instead of being clear like the quartz; this cloudiness has developed very fully in the upper right-hand corner of the crystal, where, in the figure, it is represented by a sort of stippling effect, but the whole crystal is permeated by it, although to a lesser extent. From a comparison of different rocks it is found that the felspar of some are almost clear, while in others the mineral is entirely changed. Those which have been most subjected to the action of "weathering," have suffered most. Rain, frost, and last, but not least, the atmosphere, gradually do their work, and slowly but surely demolish the crystal edifice, so laboriously built up by Nature in her constructive moods. Felspars are particularly liable to decomposition; the lime and potash or soda they contain are dissolved out by water containing carbon dioxide in solution, and leave behind a form of silicate of alumina, to which the name of kaolin has been given. This substance will be more familiar to many as "china clay." It is to this kaolin that the cloudy nature of the felspar crystals is due, and in but few rocks is the felspar entirely free from it. Not only, then, have we crystal growth and life, but these are followed by crystal decay, and ultimate decomposition. Water, the grand agent of geological denudation, not only does its work in the form of the beating wave and the rushing torrent, but also acts quietly on a gigantic scale on the constituent molecules of rock matter, and reduces them to the fine mud and sediment from which are again built up our vast formations of sedimentary rocks.

It is well known that sedimentary rocks, after a time, become much altered in appearance and properties. This is particularly noticeable in those strata which, lying deep beneath the surface, are subjected to enormous pressure and a considerable degree of heat. Although the rock may not be melted, still the heat favours in a remarkable manner the tendency of the particles to assume once more the crystalline form.

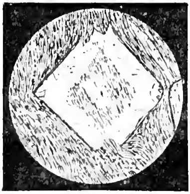


Fig. 2.

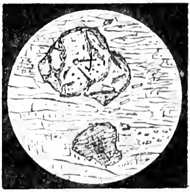


Fig. 3.

Fig. 2 represents a piece of slate from Bavaria, which has been altered by the intrusion of some eruptive rocks. Under the heat produced, crystallisation has set in, and the slate contains a quantity of crystals of a mineral known as chiastolite. The section of one, almost at right-angles, is figured. This particular specimen tells us much of the growth of the crystal. We notice that it has succeeded in thrusting the grain of the slate aside where it met it perpendicularly, but where the growth has been in the line of cleavage of the slate, the slate has held its own; two opposite corners of the crystal are thus imperfect. Fig. 3 is a sketch of rock called "granulite." It is a highly-metamorphosed, sedimentary rock; the whole mass is crystalline, the crystals being arranged, however, in regular lines, thus furnishing a clue to its origin. The two larger masses drawn are imperfect crystals of garnet—a plentiful mineral in rocks of this type.

The rocks have afforded us some striking examples of crystals—their growth and decay. One last lesson they may teach us: Nature's methods are always those of law and order, nothing is done at random. In greater matters this is self-evident, and in subjecting her work to the closest scrutiny we ever find her faithful to herself.

ENGLISH SEASIDE HEALTH-RESORTS.

By Alfred Haviland, M.R.C.S., F.R.M.C.S. Lond.

CLASSIFICATION (*Continued from page 40*).

The Daily Range of Temperature According to Latitude.

There is no more important element in climate than the range of temperature; it is the element by which we distinguish *continental* from *insular* climates; and the facts relating to this range enable us to deduce laws, so well formulated by Haughton,* viz:—

1. *In the northern hemisphere, places which enjoy a* maximum *mean annual temperature have also a* minimum *range of annual temperature; i.e., they have an Insular climate.*

2. *In the northern hemisphere, places which possess a* minimum *mean annual temperature have also a* maximum *range* of annual *temperature; i.e., they have a Continental climate.*

3. *Large masses* of land, *anywhere*, increase *the range of annual temperature;* and *large masses of* water, *anywhere*, diminish *the range of annual temperature.*

Now, although the climate of England is eminently *Insular*, yet for our present purpose we may, for the sake of comparison, divide it into *inland* and *coastal:* the former representing the *Continental*, and the latter the *Insular* division of the English climate as a whole. The sea-coast is not resorted to altogether for the sake of the pure sea air, that those who reside in inland towns so enjoy during their outings and search after health. There is yet another reason, unfortunately felt by many in weak health, and that is the necessity of avoiding the extremes of heat and cold, and the greater range of temperature, which are experienced in the inland climate. In summer, the sea moderates the heat of the coast line, and in winter tempers its cold; the more perfectly, therefore, these conditions obtain, the more perfectly will the climate of the health-resort fulfil the requirements of those who are anxious to benefit by its influences.

This can easily be illustrated by referring to the records of the daily range of temperature at the following inland and coast stations for 1881:—At Salisbury, by Thomas Challis, Esq., of Wilton House; at Stockton, near Rugby, by the Rev. W. Tuckwell; at Gloucester County Lunatic Asylum, by E. Toller, Esq., M.R.C.S., F.M.S.; at Brighton, by E. F. Sawyer, Esq., F.M.S.; at Llandudno, by James Nicol, Esq., M.D.; at Scarborough, in Dr. John W. Taylor's (M.O.H.) Annual Report for 1881; at Liverpool, by John Hartnup, Esq., F.R.A.S.; at North Shields, by Robert Spence, Esq.; and at Lowestoft, by S. H. Miller, Esq., F.R.A.S., F.M.S.

During the *first* quarter of 1881, the *greatest* range of temperature was observed at Salisbury, 15°·5; Stockton, 14°·9; Gloucester, 14°·7—*mean*, 15°·0. The *least* at Scarborough, 7°·4; Llandudno, 8°·6; North Shields, 8°·7; mean, 8°·2; difference, 6°·8.

During the *second* quarter, the *greatest* range was at Salisbury, 26°·3; Stockton, 22°·4; Gloucester, 22°·5; *mean*, 23°·7.

The *least* at Scarborough, 11°·8; Llandudno, 12°·1; Lowestoft, 12°·3; *mean*, 12°·0; difference, 11°·7.

* "Six Lectures on Physical Geography," by the Rev. Samuel Haughton, M.D., F.R.S. Dublin University Press Series.

During the *third* quarter, the *greatest* was recorded at Salisbury, 22°·8; Stockton, 21°·3; *mean*, 22°·0.

The *least* at Llandudno, 9°·7; Liverpool, 10°·4; Scarborough, 11°·8; *mean*, 10°·6; difference, 11°·4.

During the *fourth* quarter, the *greatest* range was at Salisbury, 17°·7; Stockton, 14°·0; *mean*, 15°·8.

The *least* at Scarborough, 7°·9; Llandudno, 9°·3; at Brighton, 9°·1; *mean*, 8°·7; difference, 7°·1. If we compare the above figures with the mean daily range of temperature throughout England for the four years 1878–1881 inclusive, we shall see at a glance how natural a division there is between the *coastal* and *inland* climates.

	All England—1878-1881.				
	Mean Temperature.	Mean Daily Range.	Greatest Daily Range. Inland—1881.	Least Daily Range. Coastal—1881.	Difference.
First Quarter	38°·7	11°·3	15°·0	8°·2	6°·8
Second ,,	53°·1	16°·3	23°·7	12°·0	11°·7
Third ,,	58°·3	15°·4	22°·0	10°·6	11°·4
Fourth ,,	42°·5	11°·7	15°·8	8°·7	7°·1
Annual Means	48°·1	13°·6	19°·1	9°·8	9°·3

Again, referring to the first law of climate above as to the *highest* mean annual temperatures being associated with the *least* range of temperature, we have the following figures to show how this is exemplified in England, when the *inland* and *coast* climates are compared according to latitudinal position. The temperatures belonging to the interlatitudinal space, 50° to 51° N., were all recorded at coast stations, and we have selected Ventnor as the representative of this space, simply from its central position and its separation from the mainland of England.

	All England, 1881.						
Parallels of Latitude, North.	Mean Temp. of the Air.	Mean Daily Range of Temp.	Coastal Representatives, 1881.	Mean Temp. of the Air.	Diffrnce. in favour of Coast.	Mean Daily Range of Temp.	Diffrnce. in favour of the Coast.
deg.	deg.	deg.		deg.	deg.	deg.	deg.
50–51	49·1	13·5	Ventnor	49·2	+0·1	11·4	−2·1
51–52	48·1	15·7	Barnstaple .	50·5	+2·4	13·1	−2·3
52–53	46·9	15·3	Lowestoft .	47·6	+0·7	11·8	−3·5
53–54	46·4	12·5	Llandudno ..	48·6	+2·2	10·1	−2·4
54–55	45·4	13·5	Scarborough ..	47·1	+1·7	9·5	−4·0

Thus we see that the coastal representatives have both a maximum mean annual temperature and a minimum mean daily range of temperature in accordance with the above proposition. We see also that the *greatest* daily range of temperature takes place, both inland and on the coast, during the second quarter of the year (or during April, May, and June).

We find the sea, as it were, postponing the effects of summer and autumn, and giving out its store of heat during the last months of the year, the mean temperature of which is 42°·5, compared with 38°·7 during the first quarter. On the other hand, it absorbs in spring and early summer a more than fair proportion of the solar heat. Hence it is that many seaside health-resorts afford a warmer climate up to January, and even February, than inland places, and many persons, on this account, go to them from large towns to enjoy their prolonged warmth and equability of temperature. On the other hand, after the winter has destroyed the last lingering trace of the previous summer heat, and chilled the sea and the land, then it is that invalids feel the want of shelter from cold winds during March, April, and May, and those resorts become the most frequented which afford the greatest protection from these winds during this most critical period of the year, when more fatal chills are contracted than at any other time—more latent seeds of consumption excited into activity and development than during the cold of winter. Hence it is that we find on all the more exposed parts of the coast of England a high mortality from this disease; but this subject must not be anticipated, as it will be dealt with in its proper place.

THE EYES OF SCIENCE.

By the Editor.

THE telescope, the microscope, and the spectroscope give to the student of science what may be regarded as three kinds of visual power—in one case using the visual qualities possessed by the natural eye, in the other two surpassing these greatly in degree. We can conceive creatures endowed with the powers of vision which the telescope and the microscope artificially supply. Indeed it is by no means incredible that in other worlds than ours creatures may exist possessing powers akin to these. And although it is not easy to conceive the sense of vision so increased and extended that by means of it the analysis of light effected artificially by the spectroscope could be effected naturally, yet there is nothing absolutely outside the range of possibility, even in this. The eye is, indeed, an optical instrument, precisely as the ear is an acoustical instrument; and so far as we can judge, the sense of vision might have been provided with a more complex organ, or series of organs, giving it greater range, as in the telescope, or more complete power of magnifying minute details, as in the microscope, or the power of separating light rays of different refractive nature, as in the spectroscope. There are other optical instruments also whose powers might have had their analogues in the organ of sight (as the polariscope and similar instruments); while there are others, as the stereoscope and so forth, which, like the telescope and microscope, are akin to the organ of vision, but give to it increased power in particular ways.

I have lately been led to notice how certain photographic processes and methods extend the powers of human vision, and enable us to see what, owing to certain peculiarities in the circumstances under which eyesight is employed, we are debarred from seeing in the ordinary way.

It has long been noticed that photographic vision, so to describe this method of studying natural objects, has one great advantage over ordinary vision in that it is not liable to ordinary misleading influences. In science, seeing is not always, or even generally, believing—for the simple reason that the student of science cannot always be certain what he really sees.

Thus an observer may be misled by imagination, especially if some favourite theory has possession of his mind. If he knows, or thinks he knows, what he ought to see, or might fairly expect to see, he is very apt to imagine that he actually does see it. In this way, for instance, many students of astronomy have fancied they have seen a small companion by a star in a position where they had been told such a companion existed, when, in reality, there had been some error in the description, or in their reading of it, and either no such companion existed, or else it was in some entirely different position, and perhaps quite beyond the range of the telescope employed by the observer.

Again, the eye is repeatedly deceived by effects of contrast. Thus, the French astronomer Chacornac advanced a very ingenious—indeed, masterly—theory in explanation of the circumstance that the disc of the planet Jupiter is brighter near the edge than in the middle, the only objection to his theory residing in the circumstance that the disc is darker, not brighter, near the edge, though to the eye it appears brighter there by contrast with the dark background of the sky on which it is seen projected. So again there is a charming theory, in vogue to this day among many students of the moon, explaining why the floor of the lunar crater Plato (the Greater Black Lake of the earlier telescopists) grows darker as the sun pours more light upon it (rising higher in the sky as supposed to be viewed from Plato), the real fact being that there is no such darkening, the apparent difference being entirely due to effects of contrast—the contrast of the floor with the black shadows of the crater-ring thrown upon it when the sun is low, and the contrast of the floor with the brilliant white of the surrounding crater-ring when the sun is high, one contrast making the floor look lighter than it is, while the other makes it look darker. I may cite another instance of an optical illusion, caused by an effect of contrast—a case not requiring telescopic observation for its recognition. If on a moonlit night one looks beyond a water horizon towards the part of the sky below the moon, that region looks darker than the parts of the sky on either side; yet, in reality, it is no darker—if anything slightly lighter. What causes it to look darker is the apparent* brightness of the part of the water just below the moon, where lies seemingly* a broad track of silver light. If this track of light is concealed in any way, as by holding up a sheet of card or paper, the portion of the sky immediately above is at once seen to be at least as bright as the parts of the sky on either side of it. So in multitudes of other cases—some familiar, some otherwise—the eye is deluded by effects of contrast.

Photography, or what may be called photographic vision, is not, it is true, altogether free from defects corresponding to such defects of vision (resulting in illusion) as we have just considered. As there are physiological illusions in ordinary vision in such cases, so are there in certain applications of photography, physical effects which may prove similarly illusive. For instance, there is what is sometimes called photographic irradiation, when around a dark object in a photograph a ring of light is seen, or around a bright object a ring of darkness, this ring not corresponding to any really existent object, but resulting from some change in the photographic film along the border-line around a region acted on very strongly by light.

Again, the photographic eye has long been justly valued for its artistic power, in being able to record, without defect or exaggeration, what it sees. If we take, for instance, one of Dr. Rutherfurd's photographs of the solar disc, and compare the spots there depicted with those shown even in the most carefully-executed pictures of the sun before and since, we see at once how liable the eye is either to be deceived in what it sees, or else to fail duly to guide the hand in reproducing what the eye has seen. I happen to know of a case where a draughtsman took exceptional pains to reproduce, without exaggeration, the aspect of the solar disc with its spots, when yet, on comparison being made with a photograph taken nearly at the same time (though 3,000 miles away), it appeared that the spots had been notably exaggerated. I refer to the drawing of the sun's face which forms the frontispiece of my treatise on The Sun. I was particularly struck by the aspect of the sun when that drawing was made, and I certainly spared no pains to delineate the spots correctly; but a comparison of my picture with a well-known photograph by Rutherfurd, which chanced to be taken about the same time in New York, will show that though the spots are delineated, individually, correctly enough, they are considerably too large as compared with the solar disc—an enlargement by no means necessary to enhance their importance, for the largest spot visible on that occasion had a surface several times larger than the entire surface of this earth.

* I say "apparent" and "seemingly" because the moon's rays really illuminate the region which appears dark, as brightly as the rest. It is only because of the position of the observer's eye that one region appears brighter than the rest.

Other instances of the same sort may readily be cited. A very noteworthy case, in which the imperfection of ordinary vision and ordinary methods of delineation caused many men of science to be long led astray, till photography finally came to their rescue, is that of the solar corona. The pictures of the corona which used to be drawn by different observers of the same eclipse, often by observers stationed within a few yards of each other, showed such discrepancies as to suggest to some the theory that the corona is not really a solar appendage, but an optical phenomenon, caused by the passage of the sun's rays through our own atmosphere; and although a very slight knowledge of mathematics sufficed when applied (for many mathematicians, failing to apply their knowledge, were long misled) to show the erroneous nature of this theory, it was not until photography had been employed to delineate the corona, that the groundlings were convinced on this comparatively simple point. A singular illustration of the inferiority of the unaided vision in this matter was given once at a meeting of the Astronomical Society. "Two people," said Mr. Stone, referring to the eclipse of 1875, which he had witnessed in South Africa, "were asked to make drawings of the corona, and at the end of the time one man had drawn it in one shape, and the other as different as it could possibly be." Considerable amusement was caused by Mr. Stone's sketching two absurdly dissimilar pictures on the blackboard. "The person who drew one picture was an engineer, and was sitting side by side with the other. Before the eclipse was over he turned round to look at the other's drawing, and said, 'What on earth are you doing here?' He replied, 'I am drawing the outer corona.' He said it was nothing of the kind; yet he looked and saw the outer corona just as the other had drawn it; but he had overlooked that it was the inner corona he was drawing, until his attention was called to it in that way."

On the same occasion Mr. Stone pointed out another defect of ordinary vision, as an instrument of scientific research, which is well worth noticing. He said very truly, that as soon as any feature has arrested the attention, it becomes prominent; another person may not catch the same feature, and, passing it over, seizes upon some other point and brings it out more strongly. Photography has no weakness of this kind, at least where due care is taken to use the same kind of plates and instruments, nearly equal in size and similar in quality, when comparison is to be made between pictures taken by different observers or at different stations.

PHOTOGRAPHY FOR AMATEURS.

By A. Brothers, F.R.A.S.

PART X.—THE GELATINE PROCESS.

The photographic world is chiefly indebted to Mr. Kennett for this process. In it we have one of the most simple and perfect of any of the photographic processes. The time of exposure in ordinary practice is reduced to at least one-tenth of what was required for wet collodion. This degree of rapidity may be greatly exceeded, but the beginner will find the ten-times plates quite rapid enough for ordinary work.

The first thing to attend to is to see that the room in which the plates are to be manipulated is sufficiently dark. There are many ways of effecting this. If the room have ruby glass in the window, one or two thicknesses of yellow paper as an extra covering may be sufficient. Daylight may be altogether excluded and the work conducted by artificial light. Lamps are sold for the purpose; or one may be made by cutting the neck and bottom from a hock bottle, which only requires a suitable stand to admit air, and a cover for the top, to stop the direct light of a candle or small paraffin lamp placed within. There may be plenty of light in the room, provided it be of the proper quality.

It is important that the dark slide containing the sensitive plate be covered with a black cloth when carried into the daylight, as the smallest hole or crevice in the slide or camera would admit sufficient light to *fog* the plate. The plates may be developed by the ferrous-oxalate method, or with pyrogallic acid, and a bromide and ammonia.

Instead of holding the plate in the hand while developing, as with wet collodion, a shallow dish is used, which need be only just a little larger than the plate, in order to economise the solutions. Three dishes will be necessary one to develope in, one to contain solution of alum, and the other for fixing.

Some operators prefer the ferrous-oxalate developer, which is composed of oxalate of potash dissolved in warm water to saturation, and in this is also dissolved oxalate of iron (ferrous-oxalate) till the solution will take up no more. This solution may be purchased ready for use, if preferred.

The plate having been exposed, and everything necessary got ready, it may be placed, face upwards, in the dish, and sufficient of the developing solution may be poured into the dish, so as to completely cover it. After a few minutes, the negative may be examined, and when sufficient density appears to have been obtained, it may be removed from the dish, and the oxalate solution returned to the stock-bottle. The negative must now be rinsed with water, and then put into the solution of alum, which is made by dissolving alum in warm water until no more will dissolve. Of course, all solutions must be used *cold*.

Some gelatine plates have a tendency to *frill*. This is caused by the expansion of the gelatine film by the absorption of moisture. The effect of the alum solution is to harden the film. If the plate be touched with the finger while wet with the developing solution, it will be smooth to the touch; but after immersion in the alum for a minute or two, when touched again, it will be noticed that the character of the surface has changed, and this indicates that the film is sufficiently hardened. The plate may now be rinsed under the water-tap, and is ready for the next operation—fixing—and this is effected by immersion in a saturated solution of hyposulphite of soda (or thiosulphate of soda, to use the correct name).

This method of development has the advantage of being clean and very easy to manage, but it has the disadvantage that the solution is not constant, and the results are not always to be relied on. Of course, it is possible to become so familiar with a process that difficulties in the hands of one operator are not met with by another.

Development with pyrogallic acid is the method in most general use. Mr. Kennett's formula is: Solution No. 1, pyrogallic acid 4 grains, water 1 oz. Solution 2, ammonia (sp. gr. ·880) half an oz., water 8 oz. Solution 3, potassium bromide 3 drs., water 8 oz. Solutions 2 and 3 may be kept mixed together. It is not necessary to weigh the pyrogallic acid for every plate. Keep a small bone spoon for the purpose, and after once weighing the proper quantity, notice what is required for the size of plate, and with the spoon sufficient may be *guessed*, a small quantity more or less being of very little consequence. But if Mr. Kennett's method be followed, take of No. 1 one ounce, and add to it one dram (or drachm) of the ammonia and bromide solution, which must be poured over the plate while lying flat in the tray. If any air-bubbles appear on the plate, they must be carefully removed, and the solution must be kept in constant motion, not violently, or air bubbles will be caused. In a short time the picture will appear, but the development must be continued until a strong image is seen when the plate is examined by transmitted light. Experience with a wet plate is of little use here, as the appearance of the image is quite different. The development must be continued until there is an appearance of great density, and the back of the plate being examined, the picture should to some extent be visible there. Practice with a few plates will be worth more than pages of written description.

Any make of gelatine plates may be developed with either of the solutions named, but in some cases it is advisable to follow the directions to be found with each packet of plates.

If the picture do not appear in moderate time, the exposure may have been insufficient, and more of the bromide and ammonia solution may be added. If the picture appear too quickly, it shows that the exposure has not been correctly timed. It is as well to add too little of the bromide solution, as it is easy to add more if the picture be tardy in developing. Under-exposure is apt to produce hard negatives and over exposure too little density.

Too much attention cannot be given to the washing of gelatine plates. Running water may be used—a gentle stream is sufficient—or the plate may be placed face downwards (not touching the bottom of the dish) so that the thiosulphate of soda may be washed out, the water being changed several times.

Should the negative appear to be too thin, it may be intensified as follows: While wet, flow over the plate a saturated solution of bichloride of mercury. Notice the effect, and take care not to over-intensify. At the proper moment return to stock-bottle and wash the plate thoroughly: then flow over it a solution of ammonia, one ounce to eight ounces of water. This will darken the image, and the plate must be again thoroughly washed. The mercury and ammonia solutions need not be thrown away, as they can be used till exhausted. If the mercury (or *intensifying*) solution be found to act too vigorously, it may, of course, be weakened by the addition of water. Simply flowing the solution once over the plate is often sufficient, while in other cases the action of the bichloride may be allowed to continue until the picture is bleached white.

While wet, a gelatine plate must not be dried by a fire, as a collodion plate may be. It has been suggested that if surface-dried with blotting-paper, the plate may be dried by fire-heat. If carefully done, this method is effectual. When dry, the negative may be varnished in the usual way; or if only a few prints are required, the negative may be printed from without varnishing, care being taken not to use the paper damp.

ON SOME PUBLICATIONS OF THE CHRISTIAN KNOWLEDGE SOCIETY.

The Society for Promoting Christian Knowledge has now for many years been remarkable for the singularly able manner in which its Committee of General Literature and Education have conducted the publishing arrangements of the Society. No sectarian influences are allowed to interfere with the quality and character of the books published: in every case the question which the committee seems always to have had in view is whether a subject will be treated ably, honestly, and thoroughly.

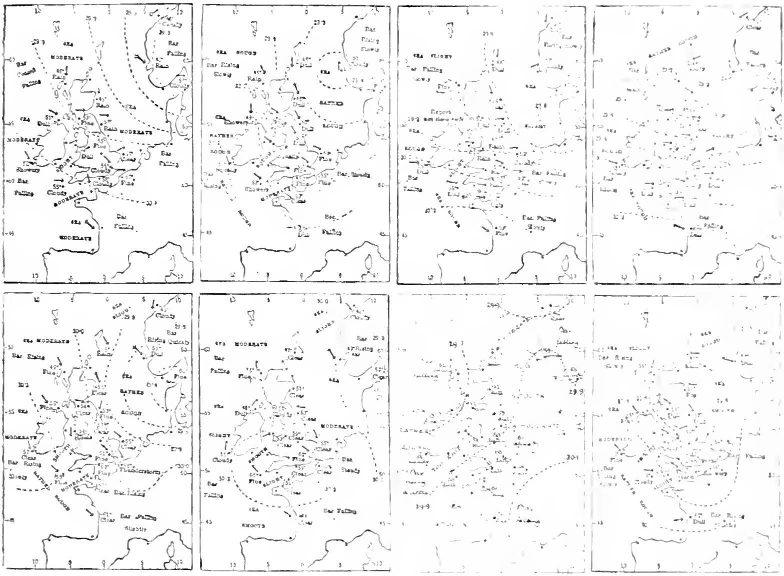
The Manuals of Elementary Science,

for example, have been prepared, without exception, by writers thoroughly conversant with their various subjects. From Professor Fleeming Jenkin we have an admirable treatise on Electricity, clearly and brightly written—and we need hardly say, soundly. Mr. Le Gros Clark has written an excellent treatise on Physiology: one of the very best extant, for its size. Those who take interest in Crystallography will find the manual by Mr. H. P. Gurney full of useful matter, verging strongly towards the mathematical; but the nature of the subject rendered this almost unavoidable. The treatise on Matter and Motion, by the late Professor J. Clerk Maxwell, is open to more serious exception in this respect, having unquestionably gone beyond the line which separates the profound from the popular. Professor Clerk Maxwell was never able to appreciate the difficulties which beginners find in dynamical and kinematical matters; but in this little book he seems to have thought that the best way to avoid them was to pass boldly into the region where vectors freely roam, and the result is mystery and misery to beginners. It does not content them to learn that, "as indicating an operation, AB is called a Vector," and that "the operation is completely defined by the direction and distance of the transference"; nor is it any satisfaction to the inquiring mind to know that "the starting-point, which is called the Origin of the Vector, may be anywhere." Yet this is all which Professor Clerk Maxwell tells them about vectors in defining these useful articles. The S.P.C.K. should have a manual prepared, to which Professor Maxwell's might serve as a sort of sequel; for, unquestionably, a student of matter and motion is much aided, later in his studies, by the vectorial method. At present, however, it must be admitted that the manual by Professor Maxwell is an exception (and a solitary one) to the generally useful character of these science manuals. Mr. Bernays' manual on Chemistry and Mr. Newton's on Zoology are excellent. Of Mr. Proctor's manual on the Spectroscope we must not say more than that the author has honestly endeavoured to bring the work up, in clearness of exposition and fulness of matter, to the standard of the series. Astronomy, by Mr. W. M. Christie, now Astronomer Royal, is a useful and instructive little treatise, not absolutely free from errors (witness the singular inversion of the effect of longitude on time, in the diagram on page 14, where places west of Greenwich have their time marked later than Greenwich time, and places east of Greenwich have their time marked earlier!), but, in the main, sound. The illustration of orbits of comets at page 93, however, is misleading. Mr. Christie explains, indeed, how and why he has changed the shapes of certain cometic orbits; but he says nothing of the entire change he has effected in the positions of all the paths. It is on such erroneous teaching that the paradoxists erect their surprising structures. If there is one point in which books of astronomy more require re-modelling than any other, it is in this—the illustrations. The subject which, perhaps—of all treated of by science writers—most requires care in illustrating, is just the one which, as a rule, is most villainously illustrated.

Overhouse Wires.—There are 9,000 miles of telegraph and telephone lines in the streets and on the house-tops of New York city; 3,500 of these belong to the Metropolitan Telephone Company. These figures should be a warning to our metropolitan authorities, for the number of telephone wires over London is increasing at an alarming rate. The Post-Office has spent an enormous sum during the past few years in converting the overhouse into underground lines.

WEATHER CHARTS FOR WEEK ENDING SUNDAY, JUNE 18.

Sunday, 11th. Monday, 12th. Tuesday, 13th. Wednesday, 14th.



Thursday, 15th. Friday, 16th. Saturday, 17th. Sunday, 18th.

In the above charts the dotted lines are "isobars," or lines of equal barometrical pressure, the values which they indicate being given in figures at the end, thus—30·4. The shade temperature is given in figures for several places on the coast, and the weather is recorded in words. The arrows fly with the wind, the force of which is shown by the number of barbs and feathers, thus .— ⟶ , light ; ⟶, fresh or strong ; ⟶ , a gale ; ⟶ , a violent gale ; ⊙ signifies calm. The state of the sea is noted in capital letters. The * denotes the various stations. The hour for which each chart is drawn is 6 p.m.

Reviews.

"CURIOSITIES OF VEGETATION."*

In this work Mr. Cooke coquets with the Darwinian theories. The book is interesting, and in parts instructive ; but it is undeniably thin, and it wants plan and purpose. The author's object has been to summarise the results of tho researches made by Darwin and others into the peculiarities of plant life, and to present their teachings in as succinct a manner as the subjects permit ; but he makes scarcely any attempt at classification ; nor does the reader, as he passes from chapter to chapter, recognise duly the scientific bearing of the evidence. The work reads like a note-book, rather than like a treatise on a scientific subject ; and, even as a note-book, portions are scrappy and valueless. The book is more likely to be dipped into than read ; and, viewing it in this way, we can recommend it as one which can hardly be opened anywhere without something of interest turning up. But if the book had been reduced to two thirds of its present size (by the omission of such comparatively unscientific statements as that rattans are the terror of schoolboys, and that Krishna gambolled with the milkmaids of Brindabun, under the Kedamba tree), and its subject matter duly arranged and systematised, it would have had greatly-increased value. Still, the book is one well worth reading.

* "Freaks and Marvels of Plant Life ; or, Curiosities of Vegetation." By M. C. Cooke, M.A., LL.D. (Published by the Society for Promoting Christian Knowledge. London.)

"STORY OF A MUSEUM."*

This is a capital book for young people, but also contains much excellent and amusing reading for older folk. The author shows what can be done in the matter of collecting objects of interest for a museum, when

* "The Story of our Museum ; showing how we formed it and what it taught us." By the Rev. H. Housman. (Published by the Society for Promoting Christian Knowledge. London.)

the task is set about in earnest. Mr. Housman expresses regret, and rightly, at the indifference to natural history and science too commonly manifested by the young men of the present day. "Brought up with their eyes unopened to the wonders of Nature, they pass through life in the same state of blindness; leisure often hangs heavy on their hands; the country, save for purposes of sport, is voted dull; travel is deprived of some of its greatest charms; and *wisdom at many entrances quite shut out.*" He notes truly how completely all this is reversed in the case of those who have imbibed an enthusiasm for studying and collecting, in any department of natural or historical science.

Every page of this book is full of interest, from the most amusing account of the author's first attempts at bird stuffing (the illustration at p. 35 is worth the price of the book, to our mind) to the closing chapters on antiquities and coins. This is just the sort of book to select as a present for a clever, intelligent boy. Mr. Housman's remarks on Natural History Collections (Appendix A.) deserve careful study.

BUTTERFLIES AND MOTHS.

By W. J. H. Clark.

We have now enumerated the principal and most generally adopted methods of catching, rearing, and preserving both butterflies and moths, but there are several others more or less efficacious, which find favour in the eyes of different individuals.

On the Continent, especially in France and Italy, old soap-suds which have become putrid are considerably used, and they appear to attract moths fairly well. We have tried the plan ourselves, but up to the present only slight success has attended our efforts; however, we mean to give it a few more trials.

Brewers' grains, when stale, is very "fetching," and fruit which has burst through over-ripeness makes another very good bait, especially for butterflies and other day-flying Lepidoptera.

The flowers of the ivy and sallow are also very great attractions to moths, and have a peculiar intoxicating or stupefying effect on the insects, which, whilst under this influence, can be knocked off the flowers into a net without the slightest trouble. This method must be worked at night with a lantern.

Besides these, the following flowers, together with many others, are often visited by both diurnal and nocturnal Lepidoptera:—The heather, mistletoe, bramble, catchfly, viper's bugloss, valerian, several kinds of grasses, scabious, honey-suckle, &c. The flowers must be well watched, and when the insect is hovering over or has settled, the net will have to be used quickly, and with precision, or failure will result. Most of the hawk moths can be caught in this way, as none of them come freely to sugar.

The females of some moths also have an extraordinary attracting power for males of the same species, the "scent" appearing to travel to great distances, and by exposing one of these virgin females in a small box covered with a piece of fine muslin, numbers of the other sex will come flying round in great excitement, and settle on the box or near it, when they can be easily taken.

Probably the females of all moths have this peculiar power in a greater or less degree, but in the case of the Vapourer (*Orgyia Antiqua*), the Oak Eggar (*Bombyx quercus*), the Emperor (*Saturnia Carpini*), the Kentish Glory (*Endromis Versicolor*), and one or two others, it is so very marked that even a person who knows nothing of entomology can hardly fail to notice it.

The Purple Emperor (*Apatura Iris*), the most beautiful of our butterflies, and at the same time the most difficult to capture, possesses a very [illegible] depraved taste, the greatest delicacy he can [illegible] being decomposed animal matter, and if a dead [illegible] animal in a state of putrefaction happens to be placed near his haunts, he is sure to descend to the feast.

This noble butterfly seldom visits the ground unless under these circumstances, always flying about the tops of tall oak trees, hence the difficulty experienced in catching him. Some people use a net with a handle 30 or 40 feet long, but it is so exceedingly unwieldy and awkward that we cannot recommend its use; the only way we have found successful being to wait beneath the tree until his majesty condescends to come to earth, when a sharp sweep with the net may capture him.

Light is very attractive to many moths; and if on a still warm night the windows are left open and a strong light kept burning in the room, numberless insects will flock in, apparently fascinated by the glare, and the operator, by standing near with a net, can capture as many as he requires. They must, if possible, be taken immediately on entering, as, if not, the wings are sure to become more or less injured, owing to the frantic efforts of the moths to get to the light.

Going round to the street lamps from about eleven to one o'clock at night is often very productive; and if half-a-sovereign or so be given to the man who extinguishes the lamps, and a supply of chip boxes, with instructions to catch and bring to you all the moths he finds, very many rarities will be obtained, and a considerable amount of trouble spared.

If any particular species is desired, the most likely spot for its capture is the tree or bush on which the caterpillar feeds, as the female moth, impregnated or otherwise, always flies about in its neighbourhood, and the males are generally not very far off.

All the above-mentioned methods are in use, and are accompanied with a greater or less share of success; but for moths, nothing comes up to "sugar" in attracting properties, as far as my experience goes, and I should advise collectors to stick to that and the street lamps.

Immediately on seeing Mr. Mattieu Williams' communication in No. 32, page 27, we gave the bisulphide of carbon a trial. The victim, a large Puss Moth (*Cerura Vinula*), was placed in the vapour as directed, for the space of five minutes, and when taken out was quite dead.

This method appears to us to be very good, as insensibility ensues almost immediately; and though death does not come on so soon as by some other means, yet the insect cannot flutter about, which is a great consideration.

There is one great obstacle attached to its use, that is the excessively unpleasant odour which it possesses; and, as the liquid is remarkably volatile, this property soon makes itself evident.

We thank Mr. Williams for the information, and for the future shall always keep some of the liquid in the house; we advise our readers to do the same.

Time Signalling.—The following information, relating to time signalling in England, is taken from the report of the Astronomer Royal for 1881:—"There has been only one case of accidental failure in the automatic drop of the Greenwich time-ball. On four days the ball was not raised, on account of the violence of the wind. The Deal ball has been dropped automatically at one hour on every day throughout the year, with the exception of fifteen days, on which there was either failure in the telegraphic connection or interruption from telegraphic signals continuing up to one hour, and of one day when the current was too weak to release the trigger without the attendant's assistance. On three days high wind made it imprudent to raise the ball. The Westminster clock has continued to perform well, its errors having been under one second on 40 per cent. of the days of observation; between one second and two seconds on 41 per cent.; between two seconds and three seconds on 14 per cent.; and between three seconds and four seconds on 2 per cent. Time signals originating in the Observatory are distributed at 10 a.m. to all parts of the country by the Post-Office telegraphs."

A Phenomenal Canary.—The power of imitation possessed by birds of the parrot tribe has long been familiarly known, and it would not be difficult to find numerous examples of even well-educated members of the genus in this respect. We do not, however, usually regard the vocal powers of canaries as being equal to the production of articulate sounds resembling those made by the human voice. But there is at present in the possession of Dr. J. McGrigor Croft a little songster of this description, which, besides giving utterance to delicious warblings, is also able to "talk" with a clearness and precision simply marvellous. Somewhat sceptical of the accounts we had received of this animal wonder, we have, through the kindness of Dr. Croft, had an opportunity of directly proving the truth of the statements made concerning it. The canary does veritably *speak*, and enunciates a number of sentences which are clearly imitative of the voice of the lady who has had care of it since its early youth. The effect, indeed, produced by the clear, sweetly-uttered sentences pronounced by the bird is almost weird at first; but the feeling of wonder thus created quickly gives rise to a sensation of exquisite pleasure, which is deepened as the little creature suddenly at the end of a sentence rushes off into an ecstacy of song. As illustrating the exquisite pliability of the laryngeal apparatus of small birds, and the extent to which training may be carried in such cases, the tiny animal is deeply interesting to physiologists. As a mere curiosity, however, it is undoubtedly unique, and we are deeply obliged to Dr. Croft for having been enabled to witness so phenomenal a bird.—*Medical Press.*

TO CORRESPONDENTS

Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of KNOWLEDGE; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

All Letters or Queries to the Editor which require attention in the current issue of KNOWLEDGE, *should reach the Publishing Office not later than the Saturday preceding the day of publication.*

(I.) Letters to have a chance of appearing must be concise; they must be drawn up in the form adopted for letters here, so that they may go untouched to the printers; private communications, therefore, as well as queries, or replies to queries (intended to appear as such) should be written on separate leaves.

(II.) Letters which (either because too long, or unsuitable, or dealing with matters which others have discussed, or for any other reason) cannot find place here, will either be briefly referred to in answers to correspondents, or acknowledged in a column reserved for the purpose.

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"There is no harm in making a mistake, but great harm in making none. Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

"God's Orthodoxy is Truth."—*Charles Kingsley.*

TOBACCO AND CONSUMPTION.

[431]—In mentioning the immunity of the Turks from consumption, Mr. W. B. Wicken (411) has not noticed the fact that the Turkish women have never "taper waists." If all the females of cattle and horses were deformed, would any sane person expect them to produce healthy or "sound" offspring? Now, fully 90 per cent. of the women here are so deformed. From the practice in youth of wearing stays and glove-tight dress bodies, their lung-capacity is reduced, and all sorts of morbid conditions follow; yet so strong is the force of habit, that the majority of the world expect to find the children of such mothers healthy and unpredisposed to consumption, and the scientific even cast about to try and discover some far-off and occult reason for the most natural result! The marvel is that the nation is not more unhealthy. Rather let them use their influence to try and persuade young men and women to study anatomy, and to go and look at the statues in art galleries, and instead of calling a woman's natural figure "clumsy," to fix that epithet on a dress which makes it appear so.

They will see there, also, that legs are no more exclusively masculine than arms or fingers, and they may in time begin to draw the inference that a style of clothing which, from its innate ugliness requires the sacrifice of health and strength to make it presentable, is not the most advisable to persevere in upholding, if they wish to preserve the supremacy of their race, and to stamp out lung disease.—I am, Sir, &c., F. W. HARBERTON.

[432]—There are no returns showing the relative prevalence of consumption among the smoking and non-smoking males of this country, but some idea of the influence of tobacco may be obtained by comparing the deaths from phthisis of males (of whom, perhaps, one-half are smokers) and females, who are, practically, all non-smokers. The deaths from phthisis in the year 1876, for example, in England and Wales were 36,143 males and 35,221 females. The occupation of men is the chief cause of the greater prevalence of phthisis among them, but, if tobacco had any practical power of averting it, we ought certainly to find its frequency less among men than among women. J. J. RIDGE, M.D., B.A., London.

MULTIPLICATION AND DIVISION OF DECIMALS.

[433]—With your permission I venture to submit the following facts relating to this subject to your arithmetical readers, with an apology if it happens that I am telling them anything that they already know.

Arithmetic is an *exact science*, and, therefore, does not entertain the idea that when applied to calculations based upon measurements, it is working upon a more or less erroneous foundation. As a matter of fact, however, all measurements are necessarily approximations. If we reckon in the decimal notation, our measurements will be correct to so many decimal places, and no more. Suppose then that we require to multiply the numbers 3612·249 and 3·141, both of which being correct to the third decimal place, the error in each factor (due to the fourth, fifth, &c., decimal places being unknown) will cause corresponding errors in the product; but the fact is evident, that the error in the second factor (3·141) will cause a thousand times more mischief than the error in the first factor, for it is multiplied by a number a thousand times larger than is the case with the other. Is it not wise, therefore, to cut down the first factor to the same number of digits as the second, and multiply 3,612 by 3,141?

Again, since the product of two approximate numbers can never be depended upon to more digits counting from left to right than there are correct digits in *either* factor, will it not be wise to substitute cyphers for all digits beyond four in the product of the above numbers, and write 11340, instead of 11345·292? This makes our results appear to be often only very rough approximations; but what is the use of deceiving ourselves? I have seen the heating surface of a set of boilers calculated in square feet, and the result published to *two decimal places*, when a moment's consideration would show that an error of only one-hundredth of an inch in the diameter of the tubes (of which the heating surface mainly consists) would vitiate the result to the extent of twenty or thirty square feet.

Logarithms appear to have this advantage over ordinary arithmetic, namely, that they naturally fix the degree of accuracy as well as the value of our results. Logarithms put us to a lot of trouble if we attempt to get more figures in our answer than are good for us.—Yours, &c. A. N. SOMERSCALES.

[434]—Supposing that the reader has learnt how to reduce a vulgar fraction to decimal form, *i.e.*, how to divide one integral number by another not contained "exactly" in it, and to carry on that division beyond integral quotient figures, and that he accepts the truth of the statement, that "if the divisor and dividend be both multiplied by any the same number, the value of the quotient is unchanged;" then the rule for division of decimals is, "multiply the divisor and dividend by such a power of 10 as will remove all decimals, and divide the latter product by the former."

I take the examples given in KNOWLEDGE, May 6, p. 576:—

```
     127·412)   15·315
        1000      1000
     ---------  ---------
 or, 127,412)   15315·0(·120206 . . . . . .
                127412
                ------
                 257380
                 254824
                 ------
                  255600
                  254824
                  ------
                     776000
                     764472
                     ------
                      11528
     127·412)   1531·5
          1000      1000
     ---------  ---------
 or, 127412·)   1531500(12·02 . . .
                127412
                ------
                 257380
                 254824
                 ------
                  255600
                  254824
                  ------
                     776
```

From the above the following rule at once suggests itself:—

1. If the number of decimal places are not equal, make them equal by annexing zeros.

2. Then divide as in whole numbers, neglecting the decimal points in division and dividend. So far the quotient will be integral.

3. Any quotient figures found by annexing zeros to the dividend, or remainder, beyond this point, will be decimals, but the only re-

c[illegible] it has [illegible] saves the trouble of writing the figures down a second time. W. Mathias.

The School, Bideford

P.S.—You will observe that I reverse the usual order of things. In all arithmetic text-books that I am acquainted with, division of decimals precedes the rule for reducing a vulgar fraction to a decimal, whereas division of decimals might aptly and naturally follow long division.—W. M.

METEOR.

[435]—I see, in answer to a correspondent "Euclid," of Bolton, (Knowledge, No. 31, p. 13), a reference to a large fire-ball, or meteor, seen on May 4th last, at 9.30 p.m. I saw it, and as you intimate that more information on the subject might be useful, I venture to give you my version of it from notes made at the time. I was searching with my telescope for ζ Cygni, when suddenly the field of view was lit up, and the stars in the field vanished as if daylight had suddenly returned. On taking my eye away to ascertain the cause, there, right in front of me, was a great ball of intense white light, apparently almost as large as the full moon, gliding across the sky. It travelled so quickly that it is almost impossible to name its exact path, but when I first saw it it was about on the head of Draco. It passed over Cepheus and into Cassiopeia. In passing over Cepheus its colour changed from white to red, and nearly Cassiopeia, it again changed to blue, or violet, gave an extra flash up and instantly vanished, leaving behind it a long train of red sparks, which died out by degrees, and which had previously been invisible in the intensity of its light. The whole phenomenon did not occupy more than two or three seconds of time, and there was no perceptible noise. It lit up the whole sky like a lingering flash of lightning. It certainly was an awe-inspiring sight, and I heard many people in the neighbourhood, when it was taking place, give vent to their feelings in a shout of amazement. I never saw anything approaching it for grandeur in my life.

Excelsior.

[For the purpose we mentioned, "that is, to determine the true path of the meteor in our atmosphere," it would be essential that the exact course of the meteor, as seen from our correspondent's station, should be indicated, but his letter is independently interesting.—Ed.]

FLINT INSTRUMENTS AND PRE-HISTORIC MAN.

[436]—A friend of mine, who has just returned from Natal, and who had heard nothing of the discussions and theories on the above subject, and on whose veracity I can thoroughly rely, has been employed in making the Durban and Maritzburg Railway. In conversation the other evening, he told me that in making the Umgeni cutting (through red loam, gravel, and limestone rock) at 14 feet from the surface, from which a dense forest had been previously cleared, in the red loam his Kaffirs came upon the remains of a fire (charred sticks, &c.; close by this he found what he describes as a well-made and beautifully-finished flint adze-head, the cutting-face sloping from one corner to the other, with a bevelled edge like a chisel, and the other end finished off with a round flat knob.

Again, at 30 ft. from the surface, in the hard gravel, he found a [illegible] flint instruments, the two most remarkable ones being a round stone, about the size of a large orange, very much flattened at each pole, with a ¾ in. hole drilled through it, and by the side of it a stone handle 7 or 8 in. long, one end just fitting through the hole and the other end rounded off; when put together it had just the appearance of a small stonemason's mallet. At a short distance from this was a stone quoit, almost exactly like the iron ones at present in use, except that, from where the indentation for the thumb is, the circle was cut straight across, for about quarter of the circumference, [illegible] a round handle. The whole of these curiosities were taken possession of by the engineer of the line.

When the geological formation of Natal, and the pretty well-founded idea that the whole of the country has been denuded by a great outrush of waters from a great lake once covering nearly the whole of what is now the Orange Free State, is considered, we are compelled to give an antiquity to the possessors of these implements as great as, or even greater than, that given to similar tribes of men in Europe. W. M.

THE POTATO

[437]—"Farmer" (405, p. 611) asks me whether I advocate the use of mineral manures to increase the starch in potatoes. I take it for granted that by the term "mineral" is meant potash, salts, &c., without reference to superphosphates. My own experience (not at second hand) indicates that the percentage of starch, as found under the influence of "supers," is reduced by potash salts; but the land on which I operated was naturally well supplied with potash, so that only a guess can be made at the probable results to be obtained on land poor in that element. Maercker finds but little effect on the starch from any manure. I can give no information concerning the effect on the percentage of starch in cereals exerted by "minerals." "Farmer" is somewhat hard on "F.C.S." when he says that it is nonsense that stable manure is not better than peat; therefore I add for comparison the analyses of a sample of peat and of farmyard manure:—

	Farmyard Manure. Per cent.	Peat. Per cent.
Organic matter	78·8	77.0
Mineral	3·3	3·0
Potash	0·15	0·07
Sulphuric acid	0·11	0·26
Lime	0·2	0·25
Nitrogen	0·58	0·99

Another sample of peat contained less nitrogen, but nearly double the amount of potash. Chemically speaking, this peat was in many respects better than manure, but the agriculturist would probably not consider it so, because he would find that the fibre of the peat would take so much longer to rot; also the nitrogen of the farmyard manure is in a more assimilable condition than that of the peat. It is much to be regretted that the scientist so frequently makes a statement which, though correct in itself, requires some further explanation before it becomes intelligible to the public, who, being unaware of the full facts, proceed to judge upon the matter. Because I fancy that this has occurred in the present instance, I have added this short explanation, which will, I trust, quiet "Farmer's" mind on the subject of peat, and also show that F.C.S. was correct in what he wrote—although, I daresay, he is perfectly well able to take care of himself, without my saying anything.

E. W. P.

A CALCULATION.

[438]—A solution to the following question would oblige one of your contributors. A Building Society is formed, consisting of 500 members, for the purpose of advancing a sum of £500 to each member for a term of 12½ years, free of interest. Subscription of each member £12 per year, repayment of loan at the rate of £40 per year: how long will it be before the final member receive his advance? Pyramus.

Liverpool, May 23, 1882.

GOLD IN INDIA.

[439]—Much has lately been written anent the, at present, disputed existence in India of quartz that will, on proper treatment, yield gold in quantity. Will one of your scientific friends who knows the regions there at present under exploration, give me, through your medium, his opinion on the subject? This question interests many, if not all, of your readers.—Yours faithfully,

J. T.

INSTINCT AND REASON.

[440]—May not instinct in the lower animals and reason in man be the same, with this difference—that the one is more intense in character, the other wider in range? And may not this difference be accounted for by the fact that, while the brute does one thing a thousand times, we do a thousand things once? Silchester.

"AULD ROBIN GRAY."

[441]—Concluding that the subject of music lies within the scope of Knowledge, may I hope that you will throw some light on the dispute touching the authorship of the melody associated with the words of "Auld Robin Gray?" The words are the undisputed production of Lady Ann Barnard. The melody, claimed in 1812 by the Rev. W. Leeves as his own composition, was familiar to my mother in her early youth, she having been born in 1784. Both melody and words have always been accepted by myself and many others as the work of one and the same mind. It would be a worthy tribute to the memory of Lady Ann Barnard to prove that the exquisite melody was hers, as there seems internal evidence that it really was. E. L. H.

Next week the series on "How to Get Strong," "Home Cures for Poisons," and "Electrical Generators," will be continued. A valuable paper on "How to Ride on the Tricycle," by Mr. John Browning, treasurer of the London Tricycle Club, will also appear. An important series of articles on Geology, by Mr. W. Jerome Harrison, F.G.S., will be commenced shortly, and several important papers by Messrs. Prof. Charles Tomlinson, Grant Allen, Edward Clodd, W. Mattieu Williams, Dr. Wilson, and others are in type.

Answers to Correspondents.

**** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded; nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

PECCAVI. I had *not* been able to read the question relating to the British Museum, or I should not have failed to thank you warmly for your very kind offer, but at present I have no occasion to avail myself of your kindness. With regard to the beam question, you must remember what the light has to do to make the optic nerves sensible of its source. A wave may exist when it reaches the shore, yet be too small to disturb the sand there.—J. CRAM. Thanks for magic cube on base of 11. Fear it may be some time before we find a vacant corner large enough for its insertion.—TARANAKI. You need no forgiveness "for being too plain spoken." Our waste-paper basket is not very ready to take offence.—PARSON. Thanks for kind and encouraging letter. We agree with you that the mere dilution of science into amusing twaddle would not be an improvement to KNOWLEDGE. We certainly do not intend to become popular in that way.—THOUGHTFUL. Yes; pamphlet safe.—SILCHESTER. Fear we could not find space for any more articles on health resorts than we have already provided for.—F. W. FOSTER. Is there anything to show that the vapour is other than a light mist, the condensed vapour of water?—T. J. HICKIN. I do not think that a copy of Sir Isaac Newton's "Opticks" (third edition) has any special pecuniary value.—H. R. WELLER. We cannot understand your difficulty. It is proved that under the attraction of the sun, a body, in whatever course it may be moving, will travel in one of the conic sections, according to its velocity at any given distance. The particular conic section described will be an ellipse or a parabola, or a hyperbola. The planets have such particular velocities as correspond with motion in an ellipse.—J. W. JAQUES. Attempting to indicate the distance between two heavenly bodies or the apparent size of one, in inches, feet, yards, furlongs, &c., is, as you say, utterly absurd. One might as well indicate the distance between two places in hogsheads and kilderkins.—H. D. The idea that there is life on the farther side of the moon is an old one, but is quite untenable. We have not yet seen it accompanied by the idea that on the side turned from us the moon may have an appendage like a comet's tail. You are mistaken about the centrifugal tendencies existing on the moon. They are such solely as result from her rotation on her axis once in 27⅓ days. The only cause to be considered as possibly tending to produce a difference in the condition of the moon's invisible hemisphere is the earth's attraction. This, however, can produce no such effects as you imagine. The whole subject, however, has been so often discussed that it is now overworn.—J. M. FISHER. We have not your letter. We did not insert it, because it promised to initiate a controversy, and we have no room for controversy. Dr. Wilson's answer was intended for you alone; and the method we adopted was the most space-saving one we could employ. We do not know of any rule of "fairness" requiring us to insert every letter of the kind which may be sent to us. We know that fairness to the proprietors utterly forbids our doing so. If, however, you still think Dr. Wilson mistaken, and will succinctly say in what points, we will insert your remarks.—SUNDEW. (1.) Are you sure it was the zodiacal which you saw on the 7th soon after ten? June is not usually a good time to see the zodiacal; note the position of ecliptic in our June maps. (2.) The rainbow is not necessarily part always of the same-sized circle. It can have two angular diameters, and the apparent size, even for the same angular diameter, varies according to the distance of the cloud on which the rainbow is seen.—AN OXFORD UNDERGRADUATE. Those papers are rather letters than articles; however, there will be no more of them.—M. B. ALDER. It must be satisfactory to know so certainly about the moon. I wish astronomers did. Your remarks about warm weather some time ago read strangely now, after so much unseasonable cold.—A.B. Solution correct, but author's (shorter) has appeared.—A STUDENT. We should in that case see the moon turn slowly on her axis (apparently backwards) in such sort that every part of her surface would in turn become visible to us. ASMODEUS. It is hardly in our line to give rules for preventing the beard from growing.—E. M. The number of stations at present existing is far too small to give even the roughest approximation to annual rainfall for whole earth. The sun-spot theory of rainfall is not believed in. It was only started, I fancy, to get a pull on national purse-strings.—G. T. M. E. Thanks.—H. E. KILBY. Yes; that method, like the others, is theoretically sound, but practically unavailable, because of the relative smallness of the moon's distance. Very small errors in determination of longitude and latitude of stations, and of times of contact, &c., would introduce very large errors into the estimates of the sun's distance. The conception is, however, very ingenious.—ERIN-GO-BRAGH. It is the case sometimes; so also old hens are adorned occasionally with imperfect sort of comb, and some old ladies with moustachios and beards.—A. BUTTLE. The Leprosy communication did not seem quite so generally interesting and important as that on Tubercle, and our space ran short.—W. GRANDY. Thanks for encouraging letter. On the other point, I can assure you I would gladly see my books sold at very low prices; but publishers, with whom the matter rests, cannot venture—yet, at any rate.—A. E. W. Our arrangements for indexing already made when your letter received.—F. MORRIS. Berry's Polishing Paste and Domestic Black-Lead are rather outside our lines.—T. GREEN. Do not know of any book or books on Gum, its properties and uses.

BOTANICAL.

E. C. H. (Worthing). Most cultivated "geraniums" belong really to the genus *Pelargonium*, which has slightly irregular flowers (two upper petals differing from three lower), a spurred sepal (scarcely noticeable), no glands, and few stamens (generally five). The true *Geraniums* have regular flowers, no spurs, five glands on the disk, and ten stamens. A few perennial true *Geraniums* from southern Europe are still cultivated in old-fashioned gardens, but most of the plants so-called are *Pelargoniums* from the Cape of Good Hope. *Pelargonium* is, in fact, a larger and more specialised insect-attracting type. When in doubt, look for the irregular sepal and count the stamens. GRANT ALLEN.

ELECTRICAL.

IGNORAMUS. See article in KNOWLEDGE, No. 30; ebonite can be procured from the India-rubber and Gutta-percha Company, 100, Cannon-street, London, E.C. The same article (see also errata, No. 31) answers your query anent length of wire. The generator described will make a current quite strong enough for plating: in fact, rather too strong in proportion to its other features. It will not be strong enough for a Swan lamp, which requires an electro-motive force of forty volts, or the force produced by twenty good Bunsen cells joined up in series.—H. BARNSLEY. Get a glass or earthenware jar, about three pints capacity, into this put a zinc rod for the positive element. The negative element is a small carbon plate placed in a porous pot, filled up with a mixture in equal parts of crushed carbon and black oxide of manganese, about the size of parched-peas. Great care is requisite in making this part of the cell, and you would find it cheaper to buy, well, the porous pot with carbon plate *in situ*. A saturated solution of sal ammoniac is put in the outer jar, half filling it. At Silvertown, where these batteries are made in very large quantities, the upper extremities of the carbons are dipped, at a high temperature, into melted paraffin, and subsequently placed into a mould containing molten lead, which forms a cap for the carbon, a brass terminal being simultaneously fixed into the lead. Marine glue is run over the carbon-manganese mixture, the carbon rod being in position. Vent-holes are made in the glue to allow any gases to escape. All bare metal connections must be well coated with pitch or varnish, otherwise they will soon be corroded by the gases given off by the battery. Should you buy a cell, I would recommend the new agglomerate Leclanché, with a large zinc cylinder, instead of the zinc rod. There are at the present moment some thousands of this latter form in use, comparing very favourably with the Fuller or double liquid bichromate battery. CHARLES BUSBY. You have been anticipated long since. Inventors have not yet been able to overcome the apparent partial volatilisation of the carbon, as is evidenced by the thin carbonaceous film deposited on the surface of the glass globe. IGNORAMUS. 1. Yes, the same. 2. See articles on "Generators." 3. No, not on an extensive scale. 4. The reversibility of the dynamo can be easily explained. It is due to a very simple truism, viz., the convertibility of forces. This point, we hope soon to be able to deal with under the head of "Electric Motors."

ACCORDING to the *Railway Age* (Chicago, April 20) the American Bell Telephone Company has in operation 189,374 instruments and 49,168 miles of wire. These are connected with 592 exchanges. The figures show a great increase on the preceding year. If the company is able to organise a satisfactory system of underground wires, a great further development may be expected. The charges will in this case be considerably reduced.

Our Mathematical Column.

THE LAWS OF PROBABILITY (*Concluded*).

I [illegible] in the first place, that in dealing with [illegible] the antecedent probability as well [illegible] observed facts. We sometimes hear [illegible] as the perfection of philosophic [illegible] myself," some will say, "to consider [illegible] hypothesis is likely or not; I only desire to [illegible] and experiment appear to favour it or the [illegible] ration of a principle which is excellent [illegible] observation and experiment should be the test [illegible] is examined; and in the long-run, ob- [illegible] may serve to over-balance any antecedent [illegible] in favour of an hypothesis. But during the [illegible] and while as yet the evidence derived from [illegible] is not decisive, it is essential to the [illegible] opinion that antecedent proba- [illegible] For example, let us suppose [illegible] three predictions con- [illegible] the planetary positions, and [illegible] by the event. Let us [illegible] are couched in the clearest possible [illegible] must be regarded as heavy [illegible] 9 to 1 for instance. Then [illegible] predictions will be fulfilled, if the [illegible] is erroneous, is $\frac{1}{1000}$; or [illegible] particular ball out of a bag con- [illegible] the predictions have actually [illegible] afford very striking evidence in [illegible] planetary positions do actually [illegible] the antecedent probabilities [illegible] so influenced; and 2, that [illegible] probability of the planetary hypo- [illegible] $\frac{1000}{1009}$ [illegible] unity—*i.e.*, certainty. [illegible] portion of the evidence, that, [illegible] antecedent probability against [illegible] not enter into consideration [illegible] is of such weight that the [illegible] (even though accom- [illegible] a single prediction had been [illegible] even giving the hypothesis [illegible]

[illegible] carefully whether we really [illegible] hypotheses by which observed facts [illegible] hypotheses are mutually [illegible] enumerated is not [illegible] the views of Dr. Stark [illegible] the death-rate. From the [illegible] unmarried men (the former [illegible] Dr. Stark was led to infer that marriage [illegible] (The statistics are given in my essay [illegible]) In arriving at this conclusion, [illegible] particular hypothesis that the [illegible] lives is due to bachelorhood. [illegible] favourable to longevity is not [illegible] the very marked difference con- [illegible] than the hypothesis can account [illegible] another hypothesis of which Dr. Stark [illegible] or value of married "lives" [illegible] whereby on the average of [illegible] would be [illegible] of the married than of [illegible] hypothesis vitiates Dr. Stark's [illegible] of this hypothesis, to [illegible] correct. Both hypotheses [illegible] reference to the antecedent [illegible] they are not mutually ex- [illegible] general rule. We can only [illegible] hypothesis, or else that [illegible] does not leave us three [illegible] dealt with by the hypo- [illegible] The statistics dealt with by Dr. Stark are, therefore, not capable of leading us to any definite conclusion.

But it is not to be inferred that in this case, and in other similar cases, the statistics are valueless. The fact that they point to no definite conclusion shows only that they are insufficient. Other statistical information may so supplement such imperfect knowledge as to lead to the definite conclusions we require. And the consideration of imperfect statistics usually shows us in what direction we are to look for supplementary facts. For example, to return to Dr. Stark's statistics. We have seen that they are insufficient in themselves. They point, however, to two hypotheses, and we have only to determine in what degree the two causes dealt with by these hypotheses actually operate, to form a sound opinion on the whole subject. I am not concerned, be it noted, with the practical application of such inquiries, only with the bearing which they would have on the special question considered by Dr. Stark. Now, if we study the statistics relating to the number of marriages in times of prosperity or adversity, or, again, in healthy and unhealthy seasons, we should gain some slight insight into the probability of the action of a principle resembling selection. We might obtain statistics, again, as to the trades of those who marry, so as to compare the number of married and single in the different trades. Other statistical inquiries (which might be very difficult to carry out in practice, however), such as inquiries relating to the insurance of married and single, to the health and strength of each person throughout his life, and so on, would throw further light on the subject of inquiry. Under the actual circumstances, we can only form probable inferences on these subjects, but the conclusion we arrive at is much more likely to be sound when such inferences are considered, than when no attention whatever is paid to one of the possible causes of a result so interesting as the superior longevity of the married.

Another circumstance to be very carefully considered is the actual number of cases with which our statistics may deal. It is impossible to arrive at correct conclusions unless this number is sufficiently large. Quételet has related how a person assured him that a certain street in Paris was the healthiest region, not only in Paris, but in France. When Quételet asked how this extraordinary conclusion had been arrived at, his informant remarked that Quételet's own method of statistical research had been applied: "I have found that more than two hundred persons live in that street, and there have been only three funerals in three years. Now, in what part of France is the death-rate so low as five per thousand per annum?" "I suppose, then," answered Quételet, "that if there had been no funerals at all, you would have concluded that by removing to that street you would live for ever."

One point remains to be touched upon. I have spoken of the fact that in any very great number of trials, series of events may be *expected* to occur which would appear very surprising if they happened in but a few trials. It would be a mistake, however, to infer that the occurrence of a strange series of events is to be regarded as on that account less worthy of notice. Boswell related that when he mentioned to Dr. Johnson that the first of the new hackney-coaches which he had seen had been actually No. 1, the Doctor ridiculed the notion that there was anything remarkable in the coincidence. "You were as likely," he reasoned, "to see that coach as any other." Now, although Dr. Johnson was certainly right in this instance, yet it would be a mistake to conclude that such coincidences in general should be overlooked.* When a coin is tossed, it is as likely that twenty heads will be tossed in succession as that any other specified arrangement will appear; yet undoubtedly if the event had happened we should be justified in suspecting that a two-headed coin had been used. If a die is cast twenty times, and ace appears eight times, we might reason that the observed succession of throws was antecedently as likely as any other particular succession, and this reasoning would be just; but, unquestionably, if such an undue number of aces appeared, we should think it not unlikely that the die was cogged. This opinion would be strengthened if ace was a

* [illegible] incomprehensible to the [illegible] used to call those who propound [illegible] "Strike, but hear," they [illegible] hear, and that few even think [illegible]

* Quételet relates a curious story illustrating this: "During the first Spanish war, a corps of the French army, which was employed in the siege of a town, dreaded the recurrence of Friday, as a day fatal to it, because the enemy killed or wounded then more of their men than on any other day of the week; a strong prejudice was, in consequence, established against Friday. Now after the siege, it appeared that the artillery had been changed every day, and that those who did duty on Friday were superior marksmen to the others. Superstitious ideas," adds Quételet, "have often less foundation; from the impossibility of discovering the true cause under the circumstances in which we are placed, we are apt to attribute them to objects totally extraneous, not being willing to consider effects as existing without a cause."

throw by which money was won. Without deciding at once that we were being cheated, we should watch somewhat carefully to see in what proportion aces appeared thereafter. So it is when, at card games, a player secures more frequently than probability warrants some favourable "hand." There *must* be players who seem lucky on occasion, and there *must* be some who appear exceptionally lucky for years. But this should not cause the player to blind himself to the antecedent improbability of definite runs of luck, and therefore he should not overlook the necessity for watchfulness when they have occurred. And lastly, in those affairs of ordinary life in which chance plays a more or less prominent part, but conduct yet counts for something, we are justified in inferring skilful conduct where good fortune is long continued and strongly marked. "In the conduct of life," says the great mathematician Laplace, "good fortune is a proof of skill which should induce us to prefer placing our confidence in those who appear thus lucky."

Our Chess Column.

BY MEPHISTO.

THE VIENNA INTERNATIONAL TOURNAMENT.

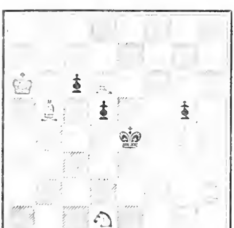
THIS week will see the finish of the Tournament, as on Wednesday, probably, the last game will have been played, and then the Chess world may devote itself to the task of honouring the victor. Who this would be formed the subject of conjecture and conversation in London Chess circles. Steinitz, who had been doing badly in the beginning, gradually crept to the front, till on the twenty-sixth round he came out ahead of all other competitors. The public like to pin their faith to tried men, and it was generally then taken for granted that Steinitz would come out as chief winner. This belief was, however, dispelled by the news that arrived from Vienna, which showed that Steinitz had relapsed into bad luck, while Mason was doing wonderfully well and carrying everything before him. According to telegraphic information received in London on Thursday, Mason was at the head of the list with 20, while Steinitz stood at 19½. It was then generally believed that Mason would win first prize, and bets were freely made on that expectation. We hope to be able to publish telegraphic information, before going to press, as to the actual result.

According to a telegram in the *Daily Telegraph*, of Monday, the following was the state of the score on Saturday night, June 17, after the conclusion of the 31st round:—Mackenzie, Steinitz, and Winawer, 21½; Mason, 21; Zukertort, 20½; Blackburne, 18½; Englisch, 17½; Paulsen, 16½; Wittek, 16; Hruby, 11½; Weiss, 11; Schwarz, 13½; Bird and Tschigorin, 12; Meitner, 11½; Ware, 10. The committee have thought fit to alter the order of the play on Thursday last; we cannot therefore properly estimate Mason's score, as it is quite possible that in spite of his being half a game behind, his position might be as good as that of any other man. The closeness of the five first men makes the finish a very exciting one.

On Monday Zukertort beat Weiss, Paulsen beat Ware, Hruby beat Mackenzie, Steinitz *v.* Bird drew, Mason was engaged with Englisch, and Winawer with Meitner.

Problem No. 45.
By B. G. Laws.

BLACK.



WHITE.

White to play and mate in three moves.

SOLUTIONS.

Problem No. 42 by J. A. Miles, p. 615.

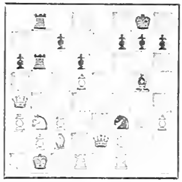
1. R takes P (ch)	1. K takes B5
2. Q to K6	2. R takes Q
3. Kt takes R (mate)	
	or if 2. K to Kt4
3. Q to R6 (mate)	
	or 2. R takes R
3. Q takes R (mate)	

By J. Lieence, p. 16.

No. 13.		No. 14.	
1. Kt to K4	K to Q4	1. P to K8 B	K to K3
2. P to Kt8 R	K to K4	2. R to B6 (mate)	
3. R to Kt5 (mate)			

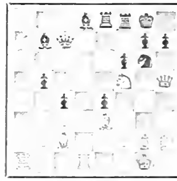
The following two pretty endings are from the *Field*:—

BLACK.
Blackburne.



WHITE.
Winawer.

BLACK.
[illegible]



WHITE.
Blackburne.

The [illegible] ended thus:—

WHITE.	BLACK.
	R [illegible]
B takes R	K [illegible]
R takes Kt	[illegible] R
R [illegible]	B [illegible] P
B to B2	R [illegible]
Kt to B [illegible]	R [illegible]

Q to K4, and [illegible] made one of his magnificent [illegible]. He answered R to Kt8 ch [illegible] K was bound to take [illegible] and Q to QKt4 ch, and White's [illegible]. The game broke down [illegible], and Winawer resigned in the [illegible], after 5½ hours' play.

In [illegible] the diagram, W[illegible] [illegible] [illegible] B [illegible] Kt [illegible] P [illegible] R [illegible] Q7. [illegible] take, [illegible] R takes [illegible] K [illegible] Kt [illegible] per [illegible] given [illegible] K [illegible] Kt4 [illegible] W[illegible] attacked [illegible] Bx [illegible] would have [illegible] of the [illegible] a pawn.

ANSWERS TO CORRESPONDENTS.

*** *Please address [illegible].*

W. L. Lambert.—Edward Wilson.

Novice.—We cannot find any fault with [illegible] p. 633. There is no Queen's Pawn [illegible] the Queen's Pawn has been captured [illegible] M. [illegible] 16, p. 634, [illegible] Q [illegible].

Correct solutions of Problems received: No. 42 by Barrow; Nos. 13 and 14, by C. S. Bright, [illegible] (Reading).

S. M.—It is not so.

J. Tilbe.—To castle after [illegible].

A report (just issued, [illegible] 21, 1881) on the incandescent lamps exhibited at the Paris Exhibition (1881), has been presented by Professor W. Crookes and [illegible] Parker, who were appointed a sub-committee for the purpose. The tests have been carried out in [illegible] manner, and [illegible] will be a matter of very great regret if a similar report [illegible] the more recent exhibition, as it is certain that [illegible] improvements have been recently made, more particularly [illegible] Swan and [illegible] Fox lamps.

The case of "the United Telephone Company (Limited) *v.* [illegible] Harrison, Cox Walker, & Co." has terminated [illegible] in favour of the United Company, who [illegible] the [illegible] Gower-Bell receiver, but are defeated [illegible] transmitter. They intend to bring the [illegible] the Court of Appeal, and if they gain [illegible] almost exclusive sway in matters telephonic. Professor [illegible], writing to the *Times*, asserts, however, that the [illegible] system, so ably described by Professor [illegible] Society of Telegraph Engineers, a few weeks [illegible] by the decision. The principles differ considerably [illegible] of the United Company's apparatus.

Our Whist Column.

By "Five of Clubs."

PLAY THIRD IN HAND, PLAIN SUITS (continued).

When, third in hand, you hold Queen or Knave and others, and a small card has been led which second player does not cover with a card higher than your honour, you must in every case play the honour. But if ten is led, and not covered by Knave, you would not play the Queen, but pass the ten; for, as already explained, you gain nothing by playing the Queen if the lead is from King, Knave, ten, while, if the ten is a strengthening card, you lose all command of the suit if you cover. If you hold Knave, nine, and others and eight is led, you may finesse the nine or pass the eight, for it can hardly be played as a strengthening card, nor from a three-card suit, containing both Ace, King, or King Queen, for from either of these combinations the proper lead is the King. If the eight is the lowest of a four-card suit, the suit can be no other than Ace, Queen, ten, eight. If the lead is from a three-card suit, the eight being the lowest, the other cards may be Ace Queen, Ace ten, King ten, or Queen ten. The ten can therefore only be to your left in the single case of the lead being from Ace Queen eight —which is an unlikely lead anyhow, though, of course, possible, since leader may hold besides four trumps, and two weak three-card suits. You are therefore, in all probability, quite safe in finessing the nine or passing the eight according as you may wish the lead to lie (supposing the trick to fall to the eight or nine).

When, third in hand, your best card is small, you play it, of course, if it is higher than the card played on your right, or higher than and not in sequence with the card led. If you cannot cover, and if the cards already played are small, remember that your card tells both your partner and your adversaries of extreme weakness, both in individual cards and numerically. In such cases the question may arise sometimes whether it may be better to deceive the enemy or not by playing a false card. For instance, if your partner leads four, second hand plays six, and you hold three and five, if you play the five, it will be thought that you do not hold any other card in the suit. Cases may arise where it may be more important to cause the adversaries to suppose this erroneously, than to leave them and your partner in doubt by playing the lower card. It is worth your while in every such case to consider which is likely to be the more advantageous course.

The play of third in hand, second round of a suit, depends generally on the fall of the cards. As a rule, you know pretty well how the cards lie at this round, whether the original lead were your partner's or your own. In the former case you have the indications from the original lead, as already explained; those from the play of second and fourth in first round, those from the renewed lead, and play of second hand second round, besides your own original hand. In the latter case, the suit is presumably your longest, you have rather more information in your own hand than in the other case, and rather less from the play; but if you have been watchful you have usually learned a good deal. Thus, suppose, having King and three other clubs—10, 4, 3—you lead the 3, and the cards fall thus,

C 3 C 8 C Q C 6

you know that, apart from signalling for trumps, your partner must hold the two and five, second player has nothing below the eight, fourth player nothing below the six. Now, suppose that on the return of the suit your partner leads the two; then, as this is not the highest left in his hand, you know that besides the five he has one other, which is not the Ace, for if he had had the Ace he would have led it. Nor can it be the Knave, for if he had had Queen Knave, he would have played the lower of the sequence. You hold the King yourself, therefore his remaining card must be either the seven or the nine. You know this before second hand has played to second round. You know also that second hand has not the Ace, or he would not have allowed the Queen to take the first trick. Suppose, now, second hand plays the nine. Then the only card whose position remains doubtful is the Knave; it may be to your right or to your left. But you can play with as much confidence as if you knew where it was. For if it lies to your left along with the Ace, which certainly lies there, you lose nothing by finessing the ten; and if it lies to your right you gain a trick—apart from nothing.

Take again the following case,—

Your hand being Q, Kn, 5, 2 of Hearts (trumps), the first round is—

A.	Y.	B.	Z.
H 2	H 9	H K	H 6

Second round, to second in hand,

is let us say		H 8	H 7

You know certainly that either four, or three, and ten lie with Y, and no more. For three and four are certainly not both with B, or he would have returned his lowest. Neither four nor three lie with Z; therefore, one of these cards lies with B, who has, therefore, led the best of two. You can thus place every card, assuming always that all are playing according to the customary rules for good play. B has either the three or four left. Y has ten, and either four or three. Z has the Ace, and is holding it back for some purpose connected with the strategy of his hand. You therefore play Knave third in hand; whereas, had you not attended to the fall of the cards, you might have thought it a fair finesse—only ten and Ace being against you, and the Ace probably in fourth hand—to pass the eight, so as to make sure of taking the last round in trumps. As it is, you know that, after your Knave has taken the second round, your third lead of the five will draw both the Ace and ten, leaving you with the long trump.

A Bumper at Whist.—A correspondent, "Hazard," asks how *to determine the odds against a bumper at Whist?* The problem is a very difficult one. In fact, it is practically insoluble. Our correspondent remarks that there are nine ways of winning a rubber of two games, meaning, we suppose, that each game may be won, either by five or more points, alone; by three or more points and two by honours; or by one point or more and four by honours; and therefore the pair of games in 3×3 different ways. But, in reality, there are many more ways than three in which a game can be won, even if we only consider the points obtained, and the honours marked. And to determine the true chances we must consider more than this. We should have to determine the number of combinations of hands by which with the best play, or with good play on both sides, or with moderate play met by bad play, or with good play met by atrocious blundering, and so forth, a game might be made in a single round; in how many ways it might be made under correspondingly varying conditions in two rounds, in three rounds, in four, and in five. The same would have to be done for the second game. The numbers thus obtained would have to be multiplied together, or rather the number squared. Then the total number of combinations for all cases of one round, two rounds, &c., for each game would have to be determined. The chance of a bumper would be the ratio of the former number to the latter. But no one could possibly work out the problem in this way.—Editor.

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CONTENTS OF No. 35.

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

BY AMELIA B. EDWARDS.

III.—THE PHARAOH OF JOSEPH.

BUT, it will be asked, what was the name of this Pharaoh, and what place did he occupy in the succession of Hykshos kings?

Tradition, represented by the Byzantine monk, George Syncellus before mentioned, and also by John of Antioch, of whose work only a few fragments are preserved (see Müller: *Fragmenta historicorum græcorum*, vol. iv., p. 555), assigns the name of Aphobis to the Pharaoh whose dream was interpreted by Joseph. Now Aphobis, or Aphophis, is the Greek way of writing Apapi; and Apapi was a name borne by at least two Hykshos rulers, one of whom belongs to the 15th and one to the 17th dynasty. Of the first Apapi nothing is known but his name. It is the second Apapi under whom Joseph is believed to have flourished; and this Apapi—the Apapi of the 17th dynasty—was the last of the Hykshos kings. It was in his time that a tributary prince of Thebes, Rasekenen Ta-aken, raised the war of national independence which ended in the expulsion of the shepherds. Sphinxes and statues engraved with the name of Apapi have been found in the mounds of Sān (the Zoan of the Bible) where the Hykshos established their capital; and a succinct contemporary account of the war of independence is found at El Kab, Upper Egypt, sculptured on the walls of the tomb of a certain naval officer named Aahmes, whose father served on the legitimate side under Rasekenen Ta aken, and who was himself distinguished for personal valour throughout the later campaigns of that same war, when the fortresses of Avaris and Sherohan were besieged and taken, and the Hykshos were driven from their last strongholds. In Apapi II., therefore, we are dealing with an historical personage; and in all that relates to the war of liberation and the expulsion of the usurpers, we are dealing with historical facts. The Sphinxes of Apapi are human-headed, and in their hard-featured, melancholy faces not only preserve the record of a singular and distinct Asiatic or Asiatic-Scythian type, but in all probability hand down to us the portrait of the king himself. The fortress-camp of Avaris (in Egyptian Ha-uar) exists to this day in the mounds of Tel Herr; and as for Rasekenen Ta-aken, Prince of Thebes, and King Ahmes I., by whom Apapi was expelled and Avaris captured, their mummies were both found last summer in the famous hiding place at Dayr el Baharee, and are now on view in the Museum of Boolak.

Historians are agreed in representing the war of liberation as a very long war, and Professor Maspero attributes to it a duration of more than 150 years. I venture, however, to think that the hypothesis which makes Joseph the interpreter of Apapi's dream is incompatible with the hypothesis of so very long a war. I would even go so far as to suggest that Joseph must not only have risen to power under some earlier Hykshos king, but that the war did not, in all probability, last longer than thirty years. Let us first take the internal evidence of the Bible narrative. That narrative relates to the youth and prime of Joseph, and the scene is evidently laid in a time of profound peace. There is plenty in the land, and there is famine in the land, and people come from far and near to buy and sell; but there is no hint of either internal or external strife. It is even said that Joseph, after he had bought up the land for Pharaoh, removed the people to cities "from one end of the borders of Egypt even to the other end thereof;" a precautionary measure which, by the way, was peculiarly Egyptian, and which Rameses II. is especially recorded to have taken in dealing with captives from the north and captives from the south, whom he transplanted in enormous gangs, from one extremity of the country to the other. But neither Rameses II. nor Joseph could have transplanted large bodies of either citizens or captives, if the whole of Upper Egypt had been in arms. Seeing, also, with what minuteness of detail the early biography of Joseph is given, it seems impossible that no mention should be made of a harassing and prolonged civil war, if such a war had at that time distracted the country. Besides, it is expressly stated that "Joseph was thirty years old when he stood before Pharaoh;" and although the age at which he is said to have died—namely, 110 years—was a typical phrase in use among the ancient Egyptians to express the ideal length of days, and is, therefore, not perhaps to be accepted literally, yet it is certain that Joseph lived to be a very aged man; so aged that he may well have flourished under two, or even under three, Pharaohs. Be this as it may, however, I do not think we can be very far wrong if we place the promotion of Joseph under the predecessor of Apapi; nor if we conclude that, having, as an old man, witnessed the beginning and greater part of the war of liberation, he died, was embalmed, and "put in a coffin in Egypt," towards the end of the reign of Apapi, the last Hykshos king.

The immediate predecessor of Apapi is identified by Dr. Birch* with a certain Hykshos Pharaoh called Sut aa peh peh (or Sut aa peh-ti) Nubti, whose name appears on a tablet discovered by the late Mariette Pasha in the ruins of Sān (the Zoan of the Hebrews, the Tanis of the Greeks), where the Hykshos established their capital city. In this tablet, which was put up by a certain governor of the province who held office under Rameses II., it is recorded that the king ordered the tablet to be made in honour of his ancestors, and that the governor came to Zoan "on the 4th day of the month of Mesori (the twelfth month of the year), of the 400th year of Sut-aa peh peh Nubti, Son of the Sun," in order to be present at the festival of its installation

* See "Records of the Past," vol. vi p. 36

The interest of this tablet," says Mariette Pasha, in his Appendix to the Catalogue of the Boolak Museum, "centres in the date. This date is not Egyptian; it is Egypto-Asiatic, as were the inhabitants of Tanis. Four hundred years before, a shepherd-king, the Nubti of our tablet, had endowed the Hykshos with a fixed calendar grafted upon the sacred year of the Egyptians. It is from this calendar that the date of the tablet is taken, so furnishing an additional proof that in Lower Egypt, under Rameses II., there yet existed a stock of alien races whom the civilisation of Egypt had not entirely deprived of their autonomy."

In other words, the Hykshos calendar was still in use in the time of Rameses II., four hundred years after its institution by Sut aa-peh peh Nubti. This festival of the erection of the tablet was accordingly said to have taken place in the year of Nubti 400; just as an event in the history of a Mohammedan country would be reckoned from the Hegira, or Year of the Flight; or as an event in the history of a Christian country would be reckoned from the Christian era.

Unfortunately, the regnal year of Rameses II. is not given; and there is nothing in the text of the tablet to show at what period in the life of this famous Pharaoh the festival of the tablet was commemorated. We therefore only know that the 400th centenary of the Hykshos era coincided with one of the sixty-seven years of the long reign of Rameses II. The coincidence is too vague to be called a synchronism; yet, despite its vagueness, it affords a kind of basis for rough calculation.

(To be continued.)

HONEY ANTS.

By Grant Allen.

THE Garden of the Gods in Colorado is a bit of show-scenery of the true American type—a green amphitheatre, studded with vast ledges and cliffs of red sandstone, weathered here and there into chimneys or pillars, in which a distorted fancy traces some vague resemblance to the sculptured forms of the Hellenic gods. Hither, a few years since, Dr. McCook of Philadelphia went on his way to New Mexico, where he wished to study the habits and manners of a famous, but little-known insect, the honey ant. To his surprise, he accidentally stumbled here upon the very creatures he had set out to find. There are two kinds of entomologists: one kind, now, let us hope, rapidly verging to extinction, sticks a pin through his specimens, mounts them in a cabinet, gives them systematic names, and then considers that he has performed the whole duty of a man and a naturalist; the other kind, now, let us hope, growing more usual every day, goes afield to watch the very life of the creatures themselves at home, and tries to learn their habits and customs in their own native haunt. Dr. McCook belongs to the second class. He forthwith pitched his tent (literally) in the Garden of the Gods, and proceeded to study the honey ants on the spot.

Like many other ants, these little honey-eaters are divided into different castes or classes; for besides the primary division into queens or fertile females, winged ants or males, and workers or neuters, the last named class is further subdivided into three castes of majors, minors, and minims or dwarfs. But the special peculiarity which gives so much interest to this species is the fact that it possesses, apparently at least, a fourth caste, that of the honey-bearers, whose abdomen is distended till it is almost spherical by a vast quantity of nectar stored within it. Dr. McCook opened several of the nests, and found these honey-bearers suspended like flies from the ceiling, to which they clung by their legs and appendages. All over the vaulted dome of the ant-hill, these little creatures were clustered in numbers, their yellow bodies pressed tight to the roof, while their big round stomachs hung down behind from the slender waist, perfect globes of translucent tissue, showing the amber honey distinctly through the distended skin. They looked like large white currants, or sweet-water grapes; and as they were actually filled with grape-sugar, the resemblance was really quite as true inside as out.

Where did the honey come from? That was the next question. Everybody knows that ants are very fond of sugar, and they often steal the nectar in flowers which the plant has put there to entice the fertilising bee. So much damage do they do in this way, that many plants have clothed their stalks with hairs, or sticky glands, on purpose, in order to prevent the ants from creeping up the stem and rifling the nectary. In other cases, however, plants actually lay by honey to allure the ants, when they have anything to gain from their visits, as in the case of those Central American acacias, mentioned by Mr. Belt, which have a nectar gland on the leaf-stalk to attract certain bellicose ants, which so protect them from the ravages of their leaf-cutting congeners. Of course, everybody has heard, too, how our own species sucks honeydew from the little aphides, or plant-lice, which have often been described as ant-cows. But it is not in either of these ways that the honey-ants get their sugar. Dr. McCook had a little trouble in settling this matter at first, for the honey ants are a nocturnal species, and he had to follow them through the thick scrub, lantern in hand; still, he satisfactorily settled at last that they obtain the nectar from the galls on an oak, where it must simply be exuded as an accidental product of injury. The workers take it home with them, and give it to the honey-bearers, who swallow but do not digest it. They keep it in their crops ready for use, exactly as bees keep it in cells of the honey-comb. When the workers are hungry they caress a honey-bearer with their antennæ, whereupon she presses back a little of the nectar up her throat, and the workers sip it from her mouth. The honey-bearers, in short, have been converted into living honey-jars. They are thus passively useful to the community, for in this curiously-ordered commonwealth they also serve who only stand and wait.

How could such a strange result as this have been brought about? Dr. McCook, though not himself an avowed evolutionist, has supplied us with facts which seem to suggest the proper answer to this difficult question. He has shown that the rotunds (as he calls them) are not, in all probability, a separate caste, but are merely certain specialised individuals taken at haphazard from the worker-major class. He saw himself in the nests many worker-majors, which seemed at that moment actually in course of transformation into honey-bearers. Now, it is easy enough to understand why these social insects should wish to store up food against emergencies. At all times, the queen, the young female ants, the males, and the grubs or larvæ are entirely dependent upon others for support. Hence, alike among bees and ants, stores of food are habitually laid by, sometimes in the form of honey in combs and bee-bread, as with the hive-bee; sometimes in the form of seeds and grains, as with the harvesting ants. During the winter months or the rainy season, when food fails outdoors, there must be some reservoir at home to meet the demand of the starving community. Under such circumstances, any trick of manner which tended to produce a habit of storing food would be highly useful to the nest as a whole; and, taking nests as units in the struggle for existence, which they really are, those nests which possessed any such trick would survive in seasons when others might perish. So the tendency, once set up, would grow and be strengthened from generation to generation, those ants which stored most food being most likely to tide over bad times, and to hand on their own peculiarities to the other swarms or nests which took origin from them.

A set of primitive ants, living upon the honey of the oak-galls, have no tendency to produce wax, like bees, because their habits with regard to their larvæ do not lead them to make such cells at all. The eggs and grubs simply lie about loose amongst the chambers of the ant-hill, instead of being confined in regular hexagonal cradles. Hence the bees' mode of honey-storing is practically impossible for them: they have not the groundwork habit from which it might be developed. But the ants have a crop, or first stomach, in which they store their undigested food, before passing it into the gizzard, exactly as in fowls. When ants come back from feeding, whether on flowers, on aphides, or on galls, their crops are very much distended; and they can bring back the food to their mouths from these distended crops, to supply the grubs and their other helpless dependents in the nest. If, therefore, some of the ants were largely to over-eat themselves, they would be able to feed an exceptionally large number of dependants.

Dr. McCook observed that some very greedy workers, returning to the nest, fastened themselves upon the roof in the same position as the honey-bearers, and in fact seemed gradually to grow into rotunds. The other ants would soon learn that such lazy, overgrown creatures were the best to go to for food; and, in time, these gorgers might easily become specialised into a honey-bearing set of insects. The workers would bring them honey, which they would store up and disgorge as needed for the benefit of the rest as a whole. If the honey passed into their gizzards and was digested, they would be a positive dead loss to the community, and so the tendency would soon be eliminated by natural selection, because the nests possessing such workers could not hold their own in bad times against neighbouring communities. But as only a very small quantity is ever digested—just as much as is necessary to keep up the sedentary life of such immovable fixtures—the effect is about the same as if the honey were stored in cells of wax. The ants, in fact, utilise the only good vessel or utensil they have at their disposal, the flexible and extensible abdomen of their own comrades.

The greatest difficulty is to understand how the workers first acquired the habit of feeding these lazy members to such repletion; but as all ants "take toll" of one another, this is much less of a crux than it looks at first sight. A very greedy ant, which not only ate much itself while out foraging, but also took toll of all others in the nest, after it was too full to move about readily, would be in a fair way to become a rotund. And as it would thus be performing a useful function for the rest, at the same time that it was gratifying its own epicurean tastes, the habit would soon become fixed and specialised, till at last we should get just such a regular and settled form of honey-storing as we see in this Colorado species. Indeed, another totally distinct type of ant in Australia has arrived at exactly the same device quite separately, as so often happens in nature under similar circumstances. Whatever benefits one creature under any given conditions will also benefit others whose conditions are identical; and thus we often get adaptive resemblances between plants and animals very widely removed from one another in genealogical order.

HOW TO RIDE A TRICYCLE.

By JOHN BROWNING

(Treasurer of the London Tricycle Club).

THE greatest disadvantage the tricycle has to contend with is the supposition that anyone can ride it without learning. I have proved the reverse, to my own satisfaction, in the following simple manner:—I have driven a double tricycle with my wife by my side and fifty pounds of luggage behind us for twenty miles without fatigue, while I have ridden with a strong man less than eight miles on the same machine without luggage and been tired out. Yet my wife, on the occasion to which I refer, did not drive, but had her feet on the foot-rests, while the gentleman, being a very powerful man, was, I feel certain, exerting twice the strength I was using myself. There seems to me but one possible explanation of this—that riders without practice press down both feet together, pressing one foot down a little harder only than the other, instead of lifting up one foot and pressing down the other at the same time.

Again, tricycle riding brings muscles into action that are not used in walking, and these muscles require to be gradually strengthened by practice before either long rides or fast riding are attempted. Many persons having hired a machine, and driven it a few miles, have found it very hard work, and given up all idea of purchasing one. Beginners should restrict themselves for several weeks to riding from five to ten miles at a pace not exceeding six miles an hour.

I know one case in which a gentleman bought a tricycle, and against advice rode it home about ten miles. The next day he wrote to the agent and asked him to send for the machine and sell it for any price he could get for it. Another instance I was told of where a gentleman hired a tricycle in the north of London for a week, and paid for it, and started to ride to Portsmouth. In less than two hours he brought the machine back, and asked to return it and forfeit any amount of the payment he had made the maker pleased, adding that he had had enough of it.

Hills should never be attempted until the rider can ride well on the level. Considerable practice is required to ride hills without great fatigue. Time and strength are saved in the long run by dismounting as soon as the strain is felt to be at all severe. An exceptionally strong rider may soon succeed in riding up a tolerably steep hill, but he will waste strength which would have carried him at a greater pace or to a further distance if he had husbanded it by dismounting. After a few months' practice the rider will run up hills almost unconsciously which would at first have taxed him severely.

Next, as to riding down hill. Choose a machine with a break which is applied to *both* the driving wheels. When riding on the level or down a slight incline put on the break slowly, but firmly. If it acts efficiently it will bring the machine to a standstill without causing it to swerve to either side. Should it swerve round the rider should not attempt to descend a steep hill on it until the fault has been corrected, under the penalty of being thrown out by its turning over. The swerving is caused by one break acting on one tire more than the break on the other. Machines which drive both wheels by means of what is called a balance gearing from one chain are not liable to this serious fault.

In descending a hill on a tricycle with a trustworthy break, the feet should be taken off the pedals and planted firmly on the foot-rests, as the body is steadier, and the machine can be steered more accurately than when the legs are moving rapidly, and the legs are, of course, rested.

The machine should not be steered to avoid loose stones when running down hill, the speed should be decreased, and the rider should go straight through them. A tricycle will turn in a much shorter space than a bicycle, but it should never be turned when running quickly. The speed should be reduced to about four or five miles an hour, and the rider should lean over in the direction towards which he wishes to turn.

The rule of taking the feet off the pedals when riding down hill will not apply to the Humber Tricycle. That machine throws a great strain on the arms as soon as the feet are taken off the pedals. The feet are, with practice, unconsciously used in steering, and after a time an expert rider can steer this machine without holding the handles.

Beginners will find it well not to pull hard at the handles of any tricycle continuously; but to use them scarcely at all when riding down an incline, only moderately when on a level road; and to reserve them principally for use when working on rising ground, when, from having been only occasionally used, they will be a powerful assistance. Their constant use will be found very fatiguing.

In all that I am saying I am supposing the rider wishes to travel as far as his strength will allow him, at a pace of about seven or eight miles an hour.

Should his only object be to ride at the top of his speed, he must almost stand on his pedals, lean well forward, and pull hard at the handles.

A strong rider, with practice, can ride at the rate of twelve miles an hour for two or three hours, and at the rate of ten miles an hour for four or five hours. The amateur champion, Mr. Lacy Hillier, has ridden fifty miles over an exceedingly hilly road in four hours, fourteen minutes.

I am often asked to state the comparative speed of bicycles and tricycles. I consider the tricycle is about two miles an hour slower than the bicycle. The remark is frequently made that the tricycle is much harder work than the bicycle. I reply, not at the relative speeds I have named. The tricycle has an immense advantage over the bicycle in being capable of adjustment to the strength of the person who is going to use it. A machine with driving-wheels 54 in. in diameter, geared level, would require a strong and practised rider to drive it up a moderate incline; but by replacing the lower wheel, which carries the chain, with a wheel from an inch to two inches smaller, the machine can be made to run so lightly that it may be driven easily—of course at a slower pace—up moderate inclines by a lady, or even by a child.

Tricycle riding is gaining ground more rapidly even than bicycling. The best makers of well-known machines cannot execute orders under about two months, and makers of one well known Sociable (that is double tricycle) will not at present accept orders to be executed in a stipulated time. The cranks of double tricycles are made in two ways. In one construction the right foot of each driver rises and falls at the same time. In the other the right foot of one driver is half way up when the other is either up or down. This is called putting the crank on the quarter turn. The last arrangement is the best for hill-riding, but is not so convenient or efficient generally, as it gives the appearance and sensation of two scullers in a boat taking strokes alternately a proceeding most ungraceful in appearance, and one by which strength is wasted.

The advantages of tricycles over bicycles are numerous and evident. They can be ridden at a slower pace than the bicycle, or stopped at any time, without dismounting, to admire a view, inspect a building, read the direction on a finger-post, or speak to a friend. They will carry almost any amount of luggage. A great many tricycles are now employed by the postmen in country districts for carrying letters and parcels. Policemen and lamplighters are also using them. Tricycling brings more muscles into play than walking, and is a more exhilarating exercise. To the healthy and strong it is even more exhilarating than horse-riding.

Our greatest authority on health, Dr. B. W. Richardson, F.R.S., recommends stout people to adopt it, and says that a very stout person will find that he can ride six miles with less fatigue than he can walk one.

I know many persons who have given up rowing after a short experience of tricyling, saying that the rush down a breezy hillside is more exciting and exhilarating than a row on either river or sea.

I consider that a tricycle-rider has almost as great an advantage over a walker as a rider in a railway train has over a rider in a coach. Where roads are fairly good, a tricyclist can cover six miles with less fatigue than a pedestrian can travel three. It is probable that the rapid increase of tricycling will, before long, cause a great improvement in our country roads. Were they made exceedingly good, ten miles an hour could be ridden on a geared-up or speeded tricycle (in which the wheels would turn round quicker than the cranks moved by the feet) easier than a pedestrian could walk four miles an hour.

The rapid improvement being made in double tricycles is inducing many bicyclists to adopt them who have not been tempted by the single tricycle. The weight of a double tricycle is much less than that of two single tricycles, and they can be ridden by two good riders at as great a pace as a bicycle. The enjoyment of riding one of these machines with a friend, particularly with a lady friend, must be tried before it can be fully appreciated.

THOUGHT-READING.

By the Editor.

Dickens describes another feat which the conjuror performed, which, were it not that the first can only be explained as a feat of mind-ruling, we might explain as a trick merely of legerdemain and quickness of vision. But, under the actual conditions, it seems to indicate powers of mind-reading far more surprising than any ever noticed in parlour experiments. The conjuror "had several common school-slates about a foot square. He took one of them to a field-officer from the camp, *decoré* and what not, who sat about six from our seats, with a grave, saturnine friend next him. 'My General,' says he, 'will you write a name on this slate, after your friend has done so? Don't show it me.' The friend wrote a name, and the General wrote a name. The conjuror took the slate rapidly from the officer, threw it violently down on the ground with the written side to the floor, and asked the officer to put his foot on it and keep it there, which he did. The conjuror considered for about a minute, looking devilish hard at the General. 'My General,' says he, 'your friend wrote Dagobert upon the slate under your foot.' The friend admits it. 'And you, my General, wrote Nicholas.' General admits it, and everybody laughs and applauds. 'My General, will you excuse me, if I change that name into a name expressive of the power of a great nation, which, in happy alliance with the gallantry and spirit of France, will shake that name to its centre?' [This was in 1854.] 'Certainly, I will excuse it.' 'My General, take up the slate, and read.' General reads: 'Dagobert, Victoria.' The first in his friend's writing; the second in a new hand. I never saw anything in the least like this; or at all approaching to the absolute certainty, the familiarity, quickness, absence of all machinery, and actual face-to-face, hand-to-hand fairness between the conjuror and the audience with which it was done."

It is clear that in this feat there was legerdemain, and (in a sense) machinery, too. Several common school slates were brought in, but one slate only was used. We may be sure this, however it resembled the others, was not, like them, a common school slate; and that the name, Victoria, was already written on it under the surface which was prepared to receive whatever name the General's friend might write. We might also explain the conjuror's knowledge of what the General and his friend had written, by the wonderful quickness and keenness of sight which conjurors obtain with constant practice. That some can tell what name is being written, by watching the movements of the pencil-end remote from the slate or paper, is certain. I am disposed, however, to consider this a case of mind-reading, after the much more wonderful case cited before, which can only be explained as an instance of mind-ruling. In the following cases it seems doubtful whether mind-reading or mind-guiding were in question. Prof. Barrett is referring to trials made with the children and a young servant-girl of the Rev. Mr. C., of whose personal integrity he was convinced (though, of course, this statement respecting a person unnamed must be taken only for what it is worth, that is, as an expression of opinion).

"Having selected at random one child, whom we desired to leave the room and wait at some distance, we would choose a card from a pack, or write on paper a number or a name which occurred to us at the moment. Before leaving the room the child had been informed of the general nature of the test we intended to select, as 'this will be a card,' or 'this will be a name.' On re-entering she stood—sometimes turned by us with her face to the wall, often with her eyes directed towards the ground, and usually close to us, and remote from her family—for a period of silence varying from a few seconds to a minute, till she called out to us some number, card, or whatever it might be. . . . The first attempt was to state, without searching, the hiding-place of some small object, the place having been chosen by ourselves, with the full range of the house, and then communicated to the other members of the family. This was effected in one case only out of four. The next attempt was to give the name of some familiar object agreed on in the child's absence, as 'sponge,' 'pepper-caster,' &c. This was successful on a first trial in six cases out of fourteen. We then chose a card from a full pack in the child's absence, and called upon her to name it on her return. This was successful at once in six cases out of thirteen. . . . . A harder trial was now introduced. The maid-servant having left the room, one of us wrote down the name 'Michael Davitt,' showed it round, and then put the paper in his pocket. The door was now opened, and the girl recalled from the end of the passage. She stood close to the door amid absolute silence, and with her eyes on the ground—all of us meanwhile fixing our attention on the appointed name—and gave after a few seconds the name 'Michael,' and then almost immediately 'Davitt.' To avoid any association of ideas, we then chose imaginary names, made up by ourselves at the moment, as 'Samuel Morris,' 'John Thomas Parker,' 'Phœbe Wilson.' The names were given correctly *in toto*, at the first trial in five cases out of ten. Three cases were complete failures, and in two the names given bore a strong resemblance to those selected by us, 'Jacob Williams,' being given as 'Jacob Wild,' and 'Emily Walker,' as ''Enry Walker.' It was now getting late, and both we and the younger children were very tired; and four concluding attempts to guess the name of a town in England were all failures, though one of us had previously obtained remarkable success in this very experiment."

It appears to me that the failures in these and other cases yet to be cited, are as important a part of the evidence in favour of mind-reading or mind-ruling, as the successes. For they tend to show that there was no general system of deception by which the members of the family who had been present when the names were selected informed the children by signals previously agreed upon. However, as it will be obvious that there can be no absolute certainty on this point in cases in which any members of the family knew what was selected, we proceed to consider cases in which only the committee of investigation knew the words or things chosen.

(To be continued.)

HOW TO GET STRONG.

WE have received, through the Editor, a great number of communications, with which we propose to deal consecutively before passing to the consideration of other exercises for the expansion and development of the chest.

Several correspondents ask about the instrument called an inspirometer, which is mentioned in a quotation from an American work. We must trust to American readers to answer this question; for we have not ourselves seen or used this instrument. The breathing test, used at various places of amusement, though on a different principle, serves the same purpose when properly used. Very few people seem to know how to use this instrument. The Editor writes to us as follows, very much to the point, on this subject:—"Have you ever noticed what very poor records most persons make with the breathing apparatus, compared with what they *can* make when they go to work properly? You will see a well built man, standing some six feet in his stockings, who, advancing to the instrument, will begin to blow, watching the index with a look as if he would send it round to 100 at least, yet will barely mark 200; yet there is nothing wrong with the big fellow's lungs, as from such a record for such a height one might judge. Tell him *how to do it*, and he will send the index well over 300. I have watched a score of men who ought to reach 250, averaging not more than 150. Then I have taken the tube, and though below the middle height, and too fleshy for full breathing, have sent the index on beyond 200 to 250, to 300 (till people began to ask whether I was breathing out of my boots), and on to 340 or 350—the greatest I have reached being 353. Then one or two have asked me, apart, how the thing was done, and I have explained that before expiring, the breath is to be drawn in till you can draw in no more, and every atom of air so drawn in is to be let out steadily through the tube, none escaping beforehand. I have then seen a man who had just, with utmost efforts, reached 180, go easily above 300."

Speaking of fleshiness, it should be added to the usual instructions respecting the use of the breathing apparatus, that any addition to the weight beyond that due to fair condition, is certain to affect the record with the breathing apparatus.

Several correspondents ask our opinion of various exercises, as rowing, riding, walking, tricycling, boxing, cricket, &c. It will probably sound paradoxical, after the stress we have laid on the necessity for exercise, to say that we consider each one of these exercises, *as pursued by* *specialists*, undeniably bad for the development of a well-proportioned and thoroughly healthy frame. Take, for instance, any first-class eleven at cricket; select, if you please, an eleven such as the Australian, in which all-round aptitude is a characteristic feature, and you will invariably find so large a proportion of ill-shaped men as to show that thoroughly well-built cricketers owe their goodly proportions to exercises outside cricket. Despite the running involved in the game, four cricketers out of five have badly developed chests. One would say a good bat should have good shoulders, but that batting does not tend to improve the shoulders is shown by two, at least, of the finest Australian bats. Take rowing, again. Unless a rowing man does other work especially intended to correct the defect, he has invariably poor arms above the elbow, a marked inferiority in the development of the chest as compared with the back, and he generally has round shoulders and a forward hang of the head and neck. Boxing is better, but it cannot be pursued with advantage as the chief exercise a man or boy takes, and it is entirely unsuited to girls and women (for whom we write, by-the-way, quite as much as for boys and men, though for girls our calf-skin dumb boxer may not be the best of all chest-opening exercises).

In answer to many inquiries, we note that Mr. Blackie's work, "How to Get Strong," is published by Harper & Brothers, New York. We do not know the price. Much of its contents are specially intended for American readers. Maclaren's little book (not on Dumb-bells, as some readers seem to suppose, but on Training), is published by Messrs. Macmillan.

Other correspondents ask us what weight dumb-bells should be for persons of given height and weight. Every one who uses dumb-bells should have them of different weights for different exercises. There are some chest exercises for dumb-bells which would tax the strength too much if the dumb-bells weighed more than two pounds each (these would be wooden), while for exercises in putting up weight, the dumb-bells should weigh from six pounds each to ten pounds each. It is better to have them too light than too heavy, unless the person using them is going in for athletic honours; but we are not writing for such persons.

Clubs have several uses for which dumb-bells are not available, especially for exercise in wrist play. We are asked by some of what shape they should be, and where to be purchased. We thought every one knew the ordinary shapes of Indian clubs, straight handle, with a knob to prevent the club slipping out of the hand and spindle-shaped heavier part, in plain or polished wood. Any wood-turner would make a pair for a few shillings, and would require no other instructions but "Indian clubs of such and such weight each." The clubs ought not to be heavy. Five pound clubs (that is ten pounds weight the pair) will serve men strong enough to *wield* clubs of twice or thrice their weight; in fact, many flourish about heavy clubs and sway heavy dumb-bells with apparent ease, but really to their own detriment; for to support the strain of heavy clubs or dumb-bells, the chest assumes a constricted attitude, just as it does in very hard rowing, and in several other exercises which men pursue under the impression that they are improving their development.

The effect of constant hard work in special directions may best be judged by noticing porters, coal heavers, and the like away from their ordinary employment. They do their work so well, that one would say they were very powerful men, and so in a way they are. But they cannot walk freely; nay, some of them can scarcely stand upright.

(*To be continued.*)

HOME CURES FOR POISONS.

ANTIMONY.

Antimony and its compounds would not be dangerous were it not for the too prevalent opinion that they may be used in all cases, safely, as emetics. Antimony itself cannot be used in this way until it has been so modified by chemical admixture as to be capable of decomposition by the fluids of the body. For this purpose tartarised antimony, in the form commonly known as *tartar emetic* (the double tartrate of potash and antimony) is usually employed; and most cases of antimonial poisoning have arisen from the administration of tartar emetic in large doses. The employment of this substance to detect children or servants who have taken forbidden articles of food has led to some very sad cases of poisoning. The practice cannot be too strongly reprehended. Tartar emetic has also been used, as foolishly, to cure confirmed drunkards of their bad habit, by causing sickness. The latest case in which the use of antimony as a poison, with criminal intent, was suspected, was the so-called Balham tragedy. The case was very difficult to understand, but very instructive. It may be remembered that Mr. Bravo had bought a quantity of tartar emetic for the purpose of dosing Mrs. Bravo's wine, so that she might be cured, if possible, of her tendency to drink it in undue quantities. After a quarrel he had gone to his room, and soon after began to suffer severely from what eventually proved to be the effects of antimonial poisoning. He lingered in great pain for two or three days, and during that time nothing transpired to suggest that he had been wilfully poisoned. After his death the body was examined, and it was unmistakably shown that death was caused by antimonial poisoning. Mrs. Bravo was suspected of having murdered her husband, the idea being that a medical friend of hers had suggested to her the use of tartar emetic to poison Mr. Bravo. The whole theory of those who suspected Mrs. Bravo was absurd on the face of it, and, probably, but for the horror which the supposed crime excited, the case would have been quickly closed; but it was continued until the cruelty of the cross-examination to which Mrs. Bravo was subjected excited the pity of many who had had very little sympathy for her at the outset. But the difficulty was to understand how, in reality, the poison had been administered or taken. Mr. Bravo was well acquainted with the general properties of tartar emetic, and knew that in large doses the substance is poisonous. He could hardly have taken it by accident, or have taken more than a sufficient emetic dose, if he had proposed to use it in that way medicinally. The only theory which at all corresponded with the evidence was one which illustrates one of the characteristic proper- of this substance. Mr. Bravo had threatened to commit suicide, and had bought laudanum with the avowed purpose of using it to kill himself. Persons who talk in this way very seldom do commit suicide; but it seems likely that after the quarrel referred to above, in the course of which he had repeated the threat, Mr. Bravo did take a poisonous dose of laudanum,—trusting, we believe, to the tartar emetic in his possession as a safe and sure emetic by which to get rid of the laudanum, when it had served his purpose. But it so happens that while tartar emetic is very certain in its emetic action in nearly every case (being surpassed only in this respect by sulphate of zinc), it should never be taken in cases of narcotic poisoning, for in large doses tartar emetic is itself a poison unless the stomach quickly rejects it, and narcotic poisons so diminish the sensibility of the stomach that it will retain under their action what, under other conditions, it would immediately reject. Any one unaware of this, who had taken a dose of tartar emetic to cause vomiting after a narcotic had been swallowed in poisonous or almost poisonous quantity, would be apt to repeat the dose, especially if ignorant of the quantitative poisonous properties of antimony. This, in all probability, was what Mr. Bravo did, until he had taken a poisonous amount of that substance by which he had hoped to get rid of the laudanum he had taken in excess. It was a noteworthy feature of the case that even when his anguish was at its greatest, he would not take laudanum for its relief.

Be this theory correct or not (for our own part, we have no doubt of its correctness, for the simple reason that every other is in some one or other respect absurdly inconsistent with the known facts of the case), it is well to know that tartar emetic is not suitable in cases of poisoning, though very proper, under medical advice, in other cases where an emetic is required.

REMEDIES.

When tartar emetic has been taken in poisonous amount, and vomiting does not follow, it must be excited until, if possible, all the poison has been rejected. Copious draughts of tepid water, tickling the back of the throat, and other such methods of producing vomiting may be employed. If, however, the poison cannot be got rid of in this way, a decoction of tincture of quinine may be given with advantage, for tartarised antimony is decomposed by nearly all bitter or astringent vegetables which contain tannin, producing an inert tannate of the protoxide of antimony (which is the active base of tartar emetic and James's Powder). Should no quinine be at hand, a strong infusion of black tea should be administered, pending the arrival of a medical man.

THE AMATEUR ELECTRICIAN.

ELECTRIC GENERATORS (*continued*).

WE will now leave our magneto machine in the hands of our readers for a time. Possibly their own ingenuity may suggest one or two modifications. One that will reward the extra labour and care involved is, winding the armature with two wires side by side simultaneously, so that there will be four ends to deal with. By a simple contrivance the two coils may then be used at pleasure for intensity or quantity—that is to say, we may join them up so as to become one continuous coil, or we may connect the two internal ends together, likewise the two external ends. This latter course is practically doubling the size of the wire. The first arrangement would produce comparatively a current of high electro-motive force and small quantity, the second a current of low electro-motive force but large quantity.

The next step that we may notice in apparatus of this kind is the introduction of electro-magnets in place of the ordinary steel magnets. These may consist of broad, flat pieces of iron, like those in the Siemens or Brush dynamo machines (that is to say, the width extending the whole length of the pole-pieces); or of a series of iron rods enveloped with wire, as in the Weston machine. Doubtless, but few have seen this machine, but they will not go far wrong if they adopt the flat form, winding the iron with No. 18 or 20 cotton-covered wire. Wilde is credited with introducing this form of machine. He used a small machine with permanent magnets to produce the current for magnetising the electro-magnet, and thus obtained in the armature actuated by this electro-magnet a very considerable current. A small battery will serve the same purpose. The smaller machine or battery is generally known as an "Exciter." Its function is apparent. It must be remembered that the polarity of the electro-magnets must be on the same principle as that which applies to the use of permanent magnets; that is to say, the wire must be wound so as to induce north magnetism in one pole-piece and south in the other. It will be advisable to use four flat plates 4 in. by, say, 6 in., and ¼ in. thick, joining the pairs of free or external ends together by means of iron plates.

The next discovery was one of vital importance. Those who have had any experience with electro-magnets, even on so small a scale as are used in telegraph instruments, will be aware that, however soft a piece of iron may be, it is almost certain to retain, for a greater or less time, a small amount of magnetism. This is called remanent, or residual magnetism, and Siemens and Wheatstone (simultaneously but separately) found it sufficiently strong to enable them, by an ingenious arrangement, to dispense with the exciting current. It is easily accomplished by the amateur. Join one of the brushes to one of the electro magnets (or field magnets), allowing the current to pass thence through the other magnet, and out to one of the terminals. The other brush is connected to the other terminal as usual. What takes place is this:—First, there is a small amount of magnetism in the field magnets; this induces in the armature a small current, which, being made to pass through the field magnet increases the inducing effect. The increased armature current also passes through the field magnet, and so on and on, continually increasing until a very powerful current is obtained.

This brings us to the end of our descriptions of simple forms of generators. Before we can go any farther, we must devote three, or perhaps four, articles to a brief account of the various methods of measuring electric currents, and of the units adopted in so measuring, never forgetting, however, that we are writing for amateurs.

THE TELEPHONE IN FRANCE.—M. Cochery, the French Minister of Posts and Telegraphs, has asked the Chamber for a grant of 250,000 f. to enable him to establish a State telephonic service between certain towns in France.

AN ELECTRIC TRAMWAY.—The Portrush and Bushmills Electric Tramway, near Belfast, the first that has been constructed in the United Kingdom, will be opened in the first week in August. The ceremony will probably be performed by the Lord-Lieutenant.

INTERNATIONAL TELEGRAPH STATISTICS.—According to statistics recently issued, the length of wires in the various countries is as follows:—Germany, 159,910 miles; Russia, 131,465 miles; France, 125,265 miles; Great Britain, 121,720 miles; Austria-Hungary, 89,960 miles; Italy, 53,692 miles; Sweden and Norway, 28,445 miles; Belgium, 16,345 miles, and Switzerland, 10,010 miles. The total numbers of messages sent during the past year are classed as follows:—England, 29,820,445; France, 19,882,628; Germany, 16,312,457; Austria-Hungary, 8,729,321; Russia, 7,298,422; Italy, 6,511,497; Holland, 3,109,230, and Sweden and Norway, 2,028,805.

THE following should have formed part of the first paragraph on p. 63:—The conclusions arrived at by the sub-committee are, 1st. The maximum efficiency of incandescent lamps in the present state of the subject, and within the experimental limits of this investigation, cannot be assumed to exceed 300 candle-lights per horse-power of current. 2nd.—The economy of all lamps of this kind is greater at high than at low incandescence. 3rd.—The economy of light-production is greater in high resistance lamps than in those of low resistance, thus agreeing with the economy of [illegible]. 4th.—The relative efficiency of the four lamps examined, expressed in Carcel burners of 7.4 spermaceti candles each [illegible] horse-power of current, is as follows:—(A.) At 16 candles: Edison, 26.5; Swan, 24; Lane-Fox, 23.5; and Maxim, 20.4. (B.) At [illegible] candles: Edison, 41.5; Lane-Fox, 37.4; Swan, 35.5; and Maxim, 32.4. To double the light given by these lamps the current [illegible] was increased, for the Maxim and Lane-Fox lamps 26 per cent., for the Edison lamp, 28 per cent., and for the Swan lamp [illegible] 37 per cent.

ELECTROMANIA.

BY W. MATTIEU WILLIAMS.

A HISTORY of electricity, in order to be complete, must include [illegible] distinct and very different subjects: the history of elec[illegible] and a history of electrical exaggerations and delusions. [illegible] of the first has been followed by a crop of the second [illegible] when Kleist, Muschenbroek, and Cuneus endeavoured [illegible] supposed fluid, and in the course of these attempts [illegible] the "Leyden Jar."

[illegible] of Berlin, describes the startling results which [illegible] imagined, "when a nail or a piece of brass wire is [illegible] up the [illegible]ary's phial and electrified." He says that [illegible] is electrifying, I put my finger or a piece of gold which [illegible] hand to the nail, I receive a shock which stuns my [illegible] shoulders." At about the same date (the middle of the [illegible]), Muschenbroek stated, in a letter to Réaumur, that, [illegible] shock from a thin glass bowl, "he felt himself struck [illegible] shoulders, and breast, so that he lost his breath, and [illegible] two days before he recovered from the effects of the blow and [illegible] terror"; and that he "would not take a second shock for the [illegible] of France." From the description of the apparatus, it is [illegible] that this dreadful shock was no stronger than many of us [illegible] taken scores of times for fun, and have given to our school[illegible] when we became the proud possessors of our first electrical [illegible].

[illegible] itinerant quacks, and other adventurers [illegible] throughout Europe, and were found at every country fair [illegible] displaying the wonders of the invisible agent by giving [illegible] professing to cure all imaginable ailments.

Then came the discoveries of Galvani and Volta, followed by the [illegible] of Galvani's nephew Aldini, whereby dead animals [illegible] display the movements of life, not only by the elec[illegible] voltaic pile, but, as Aldini especially showed, by a [illegible] of the mysterious agency from one animal to another.

According to his experiments (that seem to be forgotten by [illegible]) the galvanometer of the period, a prepared [illegible] could be made to kick by connecting its nerve and muscle with [illegible] of a recently killed ox, with or without metallic [illegible]rvention.

Thus arose the dogma which still survives in the advertisements of electrical quacks, that "electricity is life," and the possibility [illegible] reviving the dead was believed by many. Executed criminals [illegible] in active demand; their bodies were expeditiously transferred [illegible] the gallows or scaffold to the operating table, and their dead [illegible] were made to struggle and plunge, their eyeballs to roll, and [illegible] to perpetrate the most horrible contortions by con[illegible] nerves with one pole, and muscles with the opposite pole [illegible].

The heart was made to beat, and many men of eminence sup[illegible] could be combined with artificial respiration, and [illegible] for which the victim of the hangman might be restored, [illegible] neck was not broken. Curious tales were loudly [illegible] concerning gentle hangings and strange doings at Dr. [illegible]'s in Leicester-square, and at the Hunterian Museum, in Windmill-street, now flourishing as "The Café de l'Étoile." When [illegible] about midway between these celebrated schools of [illegible] and well remember the tales of horror that were [illegible] concerning them. When Bishop and Williams (no rela[illegible] writer) were hanged for burking, *i.e.*, murdering people in order to provide "subjects" for dissection, their bodies were [illegible] to Windmill-street, and the popular notion was that, being old [illegible] servants of the doctors, they were galvanised to life, [illegible] in their old business.

It is amusing to read some of the treatises on medical galvanism [illegible] at about this period, and contrast their positive [illegible] effected and results anticipated with the posi[illegible] by electricity as a curative agent.

Then came the brilliant discoveries of Faraday, Ampere, &c., [illegible] between electricity and magnetism, and [illegible] following them a multitude of patents for electro[illegible] of superseding steam engines by magneto[illegible]ery.

[illegible] which I copy from *The Penny Mechanic*, of June 10, 1837 [illegible] and very instructive to those who think of investing [illegible] power companies of to-day. "Mr. Thomas [illegible], a Vermont blacksmith, has discovered a mode of [illegible] and electro-magnetic power, which we have [illegible] will be of immense importance to the [illegible]. This statement is followed by reference to Professor [illegible] *Journal of Science and the Arts*, for April, 1837 [illegible] from American papers, of which the following is [illegible]:— 1. We saw a small cylindrical battery, about nine inches in length, three or four in diameter, produce a magnetic power of about 300 lb., and which, therefore, we could not move with our utmost strength. 2. We saw a small wheel, five-and-a-half inches in diameter, performing more than 600 revolutions in a minute, and lift a weight of 24 lb. one foot per minute, from the power of a battery of still smaller dimensions. 3. We saw a model of a locomotive engine travelling on a circular railroad with immense velocity, and rapidly ascending an inclined plane of far greater elevation than any hitherto ascended by steam-power. And these and various other experiments which we saw, convinced us of the truth of the opinion expressed by Professors Silliman, Renwick, and others, that the power of machinery may be increased from this source beyond any assignable limit. It is computed by these learned men that a circular galvanic battery about 3 ft. in diameter, with magnets of a proportionable surface, would produce at least a hundred-horse power; and therefore that two such batteries would be sufficient to propel ships of the largest class across the Atlantic. The only materials required to generate and continue this power for such a voyage would be a few thin sheets of copper and zinc, and a few gallons of mineral water."

The Faure Accumulator is but a very weak affair compared with this, Sir William Thompson notwithstanding. To render the date of the above fully appreciable, I may note that three months later the magazine from which it is quoted was illustrated with a picture of the London and Birmingham Railway Station displaying a first-class passenger with a box seat on the roof of the carriage, and followed by an account of the trip to Boxmoor, the first instalment of the London and North-Western Railway. It tells us that, "the time of starting having arrived, the doors of the carriages are closed, and, by the assistance of the conductors, the train is moved on a short distance towards the first bridge, where it is met by an engine, which conducts it up the inclined plane as far as Chalk Farm. Between the canal and this spot stands the station-house for the engines; here, also, are fixed the engines which are to be employed in drawing the carriages up the inclined plane from Euston-square, by a rope upwards of a mile in length, the cost of which was upwards of £400." After describing the next change of engines, in the same matter of course way as the changing of stage-coach horses, the narrative proceeds to say that "entering the tunnel from broad daylight to perfect darkness has an exceedingly novel effect."

I make these parallel quotations for the benefit of those who imagine that electricity is making such vastly greater strides than other sources of power. I well remember making this journey to Boxmoor, and four or five years later travelling on a circular electro-magnetic railway. Comparing that electric railway with those now exhibiting, and comparing the Boxmoor trip with the present work of the London and North-Western Railway, I have no hesitation in affirming that the rate of progress in electro-locomotion during the last forty years has been far smaller than that of steam.

The leading fallacy which is urging the electro-maniacs of the present time to their ruinous investments is the idea that electro-motors are novelties, and that electric-lighting is in its infancy; while gas-lighting is regarded as an old, or mature middle-aged business, and therefore we are to expect a marvellous growth of the infant and no further progress of the adult.

These excited speculators do not appear to be aware of the fact that electric-lighting is older than gas-lighting; that Sir Humphry Davy exhibited the electric light in Albemarle-street, while London was still dimly lighted by oil-lamps, and long before gas-lighting was attempted anywhere. The lamp used by Sir Humphry Davy at the Royal Institution, at the beginning of the present century, was an arrangement of two carbon pencils, between which was formed the "electric arc" by the intensely-vivid incandescence and combustion of the particles of carbon passing between the solid carbon electrodes. The light exhibited by Davy was incomparably more brilliant than anything that has been lately shown either in London, or Paris, or at Sydenham. His arc was *four inches in length*, the carbon pencils were four inches apart, and a broad, dazzling arch of light bridged the whole space between. The modern arc lights are but pigmies, mere specs, compared with this; a leap of ½ or ¼ inch constituting their maximum achievement.

Comparing the actual progress of gas and electric lighting, the gas has achieved by far the greater strides; and this is the case even when we compare very recent progress.

The improvements connected with gas-making have been steadily progressive; scarcely a year has passed from the date of Murdoch's efforts to the present time, without some or many decided steps having been made. The progress of electric-lighting has been a series of spasmodic leaps, backward as well as forward.

As an example of stepping backward, I may refer to what the newspapers have described as the "discoveries" of Mr. Edison, or the use of an incandescent wire, or stick, or sheet of platinum, or platino-iridium; or a thread of carbon, of which the "Swan" and other modern lights are rival modifications.

As far back as 1846 I was engaged in making apparatus and experiments for the purpose of turning to practical account "King's patent electric light," the actual inventor of which was a young American, named Starr, who died in 1847, when about 25 years of age, a victim of overwork and disappointment in his efforts to perfect this invention and a magneto-electric machine, intended to supply the power in accordance with some of the "latest improvements" of 1881 and 1882.

I had a share in this venture, and was very enthusiastic until after I had become practically acquainted with the subject. We had no difficulty in obtaining a splendid and perfectly steady light, better than any that are shown at the Crystal Palace.

We used platinum, and alloys of platinum and iridium, abandoned them as Edison did more than thirty years later, and then tried a multitude of forms of carbon, including that which constitutes the last "discovery" of Mr. Edison, viz., burnt cane. Starr tried this on theoretical grounds, because cane being coated with silica, he predicted that by charring it we should obtain a more compact stick or thread, as the fusion of the silica would hold the carbon particles together. He finally abandoned this and all the rest in favour of the hard deposit of carbon which lines the inside of gas-retorts, some specimens of which we found to be so hard that we required a lapidary's wheel to cut them into the thin sticks.

Our final wick was a piece of this of square section, and about $\frac{1}{8}$ of an inch across each way. It was mounted between two forceps—one holding each end, and thus leaving a clear half-inch between. The forceps were soldered to platinum wires, one of which passed upwards through the top of the barometer tube, expanded into a lamp glass at its upper part. This wire was sealed to the glass as it passed through. The lower wire passed down the middle of the tube.

The tube was filled with mercury and inverted over a cup of mercury. Being 30 in. long up to the bottom of the expanded portion, or lamp globe, the mercury fell below this and left a Torricellian vacuum there. One pole of the battery, or dynamo-machine, was connected with the mercury in the cup, and the other with the upper wire. The stick of carbon glowed brilliantly, and with perfect steadiness.

I subsequently exhibited this apparatus in the Town-hall of Birmingham, and many times at the Midland Institute. The only scientific difficulty connected with this arrangement was that due to a slight volatilisation of the carbon, and its deposition as a brown film upon the lamp glass; but this difficulty is not insuperable.

A SURGEON'S TOOLS—CLEAN OR UNCLEAN?

I HAVE told you one story out of our shop. Here is a second, true as the first, quite.

The great master of British surgery, Sir Rusty Poyntz, and the smaller (I'm not going, sir, to say smallest), which was your humble servant, met in consultation over a very sad and touching case. It was that of a young Eton lad, a fellow of keen eye, deft hands, and extra bright brains. His grand family house in a huge Belgravian square was but a golden cage for that handsome, sweet-voiced skylark; and, lark-like, he pressed his little heart against the golden bars—now singing, now sighing for the blue air, the flashing rivers, the shout of the cricketers, the hum of the nine hundred—save one—this one! It was a case of abdominal dropsy; and that were a hard, a hardest, heart which did not ache when the bedclothes were put aside, and the great, wax-like, tumid trunk disclosed to view, full to distension. It was to be tapped.

As we went up the grand stairway, Sir Rusty Poyntz opened his pocket-case of tools, and picked out one adapted for that operation. Mr. Smaller asked to look at it—previous experience having taught him that Sir R. P.'s tools wanted a little looking to. Sure enough, it was so now. The tool is called a trochar, and consists of a split tube, the canula fitting over a piercing, triangular, tapering, and pointed end. The tube is slipped down until it falls with a spring click into a groove, thus keeping the edge of the tube under cover of the shoulder of the stem, as the instrument is thrust into the body. This done, the stem is withdrawn, leaving the canula behind to form a conduit, through which the imprisoned liquid of the dropsy rushes out. When in fine order, a more beautiful, simple, painless instrument does not exist. But if the tapering point be dulled, its sides rusted, and the edge of the canula unprotected, it were hard to find a more torturing instrument. And now, reader, hearken: that was the state of the tool in question, and that cruel, cruel thing, was to be thrust through the tender skin and tissues of a sensitive and nervous boy, dull at its point, rust-coated down its sides.

It was just that which I had expected, and I showed the defective instrument to the great surgeon. He had none better, and the operation being of pressing importance, there was not time to procure another. "It don't signify, you know," said the "Great"; "But it is a cruelly hurtful instrument in its present state," said the "Smaller." Halting a little, I got some of the rust off, and I slightly sharpened the cutting point and edges. How I longed for my lovely Turkish stone and its persuasive oil. Well, the savage tool rent its ragged way, and the brave lad, pulling himself together—for you must remember that skinny, weazened little fellow had a hero's gallant blood in him—and with a few half-stifled groans, and one long-drawn sigh, the thing was done. A surprising quantity of fluid rushed through the canula, the lad found immense relief and ease of breath, and, with all of a boy's elasticity, in an hour or two he lay smiling on his couch, his cunning fingers hard at work toy-making—the cruel hurt, the operation, and the Big and the Little Surgeon "alike forgot."

But these things ought not so to be, and what is worse—rather is better—they need not to be so—for the suffering might not have been inflicted, had Sir R. P. only imitated that wise and celebrated boar, who used to keep his weapons always keen for service. Besides, who in this day of small things—the air pregnant with the beginnings of life—the earth steaming forth and the waters laden with the potentialities for evil—who, I say, can tell but that the unclean surfaces of a surgeon's weapons may not (I believe they do) poison the tissues through which they are thrust. Reader, despise not, then, these prophesyings, and if by evil fate ye then needest the surgeon, make Sir Rusty Poyntz see to his blade. Why, there is one of our craft, a canny Scot is he, who not only keeps a cutting edge on his instruments, but actually dips the keen blade into a "germ"-slaying solution before ever he lays open the million little mouths beneath the skin. I, myself, over and over again, after washing my cut surfaces with zinc chloride solution (weak), have pressed them together again, varnishing the wound with a film of blood, and then covering it over with a thick layer of cotton wool (the filtration-power of which is now known to every one), and exercising a masterly inactivity for a week or ten days, I have then gently taken off the wool, with the sure joy of finding the ugly gash healed from end to end. I cut out a hideous cancer from a lady's breast, making one single cut more than 10 in. long, and so treating it, found it strongly knit together throughout in eight days. For why? Because I cut with the very keenest of edges—thus not tearing up the tender tissues, and also because no "germ" of mischief could pass through my armour of cotton wool.

Here's a lot of sack, Mr. Learned Editor, but I must have my pennyworth of bread also devoured—and an important mouthful it is. I had great searchings of thought concerning my little sufferer, and the cruel instrument used; and on this wise: What is the figure of least resistance to the dissevering part? Does it vary with the nature of the substance to be severed, or is it similar in all cases? and in the case of human skin, muscle, and other tissues of the body, what shape of instrument passes through most easily? I earnestly seek a reply; and on no other page than that of KNOWLEDGE could I have the chance of obtaining an answer. And—now 'tis your turn to blush, sir—of no other man in England could I hope for a right, well-reasoned, and well-demonstrated reply as of you. I have made a good many hundred "cuts" in my surgeon's life; and, like another more distinguished gentleman in the art of shedding blood, I have earned my dukedom. "He must shed much more blood, and become worse to make it sit too good." But I have always tried to operate as painlessly as I knew how. Pray, if it be possible, come over and help us and our followers, and can the inquiry be offered thus for solution?

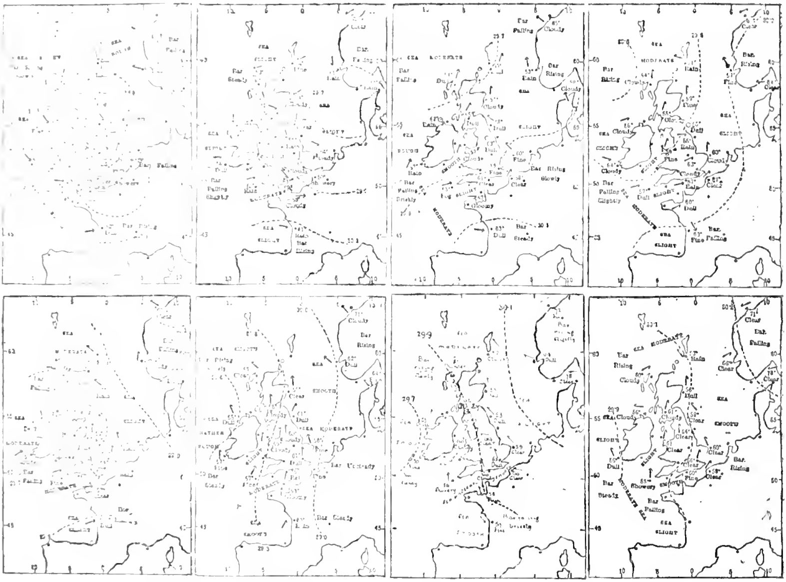
Query: What is the mathematical form (I mean shape) of least resistance, say in the instance of a tool (as in this case) which has first, to penetrate, and second, to bisect a body composed of skin overlying muscle or other forms of tissue? When that is answered, the answer-giver will have the pleasure to know that he will save a mass of human suffering if we succeed in getting our instrument-makers to adopt the formula. He has invented another crusade. Be not crusty over it, I pray. Please inform your twenty thousand readers that the astute, sympathetic, and skilful Mr. Smaller has, for some time past, left the field of the battle for life, and is now a non-combatant. Thus, sir, you perceive I may now, without treading on anybody's toes or wounding their delicate susceptibilities, sit on my little perch and crow, or more appropriately chant, the coming sunrise in, with "healing in His wings." [illegible]

Raven Spring, Mitcham.

FIRE CAUSED BY LIGHTNING.—The poor-house in the small town of Oesthamman, in Sweden, was set on fire by lightning and burnt to the ground on June 1. Out of fifty-two inmates, twenty perished in the flames.

WEATHER CHARTS FOR WEEK ENDING SUNDAY, JUNE 25.

Sunday, 18th. Monday, 19th. Tuesday, 20th. Wednesday, 21st.



Thursday, 22nd. Friday, 23rd. Saturday, 24th. Sunday, 25th.

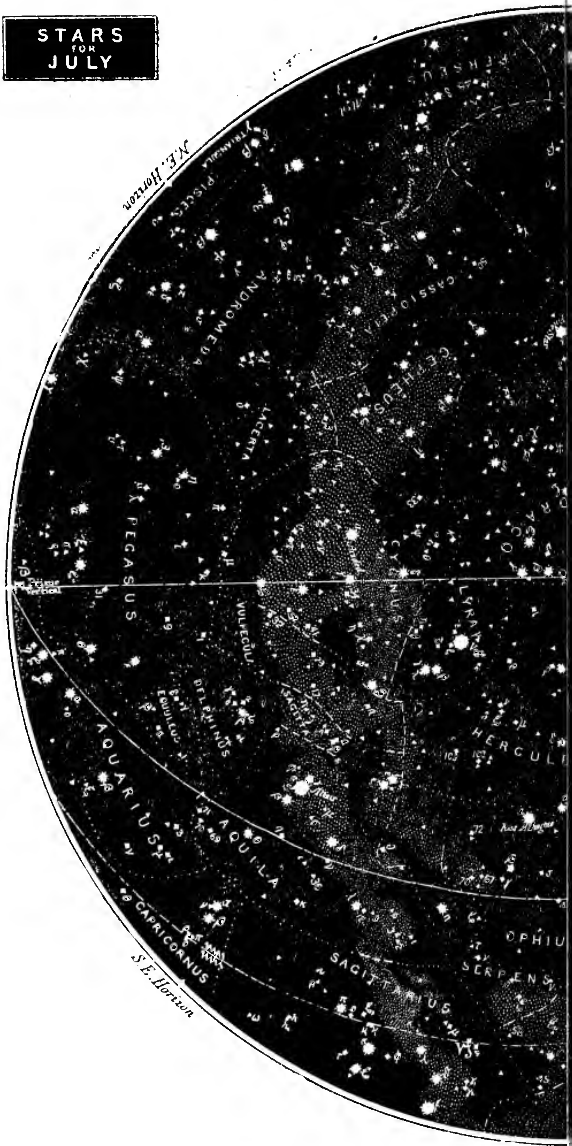
In the above charts the dotted lines are "isobars," or lines of equal barometrical pressure, the values which they indicate being given in figures at the end, thus 30·1. The shade temperature is given in figures for several places on the coast, and the weather is recorded in words. The arrows fly with the wind, the force of which is shown by the number of barbs and feathers, thus:— ⟶ light; ⟶, fresh or strong; ⟶, a gale; ⟶, a violent gale; ⊙ signifies calm. The state of the sea is noted in capital letters. The * denotes the various stations. The hour for which each chart is drawn is 6 p.m.

It is stated that within the last few months a representative of the Chicago, Milwaukee, and St. Paul Railway has purchased in England about 20,000*l*. worth of machinery for the new carriage shops of the company.

Some old bricks having been observed to affect the compass-needle by Herr Keppler, at Salzburg, in the Tyrol, he then had two bricks made from each of eight varieties of clay in the neighbourhood of [illegible], one in each case being baked. The unbaked bricks did not affect the needle, but seven of the eight baked bricks proved polarly magnetic. Some further experiments have been made by Herren [illegible] and Troettl. Particles of powder of the magnetic brick adhered to a steel magnet. Breunerite, mica-slate, argillaceous [illegible], garnet, chlorite, and hornblende were, before heating, unmagnetic; but intense heating produced a magnetic polarity, the axis of which seemed to be perpendicular to the plane of stratification.

In a recent lecture on some of the dangerous properties of dusts, Professor Abel, F.R.S., said that many experiments were tried with sensitive coal dust from Seaham and other collieries for the purpose of ascertaining whether results could be obtained supporting the view that coal-dust, in the complete absence of fire-damp, is susceptible of originating explosions and of carrying them on indefinitely, as suggested by some observers; but, although decided evidence was obtained that coal-dust, when thickly suspended in the air, will be inflamed in the immediate vicinity of a large body of flame projected into it, and will sometimes carry on the flame to some small extent, no experimental results furnished by these experiments warranted the conclusion that a coal-mine explosion could be originated and carried on to any considerable distance in the complete absence of fire-damp. Some experiments made in a large military gallery at Chatham showed that the flame of a blown-out shot of $1\frac{1}{2}$ lb. or 2 lb. of powder might extend to a maximum distance of 20 ft., while in a very narrow gallery, similar to a drift-way in a mine, the flame from corresponding charges extended to a maximum distance of 35 ft. These distances are considerably inferior to those which flame from blown-out shots has been known to extend, with destructive results, in coal-mines, and there appears no doubt that, in the latter cases, of which the lecturer gave examples, the flame was enlarged and prolonged by the dust raised by the concussion of the explosion. But in the presence of only very small quantities of fire-damp, dust may establish and propagate violent explosions; and that, in the case of a fire-damp explosion, the dust not only, in most instances, greatly aggravates the burning action and increases the quantity of after-damp, but that it may also, by being raised and swept along by the blast of an explosion, carry the fire into workings where no fire-damp exists, and thus add considerably to the magnitude of the disaster.

STARS FOR JULY



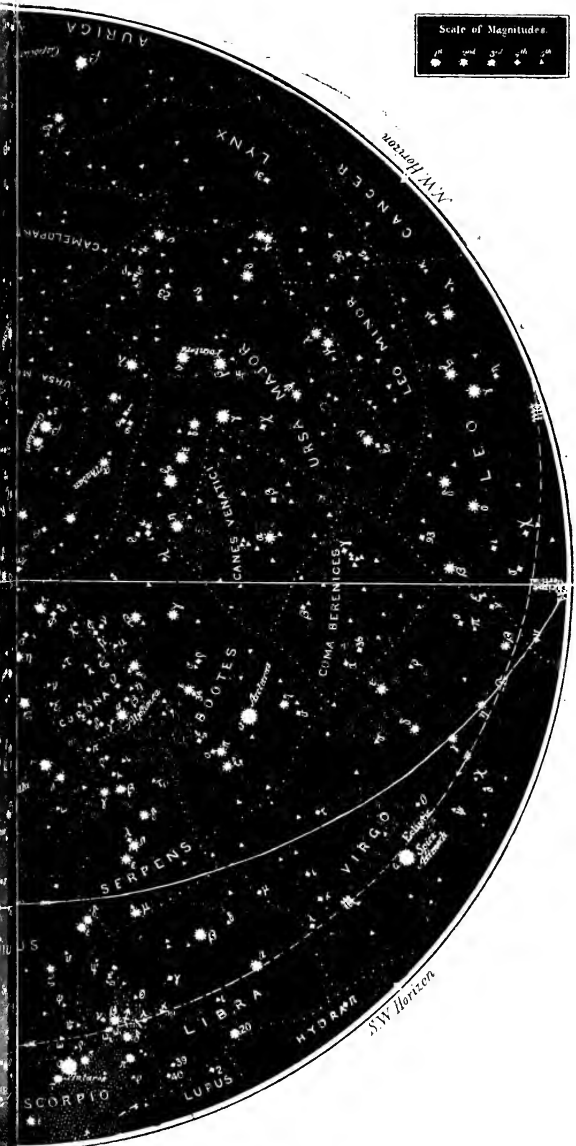
Our Star Map.—The circular boundary of the map represents the horizon. The map shows also the position of the Equator and of that portion of the Zodiac now most favourably situated for observation. The names of ninety-nine stars of the first three magnitudes are given below.

On June 30, at 10·30 p.m.
On July 3, at 10·15 p.m.
On July 7, at 10· 0 p.m.
On July 11, at 9·45 p.m.
On July 14, at 9·30 p.m.
On July 18, at 9.15 p.m.
On July 22, at 9· 0 p.m.

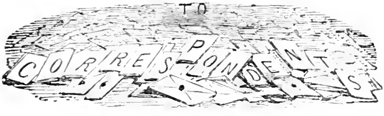
ARABIC NAMES OF STARS.

The following table exhibits the names of all the stars of the first three magnitudes whose names are in common use:—

α Andromedæ ...	... *Alpheratz*
β ——— ...	... *Mirach, Mizar*
γ ——— ...	*Almach*
α Aquarii ...	... *Sadalmelik*
β ——— ...	*Sadalsuud*
δ ——— ...	... *Skat*
α Aquilæ ...	... *Altair*
β ——— ...	... *Alshain*
γ ———	... *Tarazed*
α Arietis	... *Hamal*
β ——— ...	... *Sheratan*
γ ——— ...	*Mesartim*
α Aurigæ	... *Capella*
β ——— ...	... *Menkalinan*
α Boötis ...	*Arcturus*
β ——— ...	... *Nekkar*
ε ——— ...	... *Izar, Mezar, Mirach*
η ——— ...	... *Muphrid*
α Canum Venat.	*Cor Caroli*
α Canis Majoris ...	... *Sirius*
β ———	... *Mirzam*
ε ———	... *Adara*
α Canis Minoris ...	*Procyon*
β ———	*Gomeisa*
α² Capricorni	*Secunda Giedi*
δ ———	... *Deneb Algiedi*



α	Cassiopeiæ	*Schedar*
β	———	*Chaph*
α	Cephei	*Alderamin*
β	———	*Alphirk*
γ	———	*Errai*
α	Ceti	*Menkar*
β	———	*Diphda*
ζ	———	*Baten Kaitos*
ο	———	*Mira*
α	Columbæ	[illegible]
α	Coronæ Borealis	[illegible]
α	Corvi	[illegible]
δ	———	[illegible]
α	Crateris	[illegible]
α	Cygni	[illegible]
β	———	[illegible]
α	Draconis	[illegible]
β	———	[illegible]
γ	———	[illegible]
β	Eridani	[illegible]
γ	———	[illegible]
α	Geminorum	[illegible]
β	———	[illegible]
γ	———	[illegible]
δ	———	[illegible]
ε	———	[illegible]
α	Herculis	*Ras* [illegible]
β	———	[illegible]
α	Hydræ	[illegible]
α	Leonis	[illegible]
β	———	[illegible]
γ	———	[illegible]
δ	———	[illegible]
α	Leporis	[illegible]
α	Libræ	[illegible]
β	———	[illegible]
γ	———	[illegible]
α	Lyræ	[illegible]
β	———	[illegible]
γ	———	[illegible]
α	Ophiuchi	[illegible]
β	———	[illegible]
α	Orionis	[illegible]
β	———	[illegible]
γ	———	[illegible]
δ	———	[illegible]
ε	———	[illegible]
α	Pegasi	[illegible]
β	———	[illegible]
γ	———	[illegible]
ε	———	[illegible]
ζ	———	[illegible]
α	Persei	[illegible]
β	———	[illegible]
α	Piscis Australis	[illegible]
ε	Sagittarii	[illegible]
α	Scorpionis	[illegible]
α	Serpentis	[illegible]
α	Tauri	[illegible]
β	———	[illegible]
η	———	[illegible]
α	Ursæ Majoris	[illegible]
β	———	[illegible]
γ	———	[illegible]
ε	———	[illegible]
ζ	———	[illegible]
η	———	[illegible]
ι	———	[illegible]
α	Ursæ Minoris	[illegible]
β	———	[illegible]
α	Virginis	[illegible]
β		[illegible]
	———	[illegible]



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of KNOWLEDGE; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

All Letters or Queries to the Editor which require attention in the current issue of KNOWLEDGE, *should reach the Publishing Office not later than the Saturday preceding the day of publication.*

(I.) Letters to have a chance of appearing must be concise; they most be drawn up in the form adopted for letters here, so that they may go untouched to the printers; private communications, therefore, as well as queries, or replies to queries (intended to appear as such) should be written on separate leaves.

(II.) Letters which (either because too long, or unsuitable, or dealing with matters which others have discussed, or for any other reason) cannot find place here, will either be briefly referred to in answers to correspondents, or acknowledged in a column reserved for the purpose.

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"There is no harm in making a mistake, but great harm in making none. Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

"God's Orthodoxy is Truth."—*Charles Kingsley.*

THE LATE MR. DUNMAN.

WE should be obliged if "J. L. W." would forward his address to Mr. Litchfield, whose address is given at the foot of a letter respecting the late Mr. Dunman on p. 28 of KNOWLEDGE, No. 32. —EDITOR.

TOBACCO AND CONSUMPTION.

[442]—The narration of a piece of personal experience may not form a wholly valueless contribution to the discussion of the connection between smoking and an immunity from consumption. I may thankfully say that the solitary complaint from which I ever suffer is relaxed (or "gravelly") sore throat; and this only attacks me if I am exposed to cold or wet. If, however, under such circumstances, I take a cigar, it acts as an absolute prophylactic, apparently by drying up the mucous membrane. It is fair to add that I often do not smoke for weeks at a time. It is quite possible that, were I an habitual smoker, the very valuable effect of which I have spoken might cease to accrue. As it is, to go out into the rain without my cigar means an infallible sore throat; to "light up" as a preliminary step, assured freedom from it. W. N.

[443]—The question of a possible connection between tobacco and consumption has been raised by a correspondent. Does tobacco smoking prevent or cure consumption? This question is one of mournful interest to many English families, and it is one which we have some means of answering; for although we are, in common with most civilised nations, a tobacco-loving people, it is at present only the adult male portion that so indulges. If, then, it has any influence over the disease, we should expect to find the benefit so derived confined to men. Let us see what statistics have to teach us on this point.

Dr. Boudin gives the following figures ("Traité de Géographie et des Statistique Médicales," tome ii., p. 643, 1857):—"In England and Wales, in the year 1838, 27,935 males and 31,090 females died of consumption; 1839, 28,106 males and 31,153 females; (with the exception of London) 1842, 24,048 males and 28,098 females.

The fifth annual report of the Registrar-General (p. 398) gives the following death-rate by phthisis (consumption), in 1841, in the twenty-five large towns, comprising 1,883,693 inhabitants, and in seven counties having 1,700,434 inhabitants:—In the towns, 1,279 males and 4,427 females; in the counties, 2,886 males and 3,510 females. The general death-rate from consumptive diseases was in 1848, 31,573 males and 32,502 females; in 1851, 32,278 males and 33,746 females. "These figures," Mons. Boudin goes on to say, "are far from indicating a predominance of consumptive affections amongst women, if one remembers that in nearly all the European countries the number of women exceeds that of men."

Dr. P. C. A. Louis records ("Researches on Phthisis," translated by Dr. Walshe, p. 479. 1844), a series of 123 cases, analysed and collected in wards containing 48 beds, equally divided between individuals of both sexes, 70 of which were furnished by females, and 57 by males. Dr. Louis in order to ascertain, if possible, the influence of sex on the mean duration of the disease, says (p. 377):—"I compared two series of individuals, one of them comprising 97 women, and the other 113 men. I found that the mean duration had been twenty months in the women and seventeen in the men—a rather considerable difference, and one of the reverse kind from that which might have been expected, inasmuch as phthisis being more common in females than males, it might naturally have been supposed that the sex most strongly predisposing to the disease would also have hastened its progress."

There is nothing in these figures, then, to show that men derive any benefit in the way of preventing or retarding consumption by the use of tobacco. And if we now turn to some other statistics, we shall find that the belief that women are more subject to consumption than men is not universal.

Dr. A. B. Shepherd (Gulstonian lecture on the Natural History of Pulmonary Consumption, 1877), gives a table of 849 cases of ordinary phthisis (consumption) observed at the Victoria Park Hospital. Of these, 465 were males and 384 females. At the Lyons hospitals for this disease in 1873 were admitted 860 males and 569 females, or a proportion of the former to the latter of three to two. There is nothing very conclusive about these figures: the preponderance of male cases over female is probably due to the harder work and exposure that is oftener the lot of men than women—although this must to some extent be counterbalanced by the baneful continement of the female lower orders, from morning to night, in squalid dens and poisoned alleys. But be that as it may, there is nothing to show that tobacco has the slightest preventive or curative power over consumption.

May the day soon arrive when medical science shall discover a cure for consumption. We have much to cause us to look confidently forward into the future; and although unwise legislation, the result of specious humanitarianism, has checked the advancing tide of knowledge in England, yet men like Pasteur in France and Koch in Germany, unhindered by a paternal Government, are making discoveries that shall redound to their glory as long as the heart has woes, as long as this world shall last.

W. M. BEAUMONT, M.R.C.S., Oxford.

[444]—I have read with interest Mr. W. B. Wicken's letter (No. 411, p. 630) on Tobacco and Consumption, as also Mr. Prosser's reply thereto (No. 418, p. 28, Vol. II).

Smoking tobacco as a cure for consumption, I am afraid, will never come to the fore. Climate has, I hold, a great deal to do with the prevalence or scarcity of this disease, for we find that it is most met with in moist temperate countries, like Great Britain, and is comparatively scarce in countries which suffer the extreme of heat and cold.

But another reason for the prevalence of consumption in this country (and in others) is the habit that human beings have acquired of breathing through their mouths, and not through their nasal organs. The air we breath through the mouth goes down to the lungs unpurified, while that breathed through the nose is deprived of obnoxious matter (with which the air is always more or less filled), that organ having the property of purifying the air breathed, as well as others. Mr. Prosser, in his letter, gives an example of this. He says that tobacco smoke has undoubtedly a soothing effect, for when his laboratory is filled with acid fumes, he has no inclination to cough, as long as he uses his pipe. It is not the soothing effect of the tobacco fumes that prevents his inclination to cough, but, while he has the pipe in his mouth, he necessarily breathes through his nose, and the air is purified (so far at least) before it reaches the lungs, and causes no irritation. There are many races of Indians who still possess this natural practice, and were it reacquired in this country, I do not doubt that consumption and other diseases of the lungs would become comparatively things of the past. W. HUME.

TURKISH TOBACCO

[445]—Your correspondent, in letter 418, is a little bit out in regard to the tobacco used by the Turks for the hookah nargileh. The tobacco used, and I have smoked much of it (yet cannot stand half a pipe of the mildest tobacco used in England), is called

[illegible] —Persian tobacco. It is either very mild, or else the process it undergoes, before reaching the lungs of the smoker, robs it [illegible] of its strength. Before being placed in the nargileh it is moistened, and then the moisture squeezed forcibly from it. Let Mr. [illegible] try to smoke the English forms of tobacco—to wit, [illegible], returns, gold leaf, &c., &c.—in a nargileh, and he [illegible] to the "tunbeki" of Constantinople; [illegible] "one puff." Another case of neglected [illegible]. He missed the chance of making the acquaintance [illegible] which does not depress you, after which you have no [illegible], and to which the lower class of Turks owe their [illegible], their suavity of manner, and temperance [illegible].

A Constant Reader.

THE FEVER TREE.

[illegible] Mr. Southall, writing of the *Eucalyptus Globulus*, seems [illegible] has not yet been acclimatised in Europe. Perhaps I [illegible] to say that it grows luxuriantly all along the [illegible] more particularly in the neighbourhood of Cannes, and [illegible] consists in bearing flowers and fruit in the open [illegible] there acclimatised, for I have seen there trees [illegible] one hundred feet high, perfectly *loaded* with the [illegible] more correctly seed-vessels, from which a pointed [illegible] the magnificent crown of white stamens [illegible] the flower (there being, I believe, no [illegible]. The seeds [illegible] in the hard, woody case, are numerous [illegible], much smaller than a grain of mustard [illegible] to imagine a tree—such as one I saw, a [illegible] in the gardens of the Duc de Vallambrosa, [illegible] planted only in (I believe) 1865—having sprung [illegible].

[illegible] south of France are greatly impressed with its [illegible] rheumatism, for which latter disease they wear [illegible] the part affected, and you never mention the tree [illegible] hearing "Ah, it is very good for the fever." [illegible] of Cannes use it largely in soaps and perfumes, [illegible] vinegar, is the most exquisitely perfumed and refreshing thing of the kind I have ever met with. It [illegible] do not make more use of a tree which has [illegible], both as a febrifuge and a healthy and refreshing [illegible].

A. W. Buckland.

GLASS STYLOGRAPHS.

[447] [illegible] "H. L. C." (letter 424, p. 28, No. 32, Vol. II.) be good [illegible] enlighten your readers as to the way he makes his glass- [illegible] a trade secret) and oblige many others as well as [illegible]

Writer.

PROBABILITIES.

[illegible] remarks of "N." (401) having passed without comment [illegible] they may induce a belief in the advantage of a [illegible] or decreasing stakes, I wish to contribute my [illegible] illusion in as few words as I possibly can. [illegible] number of times, and any one stake his [illegible] given sum per throw, and retrieve losses [illegible] provided the gamester's resources are unlimited [illegible] trials ending with a successful throw will [illegible], and this will happen whatever odds may [illegible] speculator is not possessed of unlimited resources [illegible] advantage in varying the stake in any way. If a [illegible], the number of times the die is [illegible] on the second trial in proportion to the [illegible] throws on the first trial, will be as five [illegible] of unsuccessful throws on the third trial, [illegible] to the number of unsuccessful [illegible] on. The number of times the [illegible] in proportion to the number of unsuccessful [illegible] trial will be always as one to five, the [illegible] always being the same, irrespective [illegible] have been thrown successfully [illegible]. Any [illegible] of successful or unsuccessful [illegible] follow, notwithstanding [illegible] to unsuccessful throws [illegible] of one to five. When a die [illegible] the greater the number of [illegible] approach the theoretical numbers; [illegible] the first time it is thrown successfully [illegible] have been thrown on that particular trial [illegible]; if we continue to throw the die, [illegible] successful and unsuccessful throws on that particular [illegible] the proportion of one to five, and the [illegible] particular trial will be farther removed, and the more times the die is thrown, the farther removed from the first trial will be that trial in which each throw (one or more) is successful. There is another increasing stake to which the above remarks apply, viz., to win a given sum together with past losses, so that if an event happen n times in n trials ending with a successful trial, you gain n times the sum you sought to win on the first trial. This is exemplified by tossing a penny, and doubling your stake each time you lose, reverting to the original stake after each win. Supposing the resources of the gamester to be infinite, this is the lowest rate of increment from which any advantage can be gained. There would be no advantage in seeking to gain a given sum together with half the losses since the last successful trial. In games of skill and chance the most skilful player must ultimately win, as he is bound to get his share of the luck, and it is to his advantage to increase the stakes at the commencement of any fresh game, whether he has been gaining or losing previously. In playing any game of pure chance, there can be no advantage from increasing the stakes after a loss or a succession of losses; if the odds are against you, you must lose; the higher the stakes, the more you lose in proportion. Under any circumstances there is no advantage in following any system of increasing or decreasing stakes, or of investing so as to secure an increasing amount of money either after a loss or after a gain. No system has yet been or ever will be devised that will convert certain loss into certain gain. If you cannot gain by making the stakes equal, you cannot by making them unequal.

Thomas Jobson.

Bromley, Kent, *June* 15, 1882.

SPECTACLES.

[449]—Suppose you give us an article upon spectacles when convenient. A short time since I bought from a country dealer a pair of suitable focus, 30 inches, and capital frame. They were by a celebrated maker, and marked by him as "pebbles." Their nominal focus proved to be exact, each lens gave a neat solar image at precisely the assigned distance, but on testing them between two nicol prisms, I found no change of light or colour, such as is expected from quartz in polarised light.

Having a favourable opportunity, I submitted the spectacles for the several opinions of three practical opticians in London. The first said the polish was apparently too perfect for glass; but placing on a table before the window a pile of common window glass, eight or ten pieces, perhaps, about 6 inches square—a polarizing bundle in fact—he held a tourmaline before the eye with one hand, and a lens of the spectacles in the other in the line of sight between the tourmaline and the plates, and at once pronounced the material to be glass and not quartz. The second referee produced a pair of tourmaline tongs, and placing a spectacle lens between them, gave the same verdict. He showed how, when the tourmalines were "crossed," the rotation of a "pebble" lens between them restored the light at certain intervals; whereas the introduction of a glass lens produced no effect whatever. The test of the third was simpler still: he touched a lens of the spectacles with the tip of his tongue, and said it was "not cold enough for pebbles," remarking that this was the advantage possessed by quartz lenses—they were cooler to the eyes.

Now, is there anything in this? Does the question of specific heat really arise? or is the advantage only that of superior hardness, as compared with glass, and consequent less liability to scratching?

Then, too, supposing it to be conceded that quartz is the better material, is anything gained by employing sections cut at a certain angle with the axis of the crystal, as is maintained by at least one London optician? Another, of equal eminence, asserts that provided the quartz be pure, free from striæ and bubbles, and uniform in density, you may cut it into slices for spectacle lenses where and how you like.

Certainly the various appearances which are presented in the polariscope by quartz crystals, according as they are cut parallel to, at right angles, or at different angles with the axis, may indicate that it is not immaterial to the lens of the eye, what section of the crystal be taken. But on the other hand, the eye does not often use polarized light with spectacles.

T. S. B.

THE FIFTEEN SCHOOLGIRLS.

[450] The best way that I can think of to manage this problem is the following. Designate the girls by the letter C and the numbers 1 to 14. Let one group for the first day's arrangement be C 1, 2, and set the numbers 3, 5, 9 as the first members of three other groups. With 3 join any other odd number (not already used), and an even number, which must be, with 7, 6, or 10; with 11, 8, or 14; with 13, 6, or 12. With 5 join numbers formed from those with 3,

by doubling the odd number and subtracting 1 or 15, and doubling the even number and substracting 2 or 16. With 9 join numbers formed in the same way from those with 5. This will complete four groups, and the fifth group will consist of the remaining numbers, either 4, 6, 10, or 8, 12, 14.

Make the second day's arrangement by adding 2 to every number in the first day's, except 13 and 14, from which you must subtrac. 12. Make each day's arrangement from that of the preceding day in the same way, and the problem is solved.

Any solution may be varied by making the odd and even numbers change places—that is, each odd number changing places with the next greater even number.

The explanation of this solution is that in the first day's arrangement one odd number is combined with another differing from it by 2, one with another differing from it by 4 or 10, and one with another differing from it by 6 or 8; and it is the same with the even numbers. Also the combinations of odd and even numbers are such that one odd number is combined with an even number 1 greater, one with an even number 3 greater,

one with an even number 5 greater or 9 less,
" " " 7 " 7 "
" " " 9 " 5 "
" " " 11 " 3 "
" " " 1 less.

These differences are not changed by the successive additions of 2, except by changing a difference to what we may call its complement, as $+d$ to $+d-14$. The place of every number in the first day's arrangement will in the course of the six following days be occupied by every other number of the same class (odd or even as the case may be), and consequently every number will, in the course of the seven days be once joined with C, and once with a number differing from it by each possible difference, whether the difference be added or subtracted.

This method is applicable with slight modifications to most other schoolgirl problems, where the number of the girls is $12n+3$, and not otherwise; but in some cases, and as I have particularly noticed in cases of $60n-9$ girls, there are difficulties in the way of applying it which I do not know any simple way of getting over. For better illustration of the method of solving other problems, I add one solution of the problem of thirty-nine schoolgirls.

Make a series of odd numbers beginning with 3, by doubling each term and subtracting 1 or 39 to form the next, and set the series down in pairs thus:—

3	5	8
9	17	26
33	27	22
15	29	6
19	37	18
35	31	28
23	7	30
13	25	38
11	21	32
	—	
4	10	34
16	20	36
24	14	12

With each of these pairs join the even number which is the sum of the two numbers composing the pair, deducting 38 if greater than 38. These numbers are the same as the even terms in the series of odd numbers, each increased by 1. Now take the odd terms in that series in order, add 1 to each, and set them down in threes, as is here done.

These sets of three, with the addition of C, 1, 2, form the arrangement for the first day, from which the arrangements for the other days are formed by successive additions of 2 or subtractions of 36.

Algernon Bray.

MISPLACED SPA.

[451]—The efflorescence mentioned by "Curiosity" has been found by chemical analysis to vary considerably in composition. It often consists of sulphate of magnesia, also sulphate of lime, of carbonate salphate, or nitrate of soda, of chloride of soda and potash, and carbonate of potash. It is attributable sometimes to the bricks or stones of a wall, sometimes to the mortar.

In bricks barnt with coal fires or made from clay containing iron pyrites the sulphur from the fuel converts the lime or magnesia in the clay into sulphates. When the bricks are wet these dissolve; when dry they evaporate, leaving crystals on the surface. Many limestones contain magnesia; these are acted upon during calcination by the sulphur in the fuel; sulphates are formed which find their way into the mortar and produce the efflorescence mentioned. Again, the sulphur acids evolved from ordinary house fires attack the magnesia and lime in the mortar joints of chimneys; these dissolve and evaporate on the surface. The formation of chlorides is nearly sure to take place if sea sand or sea water be used, or in bricks made from clay which has been covered by salt water.

"Prevention is better than cure."

The best plan is to avoid all the materials above mentioned as likely to give rise to efflorescence, in the case of bricks; clay containing pyrites or much magnesia should not be used; special bricks may be burnt with coke or wood.

As regards mortar, the use of limestones containing magnesia to any great extent may generally be avoided. If, however, it does occur, in spite of all precautions, the following remedies may be tried:—

In the case of ashlar work, the surface may be covered with a wash of powdered stone, sand, and water, which is afterwards cleaned off. This fills up the pores of the stone, and temporarily stops the efflorescence. When the wash is removed the efflorescence will recommence, but in a weaker degree than before.

Painting the surface is sometimes efficacious if it is done before the efflorescence commences.

The mortar before use may be treated, to prevent it from causing efflorescence by mixing with it any animal matter.

W. H. Periwee.

EXTINGUISHING CANDLE-FLAME.

[452]—I do not know whether it has ever come under your notice that an ordinary wax candle may be blown out without leaving any red-hot snuff. If the candle be drawn backwards so that the flame envelopes the wick right to the end, the burning of the latter is quenched, for the obvious reason that it is in the heart of the flame where no air can reach it, and a sudden puff at this juncture puts out the flame and wick too. The proper direction to blow in is that of the tangent to the curve of the wick from the end of the latter; in fact, the experiment can, with care, be made to succeed without moving the candle at all, if attention be paid to this point.

I have also noticed that the third envelope of a candle-flame can be made distinctly visible by burning a little sodium in the neighbourhood of the flame, so that, from being faintly blue, it becomes tinged with yellow, and can be seen, in spite of the luminous layer inside it.

C. L. Barnes.

SECTIONS OF A CONE.

[453]—In drinking a glass of water, as the glass is sloped towards the lips the surface assumes an elliptical form. It has struck me that since it was thus possible to obtain a section of a cylinder, a somewhat similar contrivance might be used for demonstrating the figures commonly known as "sections of a cone." My idea is simply this—to make a hollow glass cone, and partially fill it with any tinted liquid. By giving it different degrees of inclination, the surface of the liquid might be made to assume the form of any conic section, from the circle to the hyperbola. Further, if the apparatus were so arranged that the liquid occupied exactly half the capacity of the hollow cone, we could obtain the limiting form of two straight lines, by holding the cone so that its axis should be horizontal. I think the advantages of this system are many and obvious. First, it would be cheaper than the wooden sections now in use, which require delicate workmanship; secondly, it would have the advantages of compactness and completeness, and would run no danger of being lost piecemeal; and, lastly, the demonstrator, by a motion of the hand, could actually show the ellipse in the process of passing off into either of its two limiting forms—namely, the circle or the parabola and thus attract the attention and interest of the pupil.

George E. Crawford.

Amongst the coming electrical exhibitions, that to be held at Munich in the autumn will be of especial interest, as it is the intention of the authorities to use, as the driving-power for the dynamo-machines, the water force of the river Isar, estimated at 3,000 horse-power, and to prove that it is possible to make use of it to light, at a distance of some miles the streets and houses, and to distribute the force to the different workshops.

Prices of Books.—The following very sensible paragraph appears among the answers to correspondents, in our valuable contemporary, the *School Board Chronicle*. "'Educationist' writes: 'I should be much obliged if you would add the price of the books you so excellently review,' observing that 'they may be sixpence or a guinea, and no one can tell.' We have had from time to time many communications from our readers in various parts of the country to the same effect. We can only say that it would give us great pleasure to afford this information to our readers, but we owe also some consideration to the proprietors of the *School Board Chronicle*, who naturally consider it to be the duty of the publishers of the books to inform the public through our advertising columns of the prices of the books which we review. In a large proportion of cases this information will be found among our advertisements, but not necessarily in the same week in which the review appears. We think publishers would consult their own interest by announcing the prices of the books immediately after the appearance of the reviews."

Answers to Correspondents.

•• *All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded; nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

JAS. DEAS. On re-reading, your letter seemed not to contain the [illegible] positive evidence necessary to make such cases scientifically [illegible].—W. H. BURCHART. Mr. W. Mattieu Williams has not yet [illegible] his promised work on "Comets and Nebulæ."—R. STEWART. I fear it is hardly in favour of your theory of solar energy that it is "distinct and separate from any known." I do not remember any true theory of which this could be said. At present, however, my chief difficulty is that the theory could not be condensed into less than ten pages of KNOWLEDGE. Perhaps, if you published it elsewhere, we might manage to give the essence of it in less space.—E. D. G. We agree with you that Col. Ross's definition of analogy is incorrect. As in mathematics, "Analogy or proportion is the similitude of ratios," so in general anology signifies the similitude of relations, not resemblance between things.—A. McLEAN. Many thanks. Your suggestions are all excellent. I proposed such a publication to one of the principal publishers of Victoria; but his idea was that it would hardly pay. If readers of KNOWLEDGE would not object to a series of maps doing for the southern hemisphere what those now publishing do for the northern, that would be a convenient way of producing the work. I think many, though living in the northern hemisphere, might like well to know the aspect of the constellations in the southern skies.—C. L. B. Let A B C be any triangle; P, Q, R, the centres of equilateral triangles on A B, B C, A C. Through A, draw a straight line parallel to P R, meeting the circles circumscribing the equilateral triangles on A B, A C, in *c* and *b* respectively. Thus it is obvious that *b* B and *c* C produced must meet on the circle circumscribing the equilateral triangle on B C (since the angles at *b* and *c* are each one-third of two right angles). The triangle *a b c* is equiangular, and, therefore, equilateral. But *b c* being the greatest chord which can be drawn through A to the circles *b*, *c*, it follows that *b a* and *c a* are also maximum chords. (For if longer chords could be drawn through B and C, their extremities would give an equilateral triangle circumscribing A B C, greater than *a b c*, or *b c* would *not* be a maximum chord.) Hence *b a* and *c a* must be parallel to P Q and R Q. (For it can easily be seen that the maximum chord drawn, as *b a* is drawn, is parallel to the line joining the centres P and Q.) Hence the sides of the triangle P Q R, are parallel to those of the triangle *a b c*, or P Q R like *a b c* is equiangular, and therefore is equilateral also.—CONSTANT READER. Your query seems in some way to have gone astray. We certainly put it in our box to forward to the writer of electrical articles, but suppose it was not sent.—BRITANNICUS. Would not the effect of the Saturday artillery practice be to produce heavy rainfall on Saturday and Sunday, if at all? Is there any evidence of a heavier average for these days? Again, the rainfall would be [illegible] heavy. Is there any evidence to show that there is the local effect? That under particular atmospheric conditions heavy cannonading may be followed by rainfall may be [illegible]; but "all great battles by land and sea" have not been followed by heavy rains within twenty-four hours.—F. N. NEWCOME. We might be able to find space for an occasional short [illegible] connected with India, China, or Burmah, if having [illegible] bearing. Occasional notes on actuarial matters would be welcome.—S. MIDDLETON. We have forwarded your [illegible] communication to Mr. Haviland, who is now in your town.

[illegible]. We may shortly have something to say on bicycles, but for health exercise the best use that can be made of a bicycle is to exchange it for a good, light running tricycle. Bicycle-riding [illegible] be regarded as the bold and clever achievement of a difficult and hurtful feat. Consider the cramped, awkward, chest-compressing attitude of the most skilful bicyclists in riding, and note how they walk, and you will see that their exercise cannot be good for them.—W. S. BROOK. Many thanks for your kindly and encouraging letter. In part of our last issue the final result of the Vienna Tournament was given. As we went to press before the final round was over, you can understand that the first copies could not have it.—LOCKSMITH. Your answer to your question 2 is quite correct. As to the other question, the thing to be proved is not true unless *n* does not exceed *a* in a certain degree. For instance, the integral part of $(\sqrt{a^2+1}+a)^n$ is even when $a=1$ and $n=10$; I make it 67260. So, again, when $a=2$ and $n=10$, the integral part of the expressions is even—namely, 186050. Your reply to Pyramus's question is not clear to me. Why should there be an increase of 480 each year, when it is obvious that after a few years more than 12 will get their advance?—ED. P. TOY. No conjuror who valued his repute would trust to a person choosing "a lion" for animal, and "a rose" for flower; as you say, 80 out of 100 would, even if that proportion really held. But I have asked many the question you suggest, and I find a much greater number say "horse" and "dog" than "lion," and though "rose" has a slight preference over other flowers, "daisy," "buttercup," and "heartsease," are chosen nearly as often, while "pink," "wallflower," "violet," and "primrose," are not far behind. I should say about a tenth choose "rose," leaving the other nine-tenths for all the other flowers; but certainly not so many as one-twentieth select "lion." Supposing the chance one-tenth that a rose would be selected by anyone taken at random, and one-twentieth that a lion would be selected, the chance that both would be selected is one-two-hundredth, or there would be 199 failures to one success. Taking even your numbers—80 out of 100 for each—the chance of both being selected would be 6,400 ten-thousandths, or there would on the average be thirty-six failures in 100 trials—far too many to leave a conjuror a shred of reputation.—J. W. D. CHURCHILL. Thanks; but I doubt whether so many take interest in the matter as you think.

ELECTRICAL.

A. NEAL. 1. The lamp is constructed after Swan's design, but may be only a catch-penny. Light is emitted by all parts of the filament proper, but sometimes the connecting copper or platinum wires extend some distance into the bulb. Apparently so in your lamp. You can increase the candle-power by increasing the current. 2. Ruhmkorff induction coils can be procured at all prices, from 13s. or 14s. upwards. 3. We intend writing on secondary batteries immediately.—P. C. F. The statement that, in driving a dynamo by steam the HP is in inverse ratio to R, although at first sight paradoxical, is quite correct when only E and R are given. HP is proportional to EC, that is, is proportional to C, E being fixed; but C is inversely proportional to R, therefore HP is also in inverse ratio to R. If C and R are taken, then, of course, HP is directly proportional to R, C being constant, because E increases at the same rate that R does. Taking $C^2R=\frac{E^2}{R}=CE$, whichever of these identities is used, the result is the same. Virtually, C and E are the only quantities from which HP can be obtained. Inasmuch, however, as C and E are associated with R in the manner expressed by Ohm's Law $\left(C=\frac{E}{R}\right)$; knowing any two of these three quantities, we can readily ascertain the third. To simplify matters, suppose we use a generator of low internal R, and whose E is 50 volts, to maintain incandescent lamps arranged in multiple arc. Then, if each lamp offers, say 25 ohms, the current through each will be 2 ampères. Manifestly, the H P developed will be directly as the number of lamps, but the R will be inversely proportional (from the law of parallel circuits). Joining the lamps in series will compel us to increase the E as each lamp is added. C being kept constant, the H P will be directly proportional to the R in the circuit. But in each case $\frac{EC}{746}=$ H P. By taking several of numerical examples, and working them out, identical results will be arrived at.—ALEXANDER HOWELL. The colouration of phosphoric acid, when dropped on your induction coil, was not due to electrical action, but in all probability was the result of the chemical action of the acid on the organic colouring matter used for dyeing the silk or whatever else may be the substance of the insulating material.

THE TELESCOPE.

COMET. "Portable Equatorial" is a vague term—so vague, in fact, that we cannot give a definite answer to your question without you describe your form of mounting. In order to get at the Polar region of the sky, your telescope ought to be mounted at one end of the declination axis, being counterpoised by the declination circle and a weight at the other. Of course, every equatorial stand (to be used as such) must be a fixture, its Polar axis remaining, under all circumstances, parallel to that of the earth. If you will be a little more explicit in your description, we will try to help you.—J. W. COLLBORN. No ordinary two-inch telescope will bear a higher power than 160, and it must be a very good one to perform well with such an amount of amplification. In order to obtain this power on your own instrument, you will require a Huyghenian eyepiece, whereof the focus of the field-lens is 0·35 inch, and that of the eye-lens 0·11 inch. These lenses must be placed 0·23 inch apart with, we need scarcely add, their plane sides towards the eye of the observer.—LANCASHIRE will find that selenography will supply him with work at once interesting and useful. The study of the Solar surface, too, may be pursued with an instrument of the size of his, and the addition to it of a Browning's Star spectroscope will enable him to see something of the spectra of the prominences on the solar limb, to say nothing of its use in Stellar spectroscopy. Should he possess artistic taste, and be able to sketch, careful drawings of such planets as Mars, Jupiter, and Saturn, if made at intervals, possess a direct scientific value. His best plan, however, will be to purchase forthwith Webb's admirable "Celestial Objects for Common Telescopes," which is in reality a pocket Encyclopædia for the amateur observer.—EXCELSIOR. δ Herculis, as viewed on the meridian, with an ordinary inverting eye-piece, now presents the appearance of a large star, with a very much smaller companion almost horizontally to the left of it. We have not a copy of "Half Hours" at hand; but certainly no such change as your diagrams indicate has taken place in this star. Its position angle has varied some 22° during the last eighty-two years. Prior to the year 1871, the comes was below a horizontal line to the left of its primary; now it is just above such a line. We do not know upon what authority Castor is described as a ternary system in Nollwyn's "Astronomy." At any rate, no sensible change has taken place in the relative position or distance of the principal star and the 11' magnitude one since the year 1823: and the system is universally regarded among astronomers as being simply binary, the minute star having obviously no physical connection with the well-known pair. With reference to Pollux, the word "coarse" was used as expressive of the considerable distance of the comites; "fine," as referring to their minute size. When Pollux is on the meridian on a dark night, you may pick these two companions up, both to the right, and a little below a horizontal line passing through their primary. The larger star of the two is about half as far again from Pollux as the smaller one. This last will require some looking for; though, when caught, it may be held steadily enough in a good three-inch telescope. The earliest recorded position of comet Wells is on March 19·6891, 1882, G.M.T.; when it was situated in R.A. 17° 54′ 38·1″, and declination 33° 25′ 5″ N. (which possibly ought to be 33° 24′ 5″ N.).

LONG DISTANCE TELEPHONING.—Recent experiments have been made with M. van Rysselberghe's system of telephony, during which messsages were sent by telephone over a long distance simultaneously with telegraphic messages traversing the same wire. The first experiment was made on an ordinary telegraph wire 353 kilomètres long, between Paris and Nancy; and the second between Paris and Brussels, over a wire 344 kilomètres long. It is stated that telephonic messages were distinctly heard, whilst the telegraphic messages were distinctly rendered by the Morse instruments employed. M. van Rysselberghe is the head of the Meteorological Observatory at Brussels.

ELECTRIC LIGHT IN THE CITY.—At a meeting of the Commissioners of Sewers, an abstract of the engineers' report was submitted, from which it appears that the cost for twelve months, including the fixing of machinery, lamps, &c., ranges, in district No. 1, from £2,190 to £5,750, as against the present cost of gas, £551; district No. 2, from £2,350 to £1,270, as against £363 for gas; district No. 3, from £2,470 to £3,800, as against £311 for gas; district No. 4, from £2,920 to £1,350, as against £612 for gas. Some of the companies couple with their tender a request to be allowed to light private premises within the district, and in that case the company offer to make the charge for lighting, irrespective of the machinery, &c., the same as for the gas saved plus 20 per cent. These figures show a great disparity when compared with other contracts.

THE ELECTRIC LIGHT AT CHESTERFIELD.—The bill for the public lighting of the streets of Chesterfield since November 1 last, when Messrs. Hammond & Co. undertook to illuminate the thoroughfares of the town by means of electricity, has been received by the Corporation. The period it covers is nearly five months, and the total amount charged £272. During a great part of that time there have been twenty-two arc lights and from sixty to seventy incandescent lamps in use, as well as gas-oil lamps. On the whole the town has been very fairly lit throughout that period, and at present the light supplied is excellent. The amount for public lighting per annum under the old system was £920. The work was necessitated by the cutting off of the gas supply by the local authorities, thereby leaving the town in darkness. Mr. Kingsland, who was the superintending electrician, has been appointed electrical engineer to the Yorkshire Brush Electric Light Company.

Our Mathematical Column.

TO OUR READERS.

I HAVE been in some doubt whether to take first the series of papers on the solution of Geometrical Problems, or those which I promised in an early number, on the Differential Calculus. After some consideration, however, I have decided to take the latter first, because lessons on the solution of Geometrical Problems can be obtained more easily than instruction really elementary and simple in the Differential and Integral Calculus. In the "Easy Lessons" now commenced, I propose to depart in some degree from a plan which I followed in dealing with the Differential Calculus in the pages of the *English Mechanic* some ten or twelve years ago. In pursuance of a plan suggested to me by the Rev. Mr. Griffin, of Ospringe, I propose to bring the Integral Calculus before the reader at the same time as the Differential Calculus, instead of dealing with it later on. The connection between the two subjects will thus be more clearly recognised. I propose also to illustrate geometrically as many as possible of the relations involved in dealing with the Differential and Integral Calculus, believing that in this way the real meaning and value of the methods employed will be more clearly recognised, while the interest of the subject will be enhanced.

I may notice in passing that space and time can no longer be devoted to problems set for solution by our readers—that is to say, to problems thus set in the way of puzzles. So many solutions, good, bad, and indifferent, are sent for each such problem, that the work of analysing and comparing them so as finally to publish the best, while awarding to each its due meed of praise, is more than with our present staff, we are prepared to accomplish satisfactorily. We shall always be pleased, however, to solve, or to publish for solution, problems which may have presented difficulties to students of various mathematical subjects, provided always that such problems have real interest and value, and are not merely difficult.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS

No. 1.

The differential calculus is the science which deals with the rate at which variable quantities increase or diminish. When we say that a quantity is variable, we imply that it varies as some other quantity changes. For example, the velocity of a train is variable. It varies with the *time* which has elapsed since the train started—it varies with the *distance traversed*—with the *steam power* employed—with the *state of the rails*—and so on. But the differential calculus deals only with those quantities which vary according to some definite law.

For example, when a body is let fall from rest the distance it traverses varies, according to a known law, with the time elapsed since the fall began. The differential calculus is able to deal with such a case as this. Again the sine of an angle varies according to a known law as the angle changes; and the differential calculus is therefore able to deal with this case also.

Now we can at once see the importance of a calculus which will deal with variable quantities. Algebra and geometry and trigonometry deal with absolute quantities. But it is often very necessary to learn something about the variations of quantities, to know when a variable quantity attains its greatest value, when it is increasing, when diminishing, when it changes fastest, and so on. Whenever variations take place according to a known law, this is precisely what the differential calculus will do for us. And its great advantage is that it will solve our problems systematically. An ingenious application of algebra or geometry or trigonometry will often enable us to solve problems which belong especially to the differential calculus. But we require ingenuity for the purpose, whereas the differential calculus solves such problems with certainty, even if we have not a particle of ingenuity, so long only as we follow the proper rules. Even where it fails, it teaches us that we are trying to solve an insoluble problem.

The first matter the calculus attends to is the choice of a convenient expression for the rate at which a variable quantity changes. This expression is called a *differential coefficient*. I prefer to illustrate rather than to define it. I wish also to illustrate it in such a way as to remove at the outset the chief stumbling block of the student of this special department of mathematics. I take, therefore, a familiar case of a varying quantity:—

When a body is let fall from rest, we know that as it falls its velocity continually increases. Now this varying velocity affords a very good illustration of a differential coefficient. The velocity of a body may be described as the rate with which the space it has traversed is increasing, as the time elapsed increases. When we change the time, we change the space traversed. But unless the velocity is uniform, the change of space is not proportional to the change of time. In the case of a falling body, the velocity is not [illegible]m: so that, if we consider one instant, the rate at which the [illegible] traversed would change for any given interval of time would [illegible] from the corresponding rate at some other instant. [illegible] the matter as illustrating the differential calculus, the [illegible] to be found is a general expression for the rate of change, [illegible] law determining the space traversed being supposed known.

Consider now the following way of dealing with the problem:—

At the end of t seconds the body has fallen a space represented by

$$\tfrac{1}{2}\,g\,t^2,$$

where g represents the accelerating force of gravity (or numerically, [illegible] taken as the unit of length, and a second as the unit [illegible] 32.2). A second later the body has fallen altogether [illegible] represented by

$$\tfrac{1}{2}\,g\,(t+1)^2.$$

[illegible] the course of that second the space actually traversed by the body is

$$\tfrac{1}{2}\,g\,(t+1)^2 - \tfrac{1}{2}\,g\,t^2$$
$$= g\,t + \frac{g}{2}.$$

As [illegible] during that second the body moved with uniform velocity, we [illegible] know what that velocity is. For, when a body moves uniformly over s units of length in t units of time it moves [illegible] units of length in one unit of time, and $\frac{s}{t}$ therefore represents its velocity. So that the velocity of our falling body would be

$$\left(g\,t + \frac{g}{2}\right) \div 1$$

if the body had moved uniformly during the second. But this is not the case. The body moves faster and faster as the second of time is passing; and its velocity at time t is therefore *not* obtained by the above process. We should clearly get a better result if we took a shorter interval of time. Suppose we take a very short interval indeed, as a thousandth part of a second. Then we have as before, the space fallen in t seconds

$$= \tfrac{1}{2}\,g\,t^2,$$

the space traversed one thousandth of a second later

$$= \tfrac{1}{2}\,g\left(t + \frac{1}{1000}\right)^2$$

and the space traversed in the interval

$$= \frac{g\,t}{1000} + \frac{g}{2\,(1000)^2}.$$

So that on the false supposition of uniform velocity during this minute interval, we get for this velocity,

$$\left[\frac{g\,t}{1000} + \frac{g}{2\,(1000)^2}\right] \div \frac{1}{1000}.$$

$$= g\,t + \frac{g}{2000}.$$

This is clearly nearer the truth, because in so short an interval as a thousandth part of a second the change of velocity is exceedingly [illegible]. But still we have not the exact velocity.

If we had taken a yet smaller interval, as the millionth part of a second, we should have deduced for the velocity

$$g\,t + \frac{g}{2\,(1000000)}.$$

which is yet nearer the truth.

And [illegible] the interval the minuter the second fraction [illegible] remaining unaltered. Also, the minuter the interval the nearer we get to the true value.

But there is nothing to prevent us from conceiving that the interval is taken infinitely minute, in which case the second fraction [illegible], and also we get infinitely near to the true value. [illegible] is

$$g\,t,$$

and as a matter of fact we know independently that this is the velocity acquired by a falling body in the time t.

Now the reader will not need to be told that I have not gone through this process merely for the sake of deducing this special result. I want him to [illegible] himself of the reasonableness of the [illegible] method and also I wish him to note that though the reasoning [illegible] introduced the conception of *infinitely minute quantities*, and though the result itself is a *limiting* value, yet that result [illegible]. The velocity a body has at the end of any [illegible] time is real, and not a mere mathematical fiction or approximation. Prepared then to see that a real and exact value can be deduced by a seemingly approximate method, let him consider the following way of treating the very same problem.

Let s represent the space traversed in time t, $s + \Delta s$ the space traversed in time $t + \Delta t$ (where Δs and Δt are to be looked upon as [illegible] quantities, which may be read, if we please, *increment of the space* and *increment of the time*; or else, for convenience, simply [illegible] and *delta-time*).

Then

$$s = \tfrac{1}{2}\,g\,t^2 \qquad \text{(i.)}$$
$$s + \Delta s = \tfrac{1}{2}\,g\,(t + \Delta t)^2 \qquad \text{(ii.)}$$

and therefore, subtracting (i.) from (ii.),

$$\Delta s = g\,t\,\Delta t + \frac{g}{2}\,(\Delta t)^2$$

so that if the velocity of the body during the interval Δt were uniform, this velocity, or $\frac{\Delta s}{\Delta t}$, would

$$= g\,t + \frac{g}{2}\,\Delta t.$$

This result, however, will not be true, unless Δt is infinitely minute. Let Δt be supposed to be made infinitely minute, in which condition call it dt; then Δs also becomes infinitely minute, and may be called ds; and we get

$$\frac{ds}{dt} = g\,t + \frac{g}{2}\,dt$$
$$= g\,t, \text{ since } dt \text{ is infinitely minute or nought.}$$

Now this quantity $\frac{ds}{dt}$, for which we have thus obtained a definite value (although ds and dt are each evanescent), is called *the differential coefficient of s* (the space traversed) *with respect to t* (the time). It is really *the rate at which the space is increasing at the time t.*

But the reader will presently have to consider differential coefficients in a general way. The above illustration has shown him how a differential coefficient is deduced in a special case; and also that a differential coefficient, though made up of seemingly evanescent parts, may have an exact value, and (what is yet more to the purpose) has *always* a *real* significance. The $\frac{ds}{dt}$ of our illustration is that real and familiar relation, the velocity of a falling body. And so the differential coefficients we have to deal with as we proceed, are real matters, not mathematical fictions.

But the above case will serve as well to illustrate the meaning of what is called integration as the meaning of differentiation—the process actually followed above.

(*To be Continued.*)

Our Whist Column.

BY "FIVE OF CLUBS."

IT is remarked by several of our Whist correspondents that reasoning such as we considered in the latter portion of our last article, in dealing with play third in hand, second round, is too recondite and elaborate for actual Whist play. In reality, however, it only seems recondite because considerations which occur as card after card falls, are included in a single discussion, as if they had all to be thought over before a particular card was played. As a matter of fact, the practised Whist player attends to these matters almost unconsciously, making his inferences at the time, and using them afterwards. Thus Ace being led from Ace, ten, nine, eight, two, by himself, and six, five, three falling from second, third, and fourth players, he at once notes that either second player or third is signalling, and that fourth player is *not* signalling. He *feels* the absence of the *four* rather than thinks about it. Again, where he knows that there is no signalling, and a high card is played which does not cover one already played, the practised Whist player does not require an effort of attention to note that none of the lower cards are in that player's hand—he at once knows it, and therefore acts upon it.

The following hand illustrates the way in which inferences are made, and shows how they affect the play. They seem to require much care and attention, but are all in reality perfectly simple, and such as the Whist player with sufficient practice will make at once.

THE HANDS.

A.
Clubs—Q, 10, 5.
Diamonds—A, Q, Kn, 10, 5.
Spades—8, 5.
Hearts—K, 10, 3.

B.
Clubs—8, 7, 6.
Diamonds—K, 6.
Spades—K, Q, 10, 3.
Hearts—Kn, 7, 4, 2.

Y.
Clubs—A, Kn, 9, 3.
Diamonds—8, 4, 3, 2.
Spades—A, Kn, 9, 4, 2.
Hearts—None.

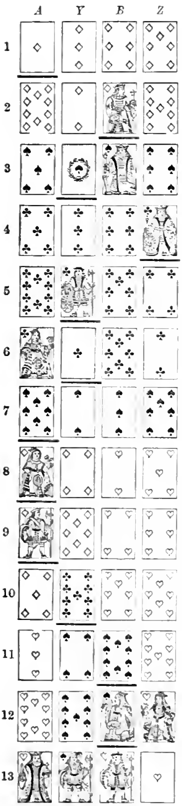
Z.
Clubs—K, 4, 2.
Diamonds—9, 7.
Spades—7, 6.
Hearts—A, Qn, 9, 8, 6, 5.

	B	
		Dealer.
Y		Z
	Trump Card, Club King.	
	A	

Score:—
A, B,—4.
Y, Z,—3.

THE PLAY.

Note.—The card underlined wins the trick, and card below leads next round.



REMARKS AND INFERENCES.

1. *A* leads correctly from suit, headed by Ace, Queen, Knave, &c., see leads. *Y* begins to signal, having four trumps, two honours, and a good suit, his partner also having turned up the King. *A* alone knows, so far, that *Y* is signalling for trumps.

2. *A* shows that he has led from Ace, Queen, Knave, ten, and at least one small one. *Y* completes the signal. *Y* knows that neither *B* nor *Z* has any more Diamonds. *A* and *B* know that *Z* has no more.

3. *B* knows that *Y* holds Two and Four of Spades. *Y* knows that *B* holds the Queen and at least two others, unless, which is unlikely, *B* has led from a three card suit.

4. *Y* knows that *Z* holds Two of Clubs.

5. *Z* returns the highest of two Clubs left, and *Y*, knowing that Two is with *Z*, at once places the remaining four Clubs with *A* and *B*. It is more probable that they are equally than unequally divided, and as *A* plays the ten, the chances are in favour of the Queen being with *A*. But at any rate, the finesse of Knave would be correct.

6. *Y* is now, of course, sure of drawing two trumps, remaining with the long trump.

7. *Y*'s purpose, of course, is to draw *B*'s Queen of Spades, remaining with the tenace in that suit, and entire command, should *B* keep to his suit. But *B* sees that whether he finesses the Ten (successfully) or takes the trick with the Queen, *Y* and *Z* must win, if besides the Two and Four of Spades already placed in his hand *Y* holds Knave and another. For *Y* has two Diamonds left, and if he held originally five Spades, can have no Hearts. So that if *B* takes two tricks in Spades, *Y* will make two tricks in that suit, whatever *B* may lead, besides his long trump. Or, at the score, *Y Z* would win two by trumps. Therefore, *B* plays for the only chance left, viz., that *A* may lie over *Z* in Spades, and bring in his Diamonds. This comes off, and

8, 9, and 10. *A* makes two tricks in Diamonds, and forcing *Y* with the thirteenth, compels him

11. To lead through *B*'s tenace.

A B win the odd trick and the game, tricks counting before honours. *Y* should at trick 7 have played the long trump, trusting to *Z* being strong in Hearts. For *Y Z* want only two tricks to win besides this certain trick. Now after taking trick 7 with the long trump, *Y* leading a Diamond would put the lead with *A*, who would make the 8th, 9th, and 10th tricks in Diamonds. Then if *A* leads a Spade, *B* would most probably put his Queen on it, winning trick 11, and play Spade in turn, when *Y* would win the last two tricks in Spades. If *A* led a Heart, he would be leading up to *Z*'s presumably best suit, and there would be a good chance of the two tricks for *Y Z* in Hearts. As the cards actually lie, either course on *A*'s part (of course the latter would be bad play) would have given *Y Z* the game, unless *B* finessed the Spade 10, which he might very well avoid as dangerous.

Our Chess Column.

By Mephisto.

THE VIENNA INTERNATIONAL TOURNAMENT.

THANKS to the willing consideration of our printer, we were enabled to give the result of Wednesday's play in part of our edition of Thursday last; according to which Steinitz and Winawer stood at 24 each, Mason at 23, Zukertort and Mackenzie at 22½, and Blackburn 21½. Winawer had a game standing adjourned from Monday, which he finished on Thursday (against Weiss); the game extended to 135 moves, the result being a draw, as anticipated. Winawer and Steinitz having tied for first place, had to play two games (we think three would have been a better number) to decide between them. The first game of this short match, which was a championship match in the fullest sense of the word, came off on Friday. The game is of the most remarkable character, and will be a memorial in the annals of chess games. Instead of, as everybody expected, a hard fight, the two champions engaged in a game of the most dashing description, with the result that Steinitz, who got a bad game in the opening lost in twenty-seven moves, exactly the same number as in his second game to Blackburne, which was likewise lost in the opening. We have much pleasure in giving the game below. In the second game on Friday Winawer had the move, which somewhat deprived Steinitz of a chance for experimenting in the opening. White opened with a Four Knights game, and systematically aimed at a draw, as that would secure him (½) the first prize. Steinitz fairly got into the middle of the game, and then he showed himself in his unsurpassed strength. By fine play he gradually enshrouded his opponent, or, to use his own favourite expression, "he accumulated small advantages," and, having succeeded in isolating Winawer's Queen's Pawns, he forced a passed Pawn to Queen on that wing, and won. The result of the two having won a game each was that the first and second prize (£240 and £100) were equally divided between them. The third prize (£48) fell to James Mason, of New York; the fourth and fifth prizes were divided (by mutual consent) between J. H. Zukertort, of London, and Mackenzie, of St. Louis, U.S.A.; while the sixth prize fell to Blackburne, of London. Although only sixth, Blackburne's position is really a very honourable one, as out of the large number of thirty-four games played, he was only two-and-a-half games behind Steinitz or Winawer; while at Berlin, where Blackburne won the first prize, the second man, Zukertort, was three games behind the first.

The following is the first game which was played in the tie for the Championship and First Prize at the Vienna Tournament between Herren W. Steinitz and S. Winawer, on Friday, June 23, 1882.

French Defence.

White. Steinitz.	Black. Winawer.
1. P to K4	1. P to K3
2. P to K5 (*a*)	2. P to KB3 (*b*)
3. P to Q4	3. P to QB4
4. P takes QBP	4. B takes P
5. Kt to QB3	5. Q to B2 (*c*)
6. B to B4 (*d*)	6. Q to Kt3 (*e*)
7. Q to Q2	7. B takes P (ch)
8. Q takes B	8. Q takes P
9. K to Q2 (*f*)	9. Q takes R
10. Kt to Kt5	10. Kt to R3
11. Kt to Q6 (ch)	11. K to Bsq
12. B takes Kt	12. P takes B
13. Q to QB5	13. Kt to K2
14. Kt to K2 (*g*)	14. Q takes R
15. P takes P	15. P takes P
16. B to R6 (ch) (*h*)	16. K to Ktsq
17. Q to Q4 (*i*)	17. Q takes RP
18. B to B4	18. Q to R4
19. Q takes BP	19. Kt to Q4
20. Q to Q8 (ch)	20. K to Kt2
21. Q to QR5	21. Kt takes B
22. Q to B3 (ch)	22. P to K4
23. Kt takes Kt	23. Q to Kt4
24. P to Kt3	24. R to Bsq
25. Kt to K4	25. Q to K2
26. Kt to Q5	26. Q to K3
27. Kt to B7	27. Q to R3 (ch)
resigns	

NOTES.

(*a*) This is one of the many experiments in the openings which Steinitz has made during the progress of this tourney, some of which resulted disastrously for him, his first game with Zukertort f[illegible] a most ludicrous example. Steinitz adopted this move against Flessig with some success, as can be seen from the game published in a former number.

[illegible] This seems a pert reply, for in case White should take the Pawn, then Black retakes with the Knight, having thereby won a [illegible], or if White support this exposed Pawn, then Black could [illegible] proceed to develope his game by attack on the advanced [illegible].

[illegible] A good move, having for its object the attack on the lonely [illegible] and also B to Kt5.

[illegible] This was either an oversight or an unsound combination.

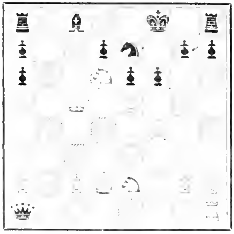
[illegible] If [illegible] P takes P, then Q to R5 (ch) would give White the [illegible]. On the other hand, by playing Q to Kt3, Black [illegible] a winning advantage at once, on account of the attack on White's QKtP and KBP.

[illegible] He elects to give up the Rook rather than the Knight, as [illegible] obtains some considerable attack, but this is very adventurous play.

[illegible] Playing after Morphy's fashion, he gives up the second Rook [illegible] to be better able to attack, as the threatened check with [illegible] Black Queen on Q5 somewhat hampers White's movements; [illegible] it is altogether an extraordinary style of play, where issues of [illegible] highest importance are at stake. The position, however, is [illegible] with ingenious combinations. We give a diagram.

Position after White's 11th Move.

Winawer.
BLACK.



WHITE.
Steinitz

[illegible] This move cost White £70 and the First Prize. He could [illegible] a draw by the following play:—

Q to KR5	Kt to Kt3 (forced)
Q to R6 (ch)	K to Kt sq
Kt to K8	K to B2
Kt to Q6 (ch) and draws, for if	
	K to K2
Q to Kt7 (ch)	K to Q sq
Kt to B7 (ch) and perpetual check.	

[illegible] Steinitz saw the draw, he ought to have gladly [illegible], considering he is minus two Rooks, his [illegible] and judgment. The proper reply; [illegible], for if Q takes KtP, then Q takes BP, [illegible] on B7 or B8, whereas now White cannot [illegible] can reply with Q takes Kt (ch), followed by [illegible] B4.

[illegible] B5 [illegible] a very promising move. Black's only reply [illegible] Kt to Kt3, [illegible] play might have resulted. White might also have tried Q to QR5, in which case Black would [illegible] compelled to play B to Kt2, giving up the Bishop, or [illegible] Q to KR5, in which case Kt to Kt3 is forced, then [illegible] Kt to B4 or Q to B3 would have given more chance to White [illegible] obtained in the actual game.

ANSWERS TO CORRESPONDENTS.

, *Please address Chess-Editor.*

C[illegible] of Problem 45 received from John O'Keeffe, [illegible] Belmont, Charles Hartley, A. B. Palmer, John Watson, C. W. Croskey, H. A. N., Berrow, Witton-le-Wear, Herbert Jacobs, Leonard P. Rees.

Berrow.—You are quite right. B to B4 would have been a better move.

Herbert Jacobs.—Problem received, with thanks.

Leonard P. Rees.—Problem received, with thanks. You are right, the pawn on B3 is rather suggestive, but we have put it there ourselves. Perhaps in your next you will tell us why.

Comet.—Correct solution of No. 42 already published.

COST OF THE ELECTRIC LIGHT.—In a letter to the *Times*, Mr. Crookes, F.R.S., has given the result of several months' experience with electric lighting in his own house by means of gas-engine and incandescent lamps. Omitting the interest on capital expenditure, which would not obtain to anything like the same amount by lighting from a central station, especially when reduced cost in keeping ceilings and curtains clean and maintaining gilding and book-bindings is taken as against it, he finds the actual cost to him to be £2. 19s. per month. Gas lighting to the same extent, he says, would cost £3. 6s. 6d. He has in his house altogether about fifty lamps of different powers.

ANTHROPOLOGICAL INSTITUTE. — June 13, General Pitt-Rivers, F.R.S., President, in the chair. Mr. Mann S. Valentine, of Richmond, Virginia, exhibited a series of figures carved in steatite and mica schist, forming part of a large collection found by him in Virginia and North Carolina. The whole collection consists of some 2,000 specimens, consisting of various animals and household utensils, cups, &c. The human beings are all clothed, and are represented riding on animals and sitting on chairs, and indicating a remarkably advanced state of civilisation; and in some instances obvious traces of contact with Europeans. Mr. A. H. Keane described the district in which the objects had been found, and the tribes that were known to have inhabited that country. The following papers were read:—"Nepotism in Travancore," by the Rev. S. Matur; "The Laws of Madagascar," by Dr. G. W. Parker; and "Cummer, Co. Wexford," by G. H. Kinahan, Esq.

Contents of KNOWLEDGE *No.* 34.

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LONDON: FRIDAY, JULY 7, 1882.

CONTENTS OF No. 36.

ANTIQUITY OF MAN IN WESTERN EUROPE.

BY EDWARD CLODD.

PART IV.

KENT'S HOLE, or Cavern, lies in a hill in the vale of Ilsham, about a mile eastward of Torquay harbour, and half-a-mile from the coast. It comprises, as the openings in the face of the cliff indicate, two caverns which run parallel with each other, widening here and there into chambers to the extreme limit, when a passage connects them. An inscription in one of the chambers, known as the "Cave of Inscriptions," shows that some curious traveller had wandered into its recesses nearly 200 years ago, and it was partially surveyed in 1825 and following years; but it is to the systematic research and unceasing superintendence of Mr. Pengelly since 1865 that we owe that full knowledge of its contents from which irrefragable conclusions concerning the high antiquity of man in this quarter of the globe are drawn.

Entering the eastern division, to which the labours of Mr. Pengelly and his committee have been restricted, we find the deposits to occur in the following order, beginning with the uppermost:—

NEOLITHIC.—1. Blocks of limestone, weighing from a few pounds to upwards of 100 tons, which have fallen from the roof under the action of frost, &c., and of which many are cemented together by carbonate of lime, *i.e.*, stalagmite. 2. Black muddy mould, from three inches to as many feet in thickness; composed almost entirely of decayed vegetable matter.

PALÆOLITHIC.—3. Granular stalagmite, varying in thickness from a few inches to five feet. 4. Layer of charred wood, about four inches in depth, but occurring in one part of the cavern only, near the entrance. This is known as the Black Band. 5. Light-red loam, called the Cave-earth, the actual depth of which, throughout, is unascertained, as the examinations have been limited mainly to a depth of four feet beneath the stalagmite. 6. Crystalline stalagmite, from three to twelve feet thick. 7. Dark-red sandy deposit quite free from limestone, in which quartz pebbles and fragments of grit are imbedded. This is called *breccia*.

In conveniently classifying these deposits by the animal remains found in them, Mr. Pengelly calls the two uppermost (which are included in Neolithic times) the *Ovine* period, because the sheep is never found below them, all the bones being those of animals still extant. The three deposits immediately below these, numbered 3, 4, and 5 in the above list, he calls the *Hyænine* period, because the bones of that animal predominate. The two lowest deposits he calls the *Ursine* period, because bones only of the cave bear are found in them. Passing through the black mould, the varying contents of which lie within the province of the antiquary, we reach the uppermost layer of the Hyænine period, the bed of granular stalagmite. Mingled with the remains of various animals, more or less extinct, as the mammoth, cave-bear, cave-hyæna, etc., with shells of cockles and cuttle-fish, with charred wood and rounded pebbles; we find herein flint-flakes, implements, and cores, or flint nodules from which flakes have been struck; and, at a depth of twenty inches, a portion of a human upper jaw, containing four teeth, together with a fifth tooth lying near it.

The black band, the site where the cave-men kindled their fires for cooking, or perchance for warmth and for scaring wild animals, contained about three hundred and fifty flint flakes and cores, an abundance of charred wood, a bone awl, bone harpoon, and needle with a well-formed eye (in the Dordogne caves the stone implements were found with which the eyes were drilled in the needles), and the remains of rhinoceros, cave hyæna, horse, ox, bear, &c.

The cave-earth was richest of all in the number of stone implements, and the abundance of teeth and bones. The flint implements were of a markedly higher type than those of the Drift, and, in their variety, suggestive of caveman's fertility of resource, as compared with his predecessors, for the list includes well-worn stone hammers and whetstones, a bone pin, and barbed harpoons. The crystalline stalagmite contained bones of the cave-bear only, but in the breccia, there were found, mingled with remains of that animal, implements of flint and chert, "much more rudely formed, more massive and less symmetrical in form than those obtained from the cave-earth and black band," and made, Mr. Pengelly adds, "by operating, not on flakes, but directly on nodules, of which portions of the original surface generally remain."

Before making brief reference to contents special to the bone-caverns of the Continent, it should be asked how the above bears out what was said in the first paper of this series concerning the enormous duration and remoteness of the ancient Stone Age. Of its remoteness we find sufficing evidence in the deepening of the valley to the extent of between 60 and 70 ft. since man and his congeners had refuge in Kent's Hole, while the period demanded for this scooping out is itself limited when compared with the time required for the successive deposits in the cavern, and for the intermittent interruptions which they suffered by the streams of running water which, as the layers of loam and sand, with their enclosed pebbles, show, now and again entered the cave, disturbing the older deposits.

At first sight it may appear that an easy method of getting rough measure of the time involved in the deposition of stalagmite is at hand in watching the rate at which it goes on now. But no such criterion serves us, because the rate at which stalagmite accumulates varies extremely, being determined by states of climate, by air currents, by the quantity and quality of the water, by the greater or lesser porosity of the rock in course of dissolution, and other causes, marked variations of rate occurring even in the same cave. "In the Ingleborough cave, in Yorkshire, it has been so swift that between 1845 and 1873 a stalagmitic boss, known as the Jockey Cap, has grown at the rate of ·2941 inch per annum;" but such a rate is exceptional, as otherwise our caves would speedily have been filled up with such accretions.

That inscription (one among others) in Kent's Hole, to which reference is made above, does, however, help us somewhat in the matter. On a large boss of stalagmite, which rises from the floor, and which has been subject to the continuous drip of lime-charged water from the roof, this inscription is yet clearly to be read: "Robert Hedges, of Ireland, Feb 20, 1688." Evidence of its genuineness is at hand in the description of it left on record by the Rev. J. MacEnery, who explored the cavern in 1825. He says that "the letters are glazed over, and partly effaced," showing that they had not been recently cut. That description applies accurately to them now, after the lapse of sixty years. Now, the film of stalagmite over these is about one-twentieth of an inch in thickness, and the like applies to still older inscriptions, in another chamber, round the "Crypt of Dates," the genuineness of which inscriptions there is no reason to doubt.

If we take as our standard of reckoning the rate at which the stalagmite has accumulated on the Hedges boss and apply it to the bed around it, which is in places five feet thick, we get a result as startling as it is probably excessive, because we have assumed uniform climatal conditions throughout. True, in his notice of the last edition of Lyall's "Antiquity of Man," Mr. Alfred Wallace, an authority not given to over-estimate, remarks that the sum of half-a-million represents the years that have probably elapsed since flints of human workmanship were buried in the lowest deposits of Kent's Cavern,"* and after allowing a far more rapid rate for the formation of both the crystalline and granular stalagmites (to say nothing of intercalated deposits) than the evidence warrants, the estimate which demands the lapse of tens of thousands of years since the entombment of rude flakes in the breccia cannot be gainsaid. Some words of Mr. Prestwich, in a paper read before the Royal Society, and which Mr. Pengelly has already happily quoted, may be repeated here. He says that, "just as though ignorant of the precise height and size of a mountain range seen in the distance, we need not wait for trigonometrical measurement to feel satisfied in our minds of the magnitude of the distant peaks, so with this geological epoch; we see and know enough of it to feel how distant it is from our time, and yet we are not in a position at present to solve with accuracy the curious and interesting problem of its precise age."

* *Nature*, Oct. 2, 1873.

HOW TO GET STRONG.

III.—THE CHEST (*continued*).

A CORRESPONDENT asks how the calf-skin bag (or dumb-boxer) should be made, and how large it should be. There is no rigid rule as to size, or material, or make. A disused hair pillow, doubled and tied up, will serve very well. But, if you take nine or ten spindle-shaped pieces of calf skin about 5 in. broad and from 18 in. to 2 ft. long, and sew together, they will form a bag which, filled with sawdust or stuffed with hair, will be somewhat handier for boxing at.

The exercises for expanding the chest hitherto considered (running, boxing, and inhaling to the full extent of the lungs) produce their effect chiefly in an indirect manner, so far as the expansion of the chest is itself concerned, though in a very direct manner as regards the act of breathing: the chest is made to expand because the lungs are expanded, either by the deep and quickened breathing resulting from rapid movement, or by the actual drawing in of air in large quantity. We have now to consider exercises which act directly to expand the chest, and thus help the breathing apparatus indirectly, by giving it room for freer action. For this purpose all exercises are good which carry the arms well over the head, all those which carry the arms out horizontally backwards, and all those which bring the elbows close into the side *with a backward motion of the shoulders and upper arms*. These last words must be specially noticed. Rowing, a capital exercise for many purposes, is *not*, as is commonly thought, a good exercise for the chest; for though at the finish of the stroke the elbows are drawn close in to the sides and carried backwards as far as possible, the shoulders and upper arms are kept rather forward and drawn rather towards each other, on account of the position of the hands on the oar, and also because in hard rowing no strength can be spared for a useless backward swing of the shoulders. In steady rowing for pleasure, the hands may be set a little further apart, and the shoulders thrown well back at each stroke with great advantage, so far as the health value of the exercise is concerned. Rowing in this way is delightful, though not at all suited for racing.

Beginning with chest expansion by exercises taking the arms over the head—the best exercises of all for increasing chest-capacity—we note that there are scarcely any but artificial exercises nowadays for this purpose, that is, there are scarcely any exercises which thus work the arms, as rowing, boxing, fencing, &c., work them in other ways, or as walking and running work the legs. Climbing ropes is a rather severe form of this sort of exercise, not readily to be practised by most persons, and too severe for men past or nearing middle life, when the body is generally too heavy. The strain on the deltoid muscles tells heavily before much good has been done in the way of chest expansion. There is the same defect in hanging exercises on the parallel bars, or on the trapeze. These are for athletes, and even with them, more for the strengthening of the deltoid and other special muscles than for the expansion of the chest.

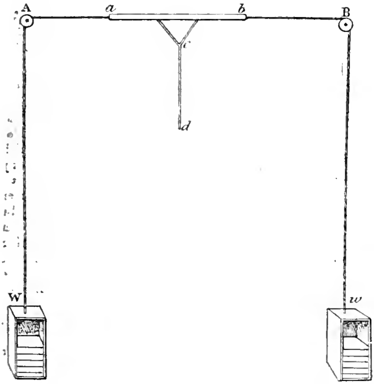
Rather oddly, we receive just here, through the Editor, a note from Sir Edmund Beckett, running as follows:—

> I do not know whether the writer on "How to get Strong" will care to hear that I know no exercise which tends so much to expand the chest as bell-ringing, being performed standing quite upright. I used to ring the heaviest bell in peals, at Cambridge and elsewhere, when I was young, and the nine o'clock at St. Mary's nearly every night, and I used always to feel that result. E. B.

Bell-ringing would be just the sort of exercise wanted to open the chest: for here, the hands being close together (instead of acting, as in rowing, to contract the chest) acts—at the most effective moment—to expand it. The construction we were about to describe for arm-above-head exercise to expand the chest, can very readily be used to give an effect akin to that obtained in bell-ringing—which is fortunate, because only a limited portion of the community can ring bells. (For 1,000,000 able-bodied men in London to get each half-an-hour's bell-ringing—peals of eight—per day, it would be necessary that there should be constant pealing from 2,600 steeples!)

Let A, B (Fig. 1) be two pullies high up, on the same level, against one of the walls of a room, W and *w* two weight boxes (of course, mere weights will do) *a* AW, *b*B*w* stout cords passing over the pulley and connecting *a* and *b*, the two ends of a stout rod *ab* (a broom-handle will serve) to the weight boxes, W, *w*. The short cord, *cd*, is simply for drawing down the rod, *ab*, till the upstretched arms can reach it.

Now let the rod *ab* be grasped overhead, the arms being vertical, and therefore the hands separated by the breadth of the chest. It is best to stand with the back to the wall. Draw *ab* steadily down, till the hands and arms are in about the position they have just before the feather in rowing; let the bar go steadily up again, to your full reach. Continue this exercise about five minutes, being careful to let the arms be drawn up to their full reach above the head each time. The weights at *W* and *w* may at first only be some 10 lb. each (so that the heavier dumb-bells tied at *W* and *w* will serve very well), but can be gradually increased as the arms gain strength: though this



is not, be it noticed, the object of the exercise. For mere muscular work they might be increased until each amounted to nearly half the weight of the body; but this would not do for work in chest expansion. In this exercise draw in the breath fully as the bar rises, hold it till you cannot comfortably hold it much longer, then begin to draw down the bar *ab* slowly, breathing out slowly as you do so, and after you have drawn the bar to its lowest position—just opposite the lowest part of the breastbone—breathe out the last particle of air you can get rid of without drawing your shoulders forward. In this way you will get most benefit from each pull, so far as chest expansion is concerned. But if you want more active muscular work, expand your chest fully when the bar is at its highest, and then pull it down and let it up steadily as often as you can without letting out your breath, which you can finally do in drawing the bar down, taking in a full breath as it rises again. Or you may take several pulls after exspiring before taking in another full breath. Only note that you ought always to let inspiration be completed when the bar is at its highest, exspiration being completed when the bar is at its lowest.

Now take advantage of Sir Edmund Beckett's useful hint. Lay hold of the cord, *cd*, near *c*, at your utmost upward reach, and pull downwards, as if ringing a heavy bell. You can continue the downward pull till the hands, close together on the rope, reach about to the abdomen. Repeat these pulls, breathing in any one of the ways described in the last paragraph, for from five to ten minutes. You will find (we have tried it, and know*) not only advantage to your health, but absolute physical pleasure in this exercise. We have never taken part in bell-ringing, but we can now very well understand how this exercise, combined with the pleasant noise of well-matched bells, should have been regarded by the Puritans as a sinful recreation — somewhat only on the principle which led some one to say that the only thing wanting to make strawberry-eating perfect was that it should be forbidden. We never before thoroughly understood that passage in Bunyan's life, in which we are told that, "having been mightily addicted to ringing, he was very unwilling, for all his reformation, to leave it; but his conscience beginning to be tender, he thought the practice thereof to be but vain, and so forced himself to leave it, *yet could not keep his mind from hankering after it.* But then he was surprised with fears that possibly one of the bells might fall and kill him, so that he durst no longer go into the steeple, but would stand at the door; and even then he was afraid lest the steeple itself should fall upon him." Yet, says the worthy chronicler, "this was only lopping off the branches of sin while the root of unregeneracy remained."

(To be continued.)

* The reader will excuse us for not saying, as usual, *Crede experto.*

PHOTOGRAPHIC SPECTRUM OF COMET (WELLS.)*

By DOCTOR W. HUGGINS, F.R.S.

ON May 31 I obtained a photograph of the spectrum of this comet, with an exposure of one hour and a quarter. On the same plate I took a spectrum of α Ursæ Majoris for comparison. The comet's spectrum on the plate consists of a strong continuous spectrum extending from about F to a little beyond H. I am not able to distinguish any of the Fraunhofer lines in this continuous spectrum. The slit was rather more open than was the

case in photographing the spectrum of the comet of last year; this would make these lines less distinct, but the lines G and H are well seen in the star's spectrum taken under the same conditions. We may therefore conclude that the part of the comet's original light which gives a continuous spectrum is much stronger relatively to the reflected solar light in this comet, than was the case in the comet of last year, and for this reason the Fraunhofer lines are not distinguishable.

Observations of the visible spectrum had already shown that the comet differs remarkably from the hydro-carbon type common to all the comets, some twenty, which have appeared since spectrum analysis has been applied to these bodies.

The photographic spectrum shows, as was to be expected, that this essential difference of spectrum exists also in the more refrangible region. The very strong ultra-violet group assigned to cyanogen is not to be seen on the plate, and the bright groups between G and *h*, and between *h* and H do not appear to be present.

* Substance of note read before the Royal Society, June 15, 1882.

The head of the comet was in sharp focus upon the slit, and the continuous spectrum with defined edges corresponds to the nucleus, which in this comet was very distinct. In this continuous spectrum at least five separate places of greater brightness are seen, which very probably represent groups of bright lines, though they are not sufficiently distinct in the photograph to admit of resolution. That this interpretation is correct, seems probable, from the circumstance that these groups, as shown in the diagram, project beyond the strong continuous spectrum on one side. This side corresponds to where the light of the coma, on the side of the nucleus next the sun, falls upon the slit. We learn, therefore, that the light of this part of the coma consists for the most part, in this part of the spectrum, of these groups, as here on the plate only an exceedingly faint continuous spectrum can be seen.

It is not possible to measure with any useful accuracy the beginnings and endings of the groups, as they are too faint at these points. Measures as accurate as the circumstances would permit have been taken of the brightest parts of the groups. The wave-lengths of these brightest parts are:

λ 4253
λ 4412
λ 4507
λ 4634
λ 4769

In the visible spectrum the bright lines of sodium appear to have been strong, and it may be that some of the light of some of the groups may be due to this substance.

Professor A. Herschel and Dr. von Konkoly showed long ago that the spectra of the periodic meteors are different for different swarms, and it does not seem surprising that we have now a comet, the matter of the nucleus of which under the sun's heat shows an essential chemical difference from the long series of hydrocarbon comets which have appeared since 1864.

Mr. Hind has kindly furnished me with the distance of this comet from the sun at the time the photograph was taken. The comet was then 12,380,000 miles distant from the sun, while the comet of last year was 69,420,000 miles distant when I obtained the photograph of its spectrum.

AIDS TO THE STUDY OF GEOLOGY.

By W. JEROME HARRISON, F.G.S.

AT the request of the Editor I have undertaken to contribute a series of geological papers to KNOWLEDGE. These papers will take the form of accounts of visits made to places of geological interest, especially to such as are well-known holiday resorts, and are easy of access. I shall also give an account of the geology of some of our great towns, showing what may be learnt by a study of the stones used in them for building, paving, &c., and what natural sections are exposed in their immediate neighbourhood.

In this preliminary paper I shall describe the apparatus, books, &c., which are required for use in the field or in the study, by those who desire to investigate the rocks.

APPARATUS FOR FIELD-WORK.—A good *map* is indispensable. The geologist should provide himself with both the plain map (Ordnance Department, Quarter Sheets, 1s. each) and the coloured map (Geological Survey, Quarter-Sheets, [illegible] each). The former will give him the hills, while the latter will show where the various beds of rock occupy the surface. Each quarter-sheet should be mounted on linen, so as to fold into six; it can then be conveniently carried in the pocket. Catalogues of the maps and other publications of these two Government Departments may be obtained from Stanford's, Charing-cross, and from these the particular maps required, according to the district to be examined, can be selected.

Another necessary article is a *hammer*: the head should weigh about one-and-a-quarter pounds, and have a square face, made of mild steel; the handle is best made of ash, and should be divided into inches, so as to serve as a measure. The shape and weight of the hammer will vary with the nature of the rocks on which it is to be used; for old tough rocks, like those of Wales, the head should be short and heavy; while for work among soft and easily splitting beds a lighter and longer hammer-head is desirable. The wedge-end of the hammer is best made at right-angles to the shaft. When rock specimens are desired, a light trimming-hammer should also be carried, to reduce the specimens into shape in the field. A *cold chisel* is a useful companion to the hammer; it enables fossils, crystals, &c., to be detached, without the risk which often attends their removal from the rock by means of blows from a hammer.

The hammer should be carried by means of a leather belt, provided with a slit through which the handle may be passed, and a leather flap to keep the hammer-head from soiling or chafing the clothes. To the belt a small leather case, containing a *compass*, may also be attached. A geologist cannot keep to the roads, and must have the means, not only of steering his own path, but also of ascertaining the direction in which the rocks run, or their *strike*, as it is called; and for each of these purposes a compass is necessary.

It is a rare thing in this country to see a bed of rock lie horizontally for any great distance; any railway cutting or quarry will usually show the strata slanting or *dipping* in some direction or other; the direction may be ascertained by the compass, but to measure the degree, or *angle of dip*, we use an instrument termed a *clinometer*. By hanging a little pendulum to the central point, marking degrees on the circle, and adding a short, flat base, we can make the compass serve also as a dip-measurer, or clinometer. This form of instrument, complete in leather case, is usually sold at one guinea; but a much cheaper clinometer can be made by drawing a graduated semicircle on a thin, flat, oblong piece of boxwood, and pivoting a brass pendulum at the centre of the arc.

The *Wallet*, or *Bag*, must not be forgotten, for an enthusiastic geologist seldom fails to meet with many specimens, in the course of a day's outing, which he will desire to take home for further examination, or to add to his collection; a leather game bag answers capitally when at work among the igneous or slaty rocks, whose weight and sharp angles rapidly cut through anything less tough than leather. The satchels made of a stout brown material which are much used to carry school-books in, also make capital collecting-bags. A good supply of brown paper should be provided, so that each specimen may be wrapped up separately, while, if fragile shells or delicate crystals are likely to be obtained, some chip boxes and cotton wool must also be taken. To identify specimens it is best to carry gummed strips of numbers; these should be detached, one by one, and affixed to each rock or fossil at the time it is obtained, an entry being made at the same time in a note-book of the locality and exact position whence the specimen was derived, with any other particulars of interest.

Many geologists always carry a little dilute *hydrochloric acid*, in a small stout bottle, in order to be able to identify any *limestone* they may meet with; the effervescence which results when a drop of this acid is placed on any rock is a sure sign that it contains a large proportion of carbonate of lime. Lastly, a *pocket magnifier*, provided with two lenses, will be needed to examine finely-grained rocks, or to scan their surface for minute fossils.

Let no one, however, think that all the above articles are indispensable to good geological work: the fact is that while they are all *useful*, they are none of them absolutely *necessary*. I have known a working-man, armed with nothing better than a coal-pick, to acquire a knowledge of the rocky structure of the district in which he lived, which has enabled him to lend valuable assistance to the Government surveyor.

APPARATUS FOR HOME-WORK.—A good *microscope* is much to be desired, and I can recommend the instrument specially designed for geological work by Mr. Swift. It is now very much the fashion to make thin *sections of rocks*, especially the igneous rocks, so as to determine, microscopically, the minerals of which they are composed: an excellent machine has been invented for this purpose by Mr. Jordan; but this costs from £8 to £10. By cementing chips of rocks to strips of glass, it is possible to rub them down by hand—first on an iron plate with emery and water, and afterwards on a water-of-ayr stone with water only, until they acquire the necessary thinness and transparency; the process is a tedious one, but a Lancashire working-man has in this way made hundreds of beautiful sections of the fossil plants of the coal-measures. A *cabinet* to keep specimens in may often be picked up second-hand; the drawers should measure about 20 in. by 15 in., and should vary in depth from 1½ in. to 4 in.

BOOKS.—The best general text-book for beginners is Lyell's "Student's Elements of Geology" (Murray); to this we may add Rutley's "Mineralogy" (Murby), and "Study of Rocks" (Longmans).

NAMING OF SPECIMENS.—Book knowledge alone is of little real value to the geologist. He must learn to recognise (1) minerals, (2) rocks, (3) fossils. To do this it is absolutely necessary to carefully examine correctly-named specimens. The dweller in London must visit the geological museum in Jermyn-street and the new Natural History Museum at South Kensington for this purpose. Named collections, or single specimens, are sold by many dealers, among whom I have long known Mr. Gregory (Charlotte-street, Fitzroy-square) to be thoroughly reliable and trustworthy. By far the best work on the study of fossils is Professor Nicholson's "Palæontology" (Blackwood), but no one must expect to make much progress in the study of fossil shells—or, indeed, any extinct forms—unless they first study, to some extent, the living species.

In my recently-published book on "The Geology of the Counties of England" (Kelly & Co.), I have given lists of the more important books and papers on general geology; and have also prefixed lists of local papers, maps, and books to the articles on each county.

There are two great libraries of geological books in this country, and of each of them a catalogue has recently been published. The library of the Jermyn-street Museum includes about 28,000 volumes. To consult the books, permission must be obtained from the curator, Mr. F. W. Rudler, to whose kindness and courtesy I, like many other workers in geology, can bear willing testimony.

The library of the Geological Society of London is lodged in Burlington House; it may be inspected by obtaining an introduction from a Fellow. Provincial libraries are, almost without exception, extremely deficient in geological works. Even the volumes of the Palæontographical Society, in which all the British fossils are being figured and described, are hardly to be met with on the shelves of one public library out of ten! Of the "Transactions" and other publications of the local scientific societies of Great Britain, I do not believe there is a complete set in any library whatsoever.

But, besides the study of specimens at home, there is much geology which can only be learnt by looking at the rocks on a grand scale in the field. It was said of Murchison that "he had a fine eye for a country," and it is the acquisition of this power of reading the surface features of any landscape that we should strive to obtain. No district can be uninteresting, or can fail to furnish useful employment to a true geologist. The pleasure of understanding the causes which have produced our English scenery doubles the delight arising from its contemplation, and when, after viewing the rocks from a distance, we interrogate them closely in the quarry or on the hillside, we shall learn from them the history of the past, told without possibility of error, and with a fulness according to our powers of interpretation.

ENGLISH SEASIDE HEALTH-RESORTS.

BY ALFRED HAVILAND, M.R.C.S., F.R.M.C.S. Lond.

CLASSIFICATION (*Continued from p. 73*).

BEFORE leaving the subject of the effect of latitude on the climate of the sea-coast, it will be well to refer to an opinion entertained by many against the more northerly health-resorts. It is supposed that because they are so many miles north of London and other large towns, that they necessarily must be cold, exposed, and unfitted for some cases—for instance, the consumptive. A more erroneous notion could not be conceived; moreover, it is one that operates prejudicially in two ways: it prevents many from deriving benefit from their pure and bracing climates, and acquiring that physical and mental tone so conducive to the prevention of the development of their latent disease: whilst it misleads them to the more Southern resorts, the mild, balmy atmosphere of which is often a short salvation to those whose disease is developed, but impotent to give the necessary vigour to the young, who hope to conquer their disease, and eventually live anywhere. That the Northern part of the English coast, and especially on the north-eastern side, has a climate in which consumption (Lat. *Phthisis*) does not thrive, may be shown by the low mortality from this cause, which characterises this part of the country, and forms so remarkable a group in the map whereon the geographical distribution of this disease is portrayed.

If we look at a map of England, we shall see that its triangular form favours, in a striking manner, the preservation of the insular character of its climate, for it tapers from its southern base, or from the fifty third to the fifty-fifth degree of north latitude, and thus enables the seas on its western and eastern coasts to approach each other, and to increase the insularity of this area almost in the direct ratio of its receding from the south. If we enclose England within an area, the limits of which are defined by the longitudes 5° 45′ W. and 1° 46′ E. (those of the Land's End and Lowestoft), and the latitudes 50° and 56° N., and divide it into six interlatitudinal zones or belts, we shall be able to judge, accurately enough for our purpose, as to the relative proportion of land to sea that obtains within each zone.

Such an area, if the width at the northern boundary be made equal to the southern, instead of following the meridians (which grow closer to each other as they approach the north) would represent about 137,144 square English miles; each zone would therefore contain about 22,907 square English miles. The distances between the parallels of latitude are longer than at the equator. The average, however, of 69½ English miles has been taken, and this would give in round numbers 23,000 square English miles to each zone. We shall now be able to estimate the proportion of land and water within each zonal area.

Interlatitudinal Zones.			Number of English Square Miles of			Percentage of	
			Land.	Sea.	Zone.	Land.	Sea.
I.	56	55 N.	8,750*	14,250	23,000	38·0	62·0
II.	55	54°	7,100†	15,900	23,000	30·8	69·2
III.	54	53°	9,450	13,550	23,000	41·0	59·0
IV.	53	52°	18,500	4,500	23,000	80·4	19·6
V.	52	51	15,600	7,400	23,000	67·8	32·2
VI.	51	50°	6,550	16,450	23,000	28·9	71·1
			65,950	72,050	138,000	47·7	52·3

* Scotland 6,900 and England 1,850 s.m. † Scotland 750 and England 6,350 s.m.

The above figures will demonstrate the remarkable difference that exists between the several zones into which the area has been divided. The percentage columns show that the whole area has more sea than land; that between the IV. and V. zones there is to be found the greatest amount of land; that the most southern (VI.), and one of the most northern (II.) have the most perfect insular character, and that the four central zones differ widely; for instance, the two northern zones II. and III. have an immediate sea area of 29,450 square miles, whilst the two below them, IV. and V., have only an immediate sea area of 11,900 square miles. This large additional amount of sea surface, close to the north-eastern and north-western coasts, which, between these parallels, are nearer to each other than at any part of the east and west coast lines, has a powerful influence not only on the climate of the coast, but on that of the interior; this influence is more evident during the periods of extreme heat and cold, as in January and July, when the weak most require it. In the winter, when the Gulf Stream tempers our climate, these, as it were, extra 17,550 square miles of sea, bring closer home its warmth, and in this way reduce the daily range of temperature. In the summer, the small area of land lying between the two seas has its sun heat cooled by them, so that an insular climate becomes as perfect in the north as it is found to be in the south.

Many of the above facts, now that they have been given in detail, may be rendered still more evident to the eye by means of chart diagrams, with one of which we hope to illustrate, next week, some of the points dwelt upon in former pages. The six zonal areas we have thus described will serve our purpose admirably for grouping together our Seaside Health Resorts; for each belt of land and sea has its characteristic climate factors, and each its physical peculiarities; each its distinctive surroundings; and we shall see how these operate in producing that variety in our climate which has rendered it so difficult a study.

We shall have, in the next place, to consider the position of the Seaside Health Resorts on the seaboard, and point out how their climates are affected by the Gulf Stream, the North Sea, and the Continent of Europe.

Electric Light in a Salt Mine.—The Witton Hall Salt Mine in Warrington road, Northwich, is now lighted up by Brush lamps in place of the candles generally used. There are sixteen large arc lamps employed.

FUTURE SOURCES OF OUR FOOD SUPPLY.

By Percy Russell.

AUSTRALASIA.

At a time when, as a nation, we are becoming increasingly dependent on foreign supplies for our "daily bread," and when there seems no prospect whatever of the home producer again meeting in any adequate degree the wants of the home consumer, it is surely equally profitable and interesting to inquire into the nature and extent of the resources beyond the seas which exist for the due provisioning of these over-peopled islands.

In truth, the national commissariat has important social and even political bearings which appear to be unduly slighted by many among us, while in its industrial and commercial aspects it is obviously of transcendant importance.

Most persons are aware, as a mere matter of general information, that we now draw a great portion of our bread stuffs from the United States, and it is known, too, that many items of dairy produce reach us from the same source, while France furnishes us with no inconsiderable part of the fruit and vegetables which might, in a great many cases, be grown by ourselves.

In effect the British islands are now, to a certain extent, regularly victualled from extraneous sources, and as the requirements of a people who are ever becoming more and more concentrated in towns and cities, constantly augment, the food importer is ever on the look out for new fields whence he may draw his enormous supplies, and thus, by introducing fresh factors into the commercial calculation, defeat the designs of those who look to monopoly for forcing up prices.

Enough has been written about the vast wheat-fields of America, and the great resources of Canada and the west of our North-American dominions, but I do not think that persons here not directly connected with our Australasian colonies have any adequate notion of their real capabilities for provisioning this country, or of the happy and mutually beneficial result that must ensue from a more complete interdependence of these islands and the great Austral continents.

I propose in this paper to give a rapid sketch of Australasia as a sufficient source in the future for all such food staples as we may need, and to show by facts and figures that in settling these remote regions of the southern hemisphere, we have unconsciously obtained a safeguard against the very possible and appalling peril of any combination that might be effected in the United States for the purpose of extorting ruinous rates on account of our evident inability to supply our own people with food.

On the one hand we have within the contracted area of these islands a population of something like 40,000,000 all told, cultivating about 3,000,000 acres for wheat, and owning, in round numbers, 10,000,000 head of cattle, 27,000,000 of sheep, and 3,000,000 of pigs, and having a trade valued at about £697,000,000. On the other hand we have an area, some 3,000,000 square miles, *i.e.*, twenty-six times the size of Great Britain, occupied by a population of less than 3,000,000, raising, on an average, nearly 40,000,000 bushels of wheat, possessing over 8,000,000 of cattle, 75,000,000 of sheep, and 1,000,000 of pigs, while the aggregate trade of this community—rich in corn and cattle up to scriptural standards—amounts to close on £100,000,000 per annum! If we carefully compare, then, the outcome in material well-being and in diffused general wealth, of the scanty Australasian communities with our own over-populated country, we cannot fail to be struck by the marvellous way in which, at the antipodes, production has outstripped population and given to progress a true cornucopia running over with an abundance of the good things of this life.

Clearly between two such communities reciprocity should exist in the fullest and most generous sense of the expression, and thanks to many happy causes, among which the great acceleration in steam navigation is one of the chief items, this reciprocity does exist in a large degree, and unless our statesmen, in dealing with these nature-favoured colonies, commit some extraordinary fiscal or political blunders, we may fully rely in the future on the readiness and ability of our Australian cousins to make good the shortcomings of our corn-fields, our stock-yards, our sheep-folds, and even of our orchards.

Let us examine in detail, then, the true character and extent of these Australasian resources in all their home-bearing aspects. Turning to the parent colony, New South Wales, we find that the total area includes 198,626,143 acres, or, in other words, it is about the size of England and France combined. It is within bounds to assert that everything produced in England can be grown in new South Wales, including—besides the familiar fruits of the temperate zone—oranges, lemons, figs, &c. During the latest year for which we have comprehensive statistics, 252,540 acres were under wheat, yielding nearly 4,000,000 of bushels, while over 50,000 tons of good potatoes were also raised, to say nothing of oats, barley, rye, sugar, and grapes, which last gave 584,000 gallons of excellent wine and 6,600 gallons of good brandy. This is, however, not all. There were, at the period in question, 706,498 acres under cultivation, and no less than 21,351,433 enclosed ready for agricultural operations, while some 6,000,000 acres lay outside ready to be brought within the productive pale.

The stock returns were no less remarkable. We find that there were on March 31, 1881, of horses 395,984; of horned cattle 2,580,040; of sheep 32,399,547; and of pigs 308,205. Such were the resources, roughly speaking, in bread, beef, and mutton of only a single member of the great Australasian group, and at the date in question the population, all told, was but 503,981 souls. The figures relative to the live stock resources are of great moment, for the requirements of Great Britain in the way of butcher's meat are computed to reach over 600,000 tons per annum, a quantity constantly increasing, be it observed It is generally admitted that in England the meat consumption per head is full 120 lb. per annum, and it is well known that we do not ourselves produce 80 lb. of this amount. The difference has, therefore, to be made good from alien sources. To fill up the deficiency requires full 20,000,000 of sheep, and here we find that a single colony—New South Wales—can very nearly accomplish this tremendous commissariat feat unaided, and still feed her own people. New South Wales, however, is by no means Australasia, as we shall presently perceive. Let us now turn to the most highly civilised and, to borrow an apt scientific phrase, differentiated of all the Australasian communities Victoria.

THE JABLOCHKOFF LIGHT.—The contract for illuminating the Avenue de l'Opéra with the Jablochkoff candles has been renewed by the municipality of Paris for three years. Power has been granted, in connection with this new contract, to introduce the light into the houses in the district.

WATER POWER AND THE ELECTRIC LIGHT.—It is rumoured that a wealthy company is making arrangements to buy the water power at Harper's Ferry, on the Upper Potomac river, with a view of lighting Washington city and Baltimore by the electric light.

Reviews.

SHAKESPEARE STUDIES.*

EVERY Englishman ought to study Shakespeare till, as far as in him lies, he knows him well. When certain passages not corresponding with our present ideas are omitted, the same may be said for every woman, and for the young folks, too. We want Shakespearean teachers for such study: so that the splendour of Shakespeare's gift to his people and to the world, to his age and to all time, may be rightly seen, while yet the spots on that splendid sun may be recognised also. But, thus far, most of our teachers—nearly all of this present day—are word-carpers, metre-measurers, comma-counters, allusion-hunters, and antiquarian note gatherers. They do good service in their own way, but it is not the kind of service which is chiefly wanted. It is interesting to know that the poet we have learned to love as Shakespeare spelt his own name Shakspere, and probably pronounced it Sháx-per; to learn that in "Love's Labour's Lost" the proportion of unstopt to end-stopt lines is 1 in 18·1432 ±, while in "The Winter's Tale" this proportion has sunk to 1 in 2·1214 ± ("Bless thee, Bottom!"), and to learn the numbers and percentages of light-endings, of weak-endings, of verse lines, and so forth ("God bless us, a thing of naught!"), and to classify the plays into Life-Plea Plays, Unfit-Nature or Under-Burden-Failing Plays, Ingratitude and Cursing Plays, and Plays of Reconciliation and Forgiveness.† But "when all is done," this is not studying Shakespeare, any more than measuring star places is studying astronomy, or counting the colours in a noble painting is studying art. Even the attempt to recognise from the style what Shakespeare really has or has not written, in works attributed to him, or what he has written when at his best or not so well, is of little real worth compared with the loving study of his grand creations. Loving, yet not unthoughtful. We would not see Shakespearean students accepting all that he has left us, as if it were beyond criticism. There is scarcely a play of his whose plot is without fault or blemish, and in many of the finest the borrowed story, which not only forms the groundwork of the plot, but is left to form the plot itself, is absurd, and sometimes even monstrous. Those who try, in their love for the poet, to defend or to praise what was no part of his work (though he was in fault for not rejecting it), in reality fail to understand him, and do his fame ill-service. Claudio's light hearted acceptance of Hero's cousin, Bertram's sudden resolve to love Helena "ever, ever dearly," the Duke's "Your evil quits you well" to Angelo (murderer in intent), Valentine's "All that was mine in Sylvia I give thee," and hundreds of such flaws, belonged as certainly to the original story as Cæsar's *Et tu Brute!* If we take them as Shakespeare's we mar his work. Nor can any thoughtful reader fail to see in his earlier writings the signs of weakness and bad taste, the weakness that of inexperience, the bad taste not his own, but that of his age and surroundings. It is only by separating these imperfections from his true and matured work that we can rightly and lovingly appreciate the greatest poet the world has known.

The edition before us is not injured by the petty talk of letter and line-counters, date hunters, and the like, for no

* "The Leopold Shakspere." Messrs. Cassell, Petter, & Galpin, London.

† If there is one thing more than another which could mark a man as thoroughly unable to recognise the true value of Shakespeare's gift to man, it is such an attempt to classify his many-sided plays.

one is obliged to touch their ill arranged note-heaps. We doubt if any one could read through what they tell us. Dipped into occasionally, such matter is often interesting enough, and always amusing. It is unfortunate that Professor Delius's arrangement of the plays in conjectural chronological order should have been followed,—the first part thus becomes mainly occupied with inferior or doubtful plays. Our ideal Shakespeare edition should not contain "Titus Andronicus," whether Shakespeare wrote all, any, or none, of this hideous play. Part I. of "Henry VI." follows, and in all three parts of "Henry VI." there is much which is entirely unworthy of Shakespeare, as we know him in his greater historic plays.* "The Two Gentlemen of Verona" comes next, an immense relief, and then the "Comedy of Errors," which Dr. Dowden, forgetting the "Taming of a Shrew," calls Shakespeare's only Farce. This play, whatever artistic faults may be found with it, is one of Shakespeare's brighest, the style of fun being something like Molière's. It is interesting, as seeming to bear undoubted reference to Shakespeare's own life. Twins (Hamnet and Judith) had been born to him three or four years before,† and twins abound in the Comedy: but that is not the point. Probably about the time when he wrote the "Comedy of Errors," he being then some 25 and his wife 33, the natural effects of his unwise marriage six or seven years before had begun to be felt rather painfully by him. He had learned the lesson which he taught a year or two later:—

> Let still the woman take
> An elder than herself: so wears she to him,
> So sways she level to her husband's heart.

Also, it is to be feared, this other lesson, that,

> However we do praise ourselves,
> Our fancies are more giddy and infirm,
> More longing, wavering, sooner lost and worn,
> Than women's are.

(At least, when the woman is much the elder.)

> Then let thy love be younger than thyself,
> Or thy affections cannot hold the bent.

It is no unfair assumption to suppose that in Adriana, Shakespeare pictured the erst fair Ann Hathaway: in Antipholus of Ephesus himself. (It would be sacrilege to think thus of any characters in his later and greater plays).

* It is rather singular that in "Titus Andronicus" and the First [illegible] "Henry VI.," both of which contain passages utterly atro[illegible] in style and treatment, insomuch that some question whether [Shak]espeare wrote a line of either, both contain lines so similar to [illegible] sonnets as to leave little doubt that they came [illegible] pen. Thus, compare "Titus Andronicus," act ii., [illegible]

> "She is a woman, therefore may be woo'd;
> She is a woman, therefore may be won."

[illegible] "Henry VI." Part I., act v., scene 3:—

> "She's beautiful, and therefore to be woo'd;
> She is a woman, therefore to be won."

[illegible] forty-first sonnet

> "Beauteous thou art, therefore to be assail'd;
> Gentle thou art and therefore to be won."

[illegible] trisyllable proverb familiar in Shake[speare's time] [illegible] been quoted or referred to, in all these [illegible]

† [illegible] born. Mr Furnivall's account of [illegible] rather exceptionally absurd. He is [illegible] Shakespeare as a [illegible] young stupid," [illegible] telling us that one day Anne and W[illegible]," he kindly explains "that is Dante's," as [illegible] Francesca de Rimini and Paolo were not known to [illegible]

Possibly he may have meant the Abbess's rather severe teaching for his wife's special benefit:—

> His meat was sauced by thy upbraidings:
> Unquiet meals make ill digestions;
> His sports were hinder'd by thy brawls:
> Sweet recreation barr'd, what doth ensue
> But moody and dull melancholy,
> Kinsman to grim and comfortless despair? &c.

The other play in this first part is "Henry VI.," Part II., little better than Part I.

All illustrations to Shakespeare are "an abomination of desolation," from Sir John Gilbert's, Harvey's, and the like, down to those illustrating Dick's "Penny Shakespeare." Those in the present edition are among the worst we have seen. Before issuing an illustrated Shakespeare, publishers should wait till they can engage an artist as great in his own line as Shakespeare in his,—and *then* they should be assured that their artist understood Shakespeare.

A NEW GUIDE TO THE ALPS.*

THE season of Continental travel has come, and guide-books are in request. Murray and Baedeker are dear, and they overlook sometimes the minor wants of travellers. They address their readers as though already experienced travellers. The guide before us is very cheap (half-a-crown cannot be called a large price for a book of more than 400 pages, with many elaborate maps and diagrams, and crowded with information on all sorts of topics important to travellers). If we do not altogether admit the scientific accuracy of the description "indispensable," which occupies a whole page at the beginning of the book, we must admit that a work such as this claims to be, is, at the price, a very desirable addition to the contents of the tourist's wallet. It treats of Switzerland and the Swiss, and Alpine animals and vegetation, gives hints to tourists, discusses the various routes of travel, and deals in special articles with hotels and *pensions*, mountaineering, what to wear, glaciers, Swiss butterflies and moths, avalanches, baths and springs, the Alps generally, the Upper Valais, the Bernese Oberland, the Italian Lakes, and many other subjects too numerous to mention.

Some omissions should be corrected in later editions. The carriage-roads over the Ober Alp should have been shown in the general map, while the railway under the Lukmanier should have been omitted. We note also the entire omission of the Gries Pass. Monte Generoso and the Rieder Alp afford good rest for the weary, not mentioned in the "J. E. M. Guide." Such omissions, however, though they might be noteworthy in an old-established Guide, may well be excused in a new one.

AMONG the many electrical companies started during the past few days is one for working a material called insulite. It is intended to be used as an insulator, superseding glazed porcelain, ebonite, &c., and is composed of sawdust and suchlike substances, held together by ozokerit. In the prospectus, it is stated that the material has been supplied to the General Post Office and a number of electrical authorities. So far, however, as our information goes, the Post Office has only had a few specimens for trial. On subjecting the insulite to a moderate temperature, it expanded like so much dough, and crumbled to pieces between the fingers. It is, moreover, incapable of taking small screws. Under these circumstances, telegraph insulator manufacturers and ebonite merchants need fear little from this substance, which has been brought out with such a blaze of trumpets.

* "The Alps, and How to See them: the J. E. M. Guide to Switzerland." Edited by J. E. Muddock. (Simpkin, Marshall, & Co.; Wyman & Sons, London.)

TRICYCLE RIDING FOR LADIES.*

THE opinions of society, at least English society, are changing, not slowly and surely, but quickly and surely, as to what women may or may not do.

This is observable more especially in the matter of sports. Hardly any athletic game is now brought forward but women can take part in it with men, if they please. And let me say this is a privilege and a benefit to both men and women, for nothing is more healthful to both than their joining together in their amusements. Men have a great respect for those, be they whom they may, who can play a good game with them. It produces a kindly, hearty feeling; and when called forth by women, brings with it the addition of a chivalric honesty. He really does wish to give her a "fair field," while she really does wish to receive "no favour." This was very pleasantly shown in a lawn tennis match which Major Wingfield (who introduced lawn tennis to the English public) and a lady, some little time ago. The lady proved such a formidable opponent, that he declared that he had the greatest difficulty in beating her, and that if she had not been unduly handicapped by the weight of her dress, the issue of the game would, no doubt, have been different. To test the truth of his conclusions, he begged that the lady might have her clothes weighed, while he would also have his weighed. His were found to weigh 1¼ lb., while hers weighed 10 lb. This disproportion of weight to carry, as any one acquainted with "sport" well knows, is enough to make either man or horse lose a race.

In a similar way women allow themselves to be over-weighted throughout the whole of their lives, whether at work or at play.

In the matter of "play," tricycle riding affords another very striking example. Nothing in modern times which has been offered them can be reckoned a greater boon. Something to vary the dull uniformity of their lives—the daily monotonous walk, the perpetual sauntering along the same streets, gazing vacantly into the same shop windows.

The *Sanitary Record* for this month has a short article recommending tricycles to its readers. It says:—"Tricycles have over bicycles the great advantage that they are suited to every age, to both sexes, and the most varied physical conditions. Every one in ordinary health, and possessing the use of his limbs, can, without effort, and without previous instruction, learn to ride a tricycle. Very little practice enables the tricyclist to traverse considerable distances with ease, comfort, and safety, and at a very adequate and satisfactory pace. A pace of from seven to ten miles per hour is easily attained on the tricycle, and maintained for several hours in succession without effort. The exercise is distinctly healthful, and the mere rapid motion through the air is of itself invigorating and refreshing. Moreover, it is so much more pleasurable to many than the slower exercise of walking, and the facilities for covering an extent of ground and getting quickly out into the country, or the most pleasant suburbs of great cities, are so great, that we cannot too strongly recommend our readers generally to try for themselves the advantages of the tricycle."

But here, again, women's clothes are a hindrance and impediment—a constant and unnecessary tax upon their strength and endurance.

It is not in this case, as in lawn tennis, the *lifting* weight of them which tells, but the *resisting* weight. The *Sanitary Record* says, everyone "possessing the use of his limbs" can learn to ride a tricycle, but can a woman tied up in petticoats be said to possess the use of her limbs? Every time she lifts her legs to move the treadles they have to encounter, resist, and battle with the weight of the overhanging skirts, while in going against the wind they offer about four times as much resistance as the man's trousers, and every tricycle rider knows how that extra labour tells in working the machine. Moreover, the really unprotected, unclothed condition of the lower part of a woman's body requires that the greater part of her attention and efforts should be directed towards defending herself against ridiculous and indecent exposure.

Women naturally sensitive on these points hold aloof from attempting tricycle riding on this account, and will continue to do so till a more suitable and safe garment is provided for them. A lady who is now a member of our Rational Dress Society wrote to me from Scotland, asking for a pattern of our divided skirt. She said that ladies in her part of the country had to drive about a good deal in dog-carts, that she had often longed for some sort of dress like the one we had introduced, because getting up and down in these vehicles was "something too dreadfully awful."

It is this fear of making a "too dreadfully awful" exhibition of herself which deters many a woman from tricycle riding, so that it is mostly confined to those who can indulge in it in the privacy of their own grounds. But these are the women who least require the exercise—they usually have carriages and horses for riding or driving anywhere they please—or they can transport themselves to "foreign parts" whenever so inclined. With women of this class, too, any amusement, however good and healthy, is but the fashion of the hour—to be indulged in for one season, and forsaken the next. But if tricycle makers wish to secure a large and constant sale of their machines, they must make them popular with that much larger class of women whose only mode of quick locomotion would be a tricycle; and when they had once experienced its pleasure and health-giving power, they would not lightly relinquish the use of it.

Those who are interested in seeing lady tricycle riders the rule instead of the exception, as at present, should turn their attention to inducing them to adopt a dress suitable to it—namely, one that clothes them properly and decently, and one that does not, by unduly handicapping them, overtask their strength and energy.

I shall be only too pleased to assist any of the lady members of the B.T.C. with suggestions as well as to aid them in forming a Ladies' Committee at any time.—Mrs. E. M. King, Hon. Sec. Rational Dress Society, 34, C[illegible], Bayswater, London.

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* From the *Monthly Gazette* of the Bicycle Touring Club for May, 1882.

BUTTERFLIES AND MOTHS.

By W. J. H. CLARK.

THERE is one branch of entomology which we are sorry to say has not received the amount of attention that [illegible] deserves; we refer to breeding from the egg. The method of [illegible] a good collection is far more satisfactory and profitable than either catching the [illegible] or breeding from the larva.

It is true that egg-hunting presents many difficulties to the beginner, owing to the extreme minuteness, in some cases, of the egg, but these will be got over with a little time and practice.

It is an undisputed fact that a very large percentage of the eggs laid annually by butterflies and moths do not develope into the perfect insect, the reason for which must be looked for in the ravages of birds, and other causes which destroy the caterpillar soon after its exit from the ova, and also in ichneumon flies which kill the insect when in the pupal state.

When bred up in the house, all these destructive influences are done away with, and a large number of the eggs will hatch out, and finally become perfect insects.

When hunting for eggs, a few shallow boxes made of thin wood or card-board should be taken, in which the eggs can be carried home.

A very careful search among the leaves (especially the under sides) and twigs of trees, stalks and leaves of grasses, fences, and numberless other places will probably yield good results; [illegible] leaf or twig should be cut off and placed in one of the before-mentioned boxes, as by this means they will not become broken by touching one another.

If the eggs are attached to a wooden [illegible] the piece on which they are deposited must, if possible, be cut away with them, as scraping or brushing [illegible] owing to the exceedingly fragile nature of [illegible] membrane.

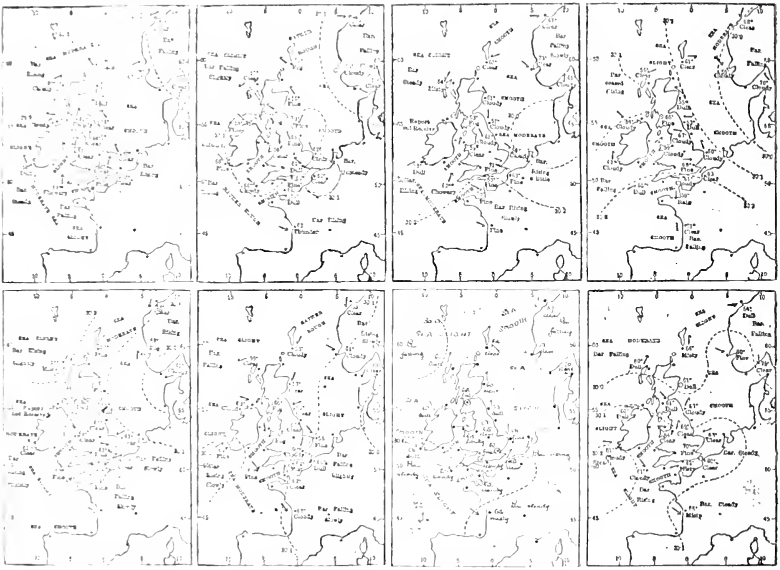
Also take notice what trees are in the [illegible] of them will [illegible] form the [illegible]

When the eggs are taken home [illegible] without a lid, carefully [illegible] of eggs [illegible] time of year and where found, whether singly or in clusters, and any other [illegible] as these notes [illegible] a very useful ref[illegible] years.

FIVE DAYS' R[illegible] A T[illegible] Acton, Hounslow, and Basingstoke to A[illegible] 73[illegible] Second day, Andover to Stonehenge, Salisbury, [illegible] Romsey, 43 miles—very hilly, and stony [illegible] Romsey to F[illegible], Wickham, [illegible] Havant, Chichester, and Arundel [illegible] and strong head wind all the day [illegible] (morning); in the evening W[illegible] day, Horsham, Crawley, Reigate, [illegible] Westminster Bridge, Thames Embankment [illegible] 104 miles. Average, 47 [illegible] stone. Lovely weather, [illegible] fatigueless ride. EX BICYCLIST.

WEATHER CHARTS FOR WEEK ENDING SUNDAY, JULY 2.

SUNDAY, 25TH. MONDAY, 26TH. TUESDAY, 27TH. WEDNESDAY, 28TH.

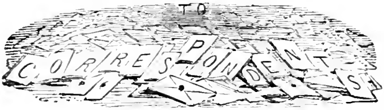


THURSDAY, 29TH. FRIDAY, 30TH. SATURDAY, 1ST. SUNDAY, 2ND.

In the above charts the dotted lines are "isobars," or lines of equal barometrical pressure, the values which they indicate being given in figures at the end, thus—30·1. The shade temperature is given in figures for several places on the coast, and the weather is recorded in words. The arrows fly with the wind, the force of which is shown by the number of barbs and feathers, thus:—⟶ light; ⟶, fresh or strong; ⟶, a gale; ⟶, a violent gale; ⊙ signifies calm. The state of the sea is noted in capital letters. The • denotes the various stations. The hour for which each chart is drawn is 6 p.m.

FORESTS AND RAILROADS.

FROM an official report made on American railroads, we have some curious facts relating to the direct connection between the railroads and the deforestation of the United States. From it we learn that it takes 200,000 acres of forests to supply cross ties for the railroads of the United States every year. It takes 15,000,000 ties to supply the demand on these railroads, for which on an average the contractors get 35 cents apiece, making in the aggregate 5,250,000 dols. In building a new road the contractors figure on 2,700 ties to the mile, while it takes 300 ties to the mile to keep a constructed road in repair. Contractors, of course, buy pieces of timber and as near to the proposed line of road as possible, paying for the timber an average of about 20 dols. per acre, or giving the proprietor of the land 10 cents for every tie got out. The average of a good piece of timber land is 200 ties to the acre and 12 ties to the tree. The size of a cross tie differs on different roads, but the usual size demanded is 8 ft. 6 in. long and 8 in. face. White or burr oak is considered the best timber for the purpose, although cherry, maple, ash, and even locust have been used. The last named were first used on the little Miami railroad and after a time thrown aside as unfit for the purpose. Railroad men much prefer ties hewn out with an axe to those sawn in a mill, and many contend that the first named will considerably outlast the sawed ties. This theory is probably a fallacy, as sawed ties have been placed alongside of hewn ties and remained sound twice as long. This business gives employment to an army of choppers, who are paid 10 cents apiece for each tie. Continued practice makes the choppers expert in the use of the axe, and a single man has been known to get out thirty-five in a day; yet the average is only ten while an expert will probably get out twenty. During the war, when ties sold at from 60 to 65 cents, choppers were paid 12½ cents apiece. Although the contractor gets 35 cents apiece from the railroads for each tie, still there is a loss of from 5 to 7 per cent. on dockage and stealage. An inspector is sent by the company to inspect the ties. This is generally a clerk from some of the offices, who frequently knows but little as regards the strength and durability of timber, and as a consequence some of the best trees are docked and only bring 20 cents apiece. The stealage is where the sectionmen put in new ties which have not been inspected and received, and fail to report the use of the same to the roadmaster. Nearly all cross-tiemen also contract for the bridge timbers and trestling, as well as for telegraph poles. For the latter, chestnut and cedar are generally used. They bring about 1·75 dols. apiece, and are cut mostly in the Tamarac swamps of Michigan and the forests of Southern Kentucky and Tennessee.—HENRY F. MOORE, in the *Journal of Forestry*.



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of KNOWLEDGE; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

⁂ All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

THOUGHT-READING.

[454]—The account in last week's KNOWLEDGE of the feats performed by a conjurer before the late Charles Dickens has reminded me of similar feats of which I was a witness at Athens in 1875. A French conjurer, whose name, I think, was Caseneuve, gave me a piece of paper, folded up, and asked me to hold it. He then gave to one of the audience a bag of lotto numbers, to another a pack of cards, to a third a bag of ivory letters, to a fourth a ball of string and a pair of scissors, and to a fifth, a friend of mine sitting next to me, a box of dominoes. At the conjuror's request the first selected a number, the second a card, the third a letter, the fourth cut at random a piece from the ball of string, and my friend chose a domino. When the first had chosen his number, he, at the conjuror's request, passed the bag to his neighbour, and so with the others. The conjuror then asked me to open the paper and to stand up and read aloud the contents, which were in French. This I did. They consisted of sentences such as the following:—The card chosen will be the Knave of Clubs; the length of the string cut will be 1 mètre 15 centimètres, and so on. In each case the prophecy was correct.

As before stated, the domino was chosen by my friend. I carefully examined the box and found it to contain a complete set of dominoes. HENRY M.

[There is a well-written note by Professor Donkin in this month's *Nineteenth Century*, endeavouring to show that the evidence given by Professor Barrett and two colleagues proves very little. Without at all accepting the Brain Wave Theory, I must confess that I have been led by several remarkable experiences, to the conclusion that mind can rule mind in some way,—physically interpretable, no doubt, but not as yet explained.—ED.]

THE "COLD SNAP" IN JUNE.

[455]—I have read a good deal in KNOWLEDGE about the cold week in May, and have seen M. de Fonvielle's asteroidal theory exploded most thoroughly, and, as I think that the abnormal temperature of 10th—12th June was as much or more marked than the three days of May, I beg to suggest that the cause of the same may be found in the enormous diameter of the cyclone, and the slow movement of its centre, which encompassed us, and the position in it, in which we were placed at that period. It must have been at least 2,000 miles in diameter.

If upon your weather chart we trace back the isobar curve, which is nearly always coincident with the direction of the wind, to the distance of the quadrant of a circle, we shall find that the air which we received must have been, only two or three days before, driving over immense tracts of ice-bound mountainous country, even beyond the arctic circle in Norway and Russia, and no doubt driving herds of icebergs into the Atlantic.

We know that air is not warmed directly by the sun, but by contact with, and radiation from, a warm surface—generally land; that air cannot be warmed appreciably above 32° where snow exists, and that only a small rise of temperature can take place in passage over water; therefore, in this position, we receive the cold blasts at a temperature very little above what they left these wintry regions at.

I think in this also may be found the disagreeableness of the N.E. wind—the cold air travelling over our warmer lands has its point of saturation so suddenly raised, that it wrings the moisture out of everything, fairly burns up vegetation, and produces that unpleasant feeling in the skin (really a dryness) so well known during these winds. It may be advanced against this that it very often rains from the N.E. I should say that on such occasions it must have started from the far north raining much heavier, and is decreasing all the way south. At such times, owing to the moisture present, the objectionable feeling of the skin is not apparent.

If this theory be correct, we should always experience such weather upon the back of a large, well-developed cyclone, or upon the front of an anticyclone, when the centre, travelling slowly from W. to E., passes to the north of us. J. MORRIS

CONSUMPTION.

[456]—Allow me to offer a few hints which do not agree with Koch's germ origin of phthisis. There are a few well-known kinds of consumption, known as the knife- or scissor-grinders', the miners' or marble-masons', and the cotton-sorters'. In all these cases the disease is due to breathing small particles of iron, coal, stone, or cotton. These particles are carried into minute tubules of the lungs, and there set up irritation and inflammation by their presence. The sputa of these patients contain iron, coal, or stone particles. There is also another kind of consumption which does not come under Koch's theory, and that is fibroid consumption, due to excessive drinking of alcoholic liquids. Consumption is caused by anything which tends to weaken the body, amongst which impure air may be set down as a great cause.

Many of the present generation are carrying the germ theory to excess. Many medical men are afraid of germs as if they were poison, and will not allow a simple wound to heal without applying some germicide. The healthy body is the best known antidote to germs; a germ cannot flourish there; it is like throwing seed on a rock—it soon perishes. [But if the body is unfortunately not healthy?—ED.]—Yours truly,

June 24, 1882. T. R. ALLINSON, L.R.C.P., &c.

BREAK FOR TWO-WHEELED VEHICLE.

[457]—Malvern town abounds in steep hills. The two-wheeled vehicles, from the doctor's gig to the butchers' and bakers' carts, have double breaks, i.e., one to each wheel, actuated by a lever similar in construction to that used on four-wheeled vehicles, applied to the back of the wheels, in a line level with the axle. R. G.

May 29, 1882.

FIELD EMETICS.

[458]—"As a practical thing to know (in the field), a charge of gunpowder is a capital emetic—[illegible]" (see KNOWLEDGE, vol. ii., p. 8). Query—Would not dolomite, shaken up with water (it would not dissolve), often be of value, on account of the carbonate of magnesia? M.

TRICYCLING.

[459]—Probably, many of your readers may be seriously thinking of procuring a tricycle, and securing exercise and change of scene by that most excellent and delightful means.

To such as may be that way inclined, a few words of advice as to adjustments, accessories, &c., from a practised cyclist may, perhaps, be useful.

I mentioned in my last letter the machine and size of wheels I have found to give me the most satisfaction, and will merely now say that, whatever may be the machine selected, it should [illegible] *wheels direct*, without any complications, but with simple chains with revolving bushes on the links. These will be found to be more reliable than anything else, in spite of objections on the [illegible] that may be urged to the contrary. I have ridden my machine some 1,000 measured miles since last June, and never yet had any trouble whatever with the chains. My advice is, specially avoid all complicated mechanism, as it is sure to go wrong before long when put to the incessant jarring of the roads, or to make an irritating, rattling noise.

With a large wheel, a weak rider can secure great ease of working by "gearing down," i.e., by having the top cog wheels with more cogs than the bottom ones, which gives increased power up hills, though, if carried to excess, it much decreases the speed.

All who wear trousers should ride upon saddles—not seats. A saddle allows the legs to hang freely downwards, and to work without [illegible] from the hips. And though in the shop it may seem that [illegible] is much easier when as [illegible] one might use an ordinary [illegible], and sat "side-saddle" upon, when riding this cannot be done, [illegible] the same time permit the legs to move from the hips (as in [illegible], which is a [illegible] for comfort in riding. A man on [illegible] seat must have his legs bent at an acute angle at the knees, and [illegible] then presents a very unsightly appearance, with his knees popping up and down almost upon his chin, besides the extra fatigue [illegible]. Saddles are made with a broad seat, and also with backs, [illegible] they are [illegible] uncomfortable, and the pommel so divides [illegible] as to [illegible]. EX-BICYCLIST.

[illegible] It may interest those of your readers who are tricyclists to [illegible] Mr. [illegible], of Nottingham, has ridden from Derby to [illegible] through [illegible], Lichfield, Shifnal, Shrewsbury, Corwen, Bettws-y-Coed, and Bangor, a distance of one hundred and eighty [illegible] twenty-three hours and three quarters on a tricycle. The [illegible] quite half the distance was mountainous, some of the hills [illegible] six and seven miles long, and in many parts the roads were [illegible] that it was like riding through the bed of a stream dried [illegible]. For a tricyclist this is the longest journey in twenty-four hours on record. JOHN BROWNING, L.T.C.

INFLUENCE OF CLIMATE ON PLANTS.

461.—In a number of KNOWLEDGE on which I cannot at present lay my hand, I noticed some facts with regard to the influence of climate on plants. It may interest your readers to know that plants [illegible] severely the change in their usual habits which takes place when they are transplanted from Europe to South Africa. The Curator of the Botanical Gardens here, who has, perhaps, more practical knowledge of tree-planting than any man in the country, informs me that this is markedly the case with regard to fruit-trees. The reversal of the seasons, occasioned by the change of hemisphere, bewilders the plants, which are in some sense "educated" to such a degree that they are not able to survive the shock. The only chance of getting them to grow is by grafting, when they [illegible] the constitution of the tree on which they are grafted, and acclimatise readily. Ordinary deciduous trees behave very irregularly also. Sometimes they will pull through, sometimes they [illegible], but the first cuttings never appear to thrive. I understand that evergreens are not affected.

Birds take to the change of season well, if one may judge by the few European sparrows which have been introduced. European [illegible] generally die. Imported oxen and horses appear to do well, provided they receive the same amount of care which they experience at home. Cats thrive.

Perhaps I may be pardoned if I suggest that the appearance of numerous articles from upholders of Darwinism in your capital magazine, must not lead your less scientific readers to imply that Darwinism is by no means universally accepted. It is, admittedly, only a hypothesis. I use the word hypothesis in the sense to which [illegible] in "Pleasant Ways in Science" (p. 315), as an opinion [illegible] based on phenomena. Dr. Mivart, one of the greatest of living [illegible], terms it, with all due solemnity, "a puerile hypothesis." May I [illegible] to commend to those of your readers, who are not [illegible] by mere weight of names on the other side to read carefully Mivart's "Genesis of Species," Dr. Elam's "Winds of [illegible]," and Dr. Beale's "Protoplasm," in which they will find [illegible] the works of Darwin, Huxley, and Haeckel, [illegible] comparative, and superlative exponents respectively of [illegible] in transcendental doctrine. Especially let [illegible] history of "Bathybius Haeckelii," two unfit [illegible] the original Darwinic idea, which have ceased to [illegible].

[illegible] (I hope you will forgive the space) may I [illegible] extensively read this side the [illegible] map of the southern sky would be [illegible] Australasia. J. NIXON.

[illegible], May 1, 1882.

THE SPAWN OF "DORIS TUBERCULATA" (CUV.).

462.—[illegible] large [illegible] of the riband spawn [illegible] the large [illegible], *Doris tuberculata*, which, I [illegible] columns. While on a visit last [illegible] Kirby, near Hoylake, Cheshire, I [illegible] which a tide of about 18 ft. [illegible] Hilbre and at the mouth of the Dee. [illegible] been fortunate enough to secure [illegible] the beautiful *Dendronotus arborescens*, I [illegible] back again. I may mention that Hilbre [illegible] the spring and autumn equinoxes is well worth visiting for specimens of marine zoology. The tides of last week, however, were not sufficiently low to expose at their full ebb the most promising places. At one spot I espied a large white mass of something hanging from a rock, and this I found to be the riband spawn of *Doris tuberculata*; it was hanging from the underledge of a rock of red sandstone, to which it was firmly fixed, except at one end of the mass, where, for about three or four inches, it hung loosely from the rest. On detaching the mass and unfolding it, I was astonished at its great length. I did not measure it, but I am sure that it was more than a mile long, and being in one uniform, uninterrupted band, it must have been the product of a single parent. The breadth of the band I afterwards found to measure one inch and four-tenths. Not far from this spot, a Hoylake fisherman, who was after prawns, scooped out in his net from under the ledges of the rock two creatures, which he politely gave to me; these were two fine specimens of the Nudibranch itself. The largest, which was of a beautiful lemon colour, without a single spot of any other colour, measures—for I have both specimens alive now—four inches in length and two-and-a-half in breadth. The other is not so large, and is handsomely marbled with yellow, dark brown, and delicate pink. I do not know whether this spawn-mass is of unusual size, but Alder and Hancock speak of an unfolded coil of *Doris* spawn of nine inches in length and nearly one inch broad as being one of large size. Specimens of *Doris tuberculata* have been found measuring five inches in length; I should think that the parent of the mass I found must have been larger; for the riband must have been fully forty inches long. This band, which is transparent, and fairly tough, is full of countless numbers of ova or embryos. I have kept a portion of this spawn in salt water nearly a week; on examining it under the microscope to-day, I find many of the embryos still alive and considerably developed. Very curious it is to witness the constant activity of these baby-nudibranchs, as they perform their rapid rotations within the enclosing transparent membranes. In some of these only one embryo is seen, in many, two are found; and not unfrequently, three are seen to disport themselves in one membrane or *chorion*. Conspicuous are the two oval lobes, which are thickly fringed with long, strong cilia, by means of which the little creature rows itself rapidly within its circumscribed "oval," and which are destined to play the same locomotive function when it is liberated from its chorion. Now these cilia are in motion, now they stop their machinery, and the little creature partially withdraws itself into an exceedingly thin, transparent shell, somewhat resembling that of the nautilus. The pedal process (foot) is apparent, and careful focussing reveals the presence of a delicate, transparent operculum on the under side of the foot. I see clearly the two circular otoliths in the region of the mouth; the stomach intestine and other viscera are evident enough, in a mass, but not easy to distinguish separately, owing to its opacity. The muscle which attaches the embryo to the bottom of the shell is seen in the shape of a semi-transparent conical organ. Nearly the whole of the rest of the body of the embryo is separated from the shell by a well-defined clear space. The figures in Alder and Hancock's Monograph (Fam. 1, pl. 3) are well shown, and what is before me convinces me of their accuracy. Of the thousands of thousands of ova contained in the spawn of the nudibranchs, how few are destined to survive and reward the marine zoologists by their presence as adult animals. I am reminded of what occurs in oysters. Delicate locomotive larvæ, when free swimmers, are at the mercy of the rough waves, and in the troubled sea of their infancy they have but little chance of settling down to a quiet life, and developing the characters which mark the respective adult species; so that, I should suppose, the nudibranch babies require similar conditions to those necessary for the development of the young ciliated oysters, *viz.*, a calm sea and a warm temperature. I secured one more nudibranch during my short visit at Hilbre, a fine *Eolis papillosa*. But, beautiful in colour and curious often in form as our nudibranchs are, it must be confessed that they are, as adults, dreadfully sluggish in their movements—painfully slow. This, I think, is especially true of *Doris tuberculata*. "Do move on, sir," one repeats in vain. I call them "Cretans." Would you know why? Because they are "slow bellies." Even as Epimenides calls the people of that island, in a line quoted by St. Paul (Titus i. 12):—

Κρῆτες ἀεὶ ψεῦσται, κακὰ θηρία, γαστέρες ἀργαί.

Of course it is only the latter description that is applicable to nudibranchs. W. HOUGHTON.

May 22, 1882.

COAL UNDER LONDON.—At the half-yearly meeting of the proprietors of the Southwark and Vauxhall Water Company, it was mentioned incidentally that in sinking a new well at Streatham, pieces of coal had been found 150 feet below the surface.—*Daily News.*

Answers to Correspondents.

**** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded; nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

M. E. H. H. Your answer to "Pyramus" is not correct. How do you make out fourteen for third year? There would be twelve for first year, each of whom at end of year would pay £40, making, with £6,000 annual subscription, £6,480; out of which, twelve more would each receive £500. At the end of second year there would be £6,960 for distribution, and thirteen (not fourteen) more subscribers would receive, each, £500, and so on.—H. J. MADGE. As stated, we were referring to the idea as presented by our correspondent. Permit us to say that your way of putting the theory is entirely unscientific—the "evolution of immense volumes of electrical energy which, flying off from the sun's body into space," &c., do such and such things, will really not do in the way of scientific description, even if the ideas underlying your account were sound. The theory that the greater eccentricity of cometic orbits is due to the cometic nucleus being "constituted of a nature less amenable to electric absorption than the planets," is utterly untenable.—F. SELLAR. Thanks; will consider both points.—ERIN-GO-BRAGH. Centre of earth generally regarded as solid. We are approaching Hercules, rate not known. Estimate usually given (150 million miles per annum) quite untrustworthy.—F. WINGFIELD. The question, p. 44, should have been, When will Arcturus cross the meridian three hours before noon? The mistake is tolerably obvious, for if sidereal time on December 9 at noon is 17 h. 10 m., it will not be 14 h. 10 m. at 3 P.M., but 20 h. 10 m.—J. CLARK wishes to know where in the writings of Augustine the saying occurs: "God is great in great things, but greatest in small things" (very kind of Augustine thus carefully to apportion his praise).—ONE OFFENDED. Your complaint is preposterous. We cannot ask advertisers to certify that the goods they offer at specific prices are worth the money. "Yea, indeed," as you put it, that would be absurd.—F. G. A. A bicycle is not kept in the vertical position in the same way as a hoop. In the case of a rolling hoop there cannot be displacement from the vertical without greater changes in the direction of motion of particles of the hoop than the hoop's weight can produce. But in the case of a bicycle, even when at high speed, the weight of the rider would suffice to bring the instrument and himself over, did he not combine with balancing movements such slight changes of direction as cause the weight which had been tending to produce sway in one direction to act in the opposite. The greater the rider's practice, the less these changes, till they are practically evanescent. But no bicyclist could trust to the steadiness resulting from the mere running of the wheels.—J. A. L. R. I doubt whether any photographs of the recent solar eclipse will be available for the "public eye" for many months to come. Very little of importance was added to our knowledge of the sun on that occasion. All that about evidence of the dissociation of the so-called elements in the sun is sheer windy nonsense. Professors Liveing and Dewar have disproved the supposed terrestrial evidence, and Professor Young the supposed solar evidence, and nothing new was obtained on that point, last May.—PHARMACEUTICAL CHEMIST. Fear it is only too true that bicycling injures the spine, though strongly-built men may not notice the effect for a long time. Theoretically, nothing could be much more mischievous to the system than jarring the body when in the attitude necessary for bicycling.—H. W. MALET. The late Sir Charles Lyell, on the contrary, attached great weight to Mr. Croll's geological investigations. The subject is, however, as you say, very difficult. I cannot quite see why the mere fact that the undated carboniferous system has buried the 3½ miles of denuded matter, justifies your considering the work of denudation to have been done under water, and so multiplying the time by 1,710! Again, the geographical, and not the physiographical (horrible word), is the true surface measure in such cases; for the average denudation per square mile is in question, not the average measured vertically to the surface, with all its varying slopes.—A READER OF KNOWLEDGE. The comet may possibly be visible in the positions indicated elsewhere; but only with a good telescope.—CAMPSIE. Fear the transference of engravings to porcelain rather outside our range, but if any readers of KNOWLEDGE know how such work is done, we will find space for their account, if not too long.—AUGUSTUS J. HARVEY. Ah, yes! get Government to do anything, and it [illegible] done well—Government not being carried on by men like the rest, but by men officially etherialised. Your "one hundred national painters," all painting "for the glory of England," would be sure to raise the tone of art. Our school boards ought to adopt this as a [illegible]—*Official Position [illegible] Continuous Assiduity.*—W. W. I would like to tell you at what point of the celestial compass our globe is at the summer solstice; but—forgive my ignorance—what is the "celestial compass"?—J. A. W. OLIVER. Thanks for your valuable and suggestive letter.—CARL S. The reverend gentlemen you quote and name imagine that because *they* can only conceive a deity very limited in his attributes (though they *talk* of Infinite Power, Omniscience, Omnipresence, and Eternity), science, which smiles at their limited deity, is atheistic. They are quite honest, however, in their denunciations. They have gravely told me of a scientific club—president, Professor Tyndall—founded for the advancement of atheism. The object, no doubt, is to get rid of all restraints, religious or moral. It is, of course, well known that nine-tenths of all the offenders brought annually to judgment in civilised communities are men of science (under disguised names).—A. AITKEN. Sorry for the mistake about postage; but the wrapper should have been sent to publishers, not to editor. I do not think your solution of Pyramus's question quite right, unless we assume that, as fast as money comes in, it is used to give subscribers their £500, or *such part of it* as can be distributed, those who have received a part paying a proportional part only of the annual £40. In that case, of course, your solution would be correct. Every one seems to understand the question differently, by-the-way.—G. L. HARRAP. If I remember rightly, there is a good exposition of the Nebular Hypothesis in Prof. Newcomb's "Popular Astronomy."—H. A. B. (1) Arago's delightful Essay on Lightning (in his "Meteorological Essays"). (2) The fact that after June 21 the days do not shorten as rapidly as they lengthen after December 21 is due to the motion of the earth being slower in June and July than in December and January. The earth, as it were, hangs longer in the solstitial neighbourhood. (3) The sun's orbit in stellar space is not circuited in hundreds of thousands of years; thousands of millions would be nearer the mark, I imagine. (4) The instinct and reason differences hard to define.—R. S. MCKERRELL. Go through the work to be indexed, writing down the title and page of each subject on a separate small slip of paper, or, if of sufficient importance, on two or more, varying the heading, as, Spots on the Sun, by W. Huggins, p. 113; Sun, Spots on, W. Huggins, p. 113; Huggins, W., Spots on the Sun, p. 113. Then sort; first into letters, then under each letter into proper alphabetical position.—W. LEES. We have such a list; but we are not free to lend it; so far as we are concerned, we would willingly do so. We do not belong to the society.—SOLARAX. A. SHAEPP. Many thanks; but electrical and telegraphic articles already provided for.—FACILITAS. That leaf (vol. vi. [illegible] No. 33), is not to be bound with the volume. The advertisement par[illegible] foot of p. 47, was inserted by mistake of printers, as you can gather by glancing over advertisement columns. The [illegible] name has promised to do what those you refer to would [illegible], and his papers will have an independent value accordingly, and be practically more useful; just as my [illegible] friend F.R.A.S. describes nothing in his "Nights" which he has not [illegible] at the telescope within a few hours of the [illegible]—J. H. CORBETT. Four weeks of ill-health (w[illegible] again, thanks) must be our excuse for not [illegible] you, we have never seen either Venus or Eve [illegible] represented otherwise than as a more or less [illegible] woman, born in the usual way. Michael Angelo, wi[illegible] Moses with horns, might have ventured on [illegible] either of those ladies, [illegible] Many thanks for [illegible] advocacy.—J. L. H. Thanks for solutions of [illegible] problems. We give shorter and more general solutions [illegible] Doubtless the comet [illegible] of reply above [illegible]—EXCELSIOR. See reply to J. H. Corbett.—A. J. [illegible] hardly be necessary to say that I personally would [illegible] more astronomy; but I yield place to others [illegible] to do part, or most of the astronomy [illegible]—A. H. [illegible] culty has been that descriptions of [illegible] be very long and illustrations rather expensive. We [illegible] correspondents' promises.—P. H. D. [illegible] but if every year there is a cold spell [illegible] time for this is a particular part of May, that w[illegible] observed fact—the three cold days.—C. M. P. [illegible] room for all. The point is that we know [illegible] [illegible] in England, a few hundred years [illegible] the earth, contained "humans" only.—T. K. Y. [illegible] Browning's Rainband Spectroscope shows the [illegible]—VERUM SAT. Yes; but how about the proprietors, if we thus do adver-

[illegible] gratis? J. W. BLOOM, ED. We shall be only too glad to [illegible] the magazine; as we wrote, your letter only to hand from [illegible] office.—ALAN. Alas! we have never played Napoleon, and your question is an enigma to us.—H. SADLER. We agree with you, and so, we fancy, would our friend, F.R.A.S., on further consideration, that the common proper motion of Castor and [illegible] implies that they *are* connected.—T. J. HAWKINS. Thanks. (1) It would be a pity were a chance given for "the enemy to blaspheme." Dr. Ball went rather beyond the record in saying that if all the planets did not revolve in the same direction, the solar system would have perished long ago. Perhaps I went also beyond the record in saying "it would have been as well with the solar system as at present if some planets went one way and some another." Laplace proved that with all the planets going the same way round, and all with small inclinations and eccentricities, there could be no destructive changes in the solar system. *But*, he never proved that if any even of the large planets went the wrong way round, there *would* be destructive changes. Dr. Ball, by saying, "at all events, the larger planets," shows that he recognises the quantitative character of the problem, with which analysis has never dealt in a quantitative manner. I am satisfied the revolution of Jupiter the wrong way round would do no more harm than that of the earth or Venus (perhaps less), when due account is taken of the much greater scale of the distances in the system of giant planets than in that of the terrestrial planets. Albeit, this has never been proved. From the nature of Lagrange's equations in dealing with this matter, it may be regarded as shown that the stability of the solar system would not be absolutely certain, as now (without much more inquiry) if any of the planets went the wrong way round. (2) Any text book of geography which states that the variation of the major axis of the earth's orbit has influenced climatic relations, has undoubtedly blundered. It should be "minor axis," though the major axis is very slightly variable, in long periods of time, in an oscillatory manner. You quote Mitchell's "Orbs of Heaven," but he was not competent to give an independent opinion on such matters. We find him confounding the parallelogram of velocities with the parallelogram of forces, and making other mistakes equally fatal to his position as an authority.—W. PARKER. It is not easy to say what books would suit you, as the range from the easiest to the most difficult is so great. East and west are different in star maps and geographical maps, because we look up to the skies and down upon the earth. Note, however, that in my maps there is no right, or left, or top, or bottom; but the middle is the top, and the bottom is all round.—E. T. C. W. Might you not as well argue that since the moon affects the tides, so may Saturn or Jupiter affect the ocean in some other, but quite as marked, manner? The influence of the moon on lunatics, assuming it to exist, might depend in some way on her attractive, luminous, thermal, or magnetic influence; compare any or all of these with any corresponding influence which any one of the planets could exert, and you will see that astrology (which assigned much *more* potent influences to Jupiter and Saturn than to the moon) cannot possibly derive support, as you suggest, from lunar influences.—R. WOOD. I referred to pure chance tossing, not to the skilful repetition of precisely identical tossings; but I said suspicion would be justified. There are two theories—one that the coin has two heads, the other that it is a fair coin; on the first the chance of the observed event is 1, on the other it is about 1-millionth. Hence, the probability of the first theory comes out, by the formula we gave, very much greater than that of the second (supposing both *a priori* [illegible] to be equally likely); or it is most probable, though not quite certain, that a two-headed coin is being used. If there were any feasible way of explaining as simply the occurrence of twenty tossings always as predicted, though not always of one kind, precisely the same reasoning would apply to a case where each of twenty tossings was in favour of the tosser. Suppose, for instance, the theory to be that he has one two-headed and one two-tailed coin, and that he is so dexterous that, while seeming always to toss one coin, he secretly changes them at will; then if he wins twenty times in succession, the chance of that theory being true would be much more likely than the chance that one coin is used, even though the odds against his being so skilful and also so dishonest, were, antecedently, a hundred or a thousand to one.—R. WOOD. Dear old Walkingame! I had quite forgotten his rules (usually very bad); but certainly those you quote for division of decimals are pretty good, though that is an awkward sentence—"*The quotient must have as many decimal places as the dividend has more than the divisor*"—regarded as a general rule, and in connection with the fact that the dividend may have *fewer* decimal places than the divisor.—GRAVAM. It is the case that any map can be painted in four colours, whatever the number and arrangement of divisions, only there must not be, as in England in counties, a part of any one county, country, or shire within another or separated from the main body. The proof is not very simple—I have forgotten it. Perhaps some reader may remember it. I have not forgotten my promise about precession or limitation of abstract space. But I have been baffled, so far, by the constant procession of new subjects and the limitation of our concrete space.

ELECTRICAL.

WILLIAM EVANS's Swan Lamps can be purchased for 5s. each (support, 1s. extra) of the Swan Electric Light Company, Mosley-street, Newcastle-on-Tyne. To light *one* will be an expensive matter. You require twenty good Bunsen cells, quart size, which can be procured at 5s. each from Orme & Co., Barbican, Townson & Mercer, Bishopsgate-street, Griffin & Co., Long-acre, London, Mottershead & Co., Manchester, or, in fact, any good physical instrument-makers. To buy the parts and make the cells yourself, the cost would be about 3s. 6d. each. These cells will take about 15 lb. of nitric acid (sp. g. 1,420), at 4d. to 6d. per lb., and 4 lb. to 6 lb. of sulphuric acid (good commercial), at 1d. per lb. The battery will last three to four hours, and the nitric acid may be used three times, after which it will be too far spent to be useful. The only other part you require is the wire, the cost of which will, of course, depend on its length.—CONSTANT READER. Originally enormous battery power was used to work Atlantic cables, but a method is now adopted with excellent results. Each end of the cable is connected to a condenser; no current is sent into the cable, the signal being transmitted by charging one side of the condenser from six or eight bichromate cells. This charge (supposing it to be +) induces a − charge on the other side, and a corresponding + charge on one side of the condenser at the remote end of the cable. The other side of the distant condenser becomes charged −ly, this latter induction actuating the receiving apparatus. The resistance of the older cables is about 7,000 ohms, but the more recent ones are a little less.—ELECTRON. The Leclanché cell; see last week's answer to H. Bardsley.—TIMOTHY FISHER. The chloride of silver battery should be charged with a weak solution of ammoniac chloride (sal ammoniac). The zinc dissolves as a chloride, and the chloride of silver is decomposed, the metal attaching in a spongy state to the silver wire, and the chlorine taking the place of that which unites with the zincs.—JAMES GRUNDY. 1. The machine is not calculated to do what you require. You want a machine wound with thick wire, and offering very low resistance; considerably less than one ohm. 2. The machine will not light two Swan lamps, unless they are very small indeed. Before I can attempt to advise any particular dimensions, I must know more about the lamps you mention. What is their reputed candle-power? 3. Two Bunsens in series would be plenty, but your Leclanché will do very well. If the resistance of the coil of wire does not exceed 8 ohms, join the cells in half-series. 4. Your diagram not quite clear. The magnets are of the horseshoe or U form, and should be so placed in the grooves as to make one pole-piece a north pole and the other a south pole. 5. Let the magnets come as closely in contact with the pole-pieces as you possibly can. 6. Jamin magnets increase the power, but you would do better still by using electro magnets. 7. You talk about using a machine where you cannot use a fire for heating purposes. Do not forget that an electric generator used in a coal-mine would, in all cases where naked flame is prohibited, prove disastrous on account of the spark at the commutator. You must send your current into the mine either by means of a wire, or in accumulation.—G. H. MORTIMER. The zinc plate in a Daniell cell should be ½ to ¼ of an inch thick. To amalgamate the plate, clean it in a weak solution of sulphuric or hydrochloric acid, then rub a little mercury over it. If the mercury does not adhere, wash the plate again and repeat until thoroughly amalgamated. There are several other methods, but this is the best under the circumstances.

CHEMICAL.

W. H. B. Your query is not correctly worded; we presume you mean that "the ignition point of ammonia gas is higher than the temperature *produced by* (not required for) its combustion." It is well known that substances have to be heated to a certain point before they will combine; thus, phosphorus, which burns so brightly in oxygen, requires to be raised above the ordinary temperature before the action commences. The heat produced by the union of the first few molecules is so intense that the neighbouring ones are heated beyond the ignition point, and so the burning proceeds vigorously. There are other substances that have very little chemical attraction for each other; consequently their union is productive of very little heat, and also they, as a rule, possess a high ignition point. Now, if one of these substances be heated sufficiently at one point to cause it to burn, as the heat produced is not sufficient to raise the temperature of the contiguous particles to the ignition point, the burning cannot continue without the continued application of external heat. The combustion of ammonia consists not only of combination, but also of separation, of atoms. The chemical change is represented by $4NH_3 + 3O_2 = 2N_2 + 6H_2O$, the hydrogen combines with oxygen, and nitrogen is liberated. The heat produced by the combustion of the hydrogen is, in great part, used up in dissociating that element from the nitrogen. For this reason the ignition point is high, and the sensible heat of combustion low.—W. P. Provided the combustion of coal gas is complete, precisely the same amount of heat is generated, whether the gas be burned from a Bunsen, or an ordinary luminous gas-burner. In the latter case, however, the combustion rarely is complete, as witness our smoky ceilings. Where the flame is used for heating, say a kettle of water, the Bunsen is more efficient, because it deposits no soot; any such deposit acts as a non-conductor of heat, and further represents fuel that ought to have been burned up. Again, a luminous flame radiates heat as well as light, and this is another source of loss. In gas cooking-stoves, meat is roasted by the radiant heat, and here small luminous jets are always employed above and around the joint, but not under. The advantage of the Bunsen under certain circumstances depends, not on its possessing a power of producing absolutely more heat, but on its producing it in a form more applicable to the purpose on hand. If instances are wanted of the densest ignorance of the elementary laws of heating, glaring examples can usually be found in any exhibition of cooking and heating-stoves.—CERTO. "Dulong and Petit, who were the earliest investigators on the subject, contended that all elementary atoms have the same capacity for heat, or, in other words, that the specific heats of all elementary atoms are the same. If this law be admitted, it is obvious that the determination of the specific heat of an element must furnish a ready means of fixing its atomic weight." (Watts's Dictionary.) This explains Frankland's rule; since 7 is the atomic weight of lithium, "the weight of any other element in the solid condition which at the same temperature contains the same amount of heat, as 7 parts of lithium must be the atomic weight." This rule is particularly useful in determining whether a particular number or a simple multiple of it really represents the weight of the atom. In the case of solids it is often difficult to determine this otherwise. Lithium is conveniently selected as the standard because its atomic weight is low. The rule, with equal propriety, might read, "the weight . . . . . . as 24 parts of solid magnesium." Lithium has a specific heat of 0·9408. Bisulphide of carbon (CS_2) is a very volatile liquid, having a most disagreeable odour. It is produced by passing sulphur vapour over red-hot charcoal, and also during the decomposition of various organic bodies. We can find no record of this substance being found in coal, or the atmosphere of coal-mines. Carbon bisulphide might be detected in a sample of air from a coal-mine by the following method:—First free the air, in the usual manner, from sulphuretted hydrogen; next pass it in a slow stream through an ethereal solution of triethylphosphine, contained in a set of nitrogen bulbs; a reddening of the liquid indicates the presence of the sulphide of carbon. Experiments of this kind require a knowledge of analytic methods and manipulation. Jago's 'Inorganic Chemistry, Theoretical and Practical,' published by Longmans & Co., at two shillings, will probably suit you. Davis's Geology, in Collin's Elementary Science Series, forms a useful introduction to the study of that science.—G. H. MORTIMER.—Laughing gas is made by heating a small quantity of ammoniac nitrate, which splits up into water or steam and nitrous oxide, or laughing gas. The gas may be collected over water. Mix it with air and breathe for a few minutes.

Our Mathematical Column.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

No. II.

ILLUSTRATING a *differential co-efficient* by the case of a body falling under the action of the constant force of terrestrial gravity, g, we supposed the space (s) fallen through by a body in a given time (t) to be known,—since for the purpose of our illustration it was not necessary to show how s is determined. But it so happens that, in taking this instance to illustrate the *integral* calculus, we have to consider how s is determined, from what, in reality, is all that is known in this case. We know that the force, g, being constant, the velocity generated in any time is proportional to the time, so that, if v be this velocity, we may write $v = gt$, suitable units of time and length being taken. (Usually the unit of time is a second, that of length a foot; in which case, $g = 32{\cdot}2$ and $v = 32{\cdot}2t$.)

Now, knowing that $v = gt$, we may try the same expedient to determine the space traversed at the end of any time t from rest, as we employed in the inverse problem. We may divide up the time into a number of small parts, and suppose the velocity uniform during each short interval of time. Let us see what comes of this experiment. Take $t = n\tau$, where τ is very small and therefore n very large. Then, at the beginning of the rth interval, the velocity is $(r-1)g\tau$, and at the end of this interval the velocity is $rg\tau$. Thus the space traversed in the interval lies between $(r-1)g\tau^2$ and $rg\tau^2$. Doing this for all the intervals, and adding, we find that the total space traversed in time $n\tau$ or t lies between

$$[0+1+2+3+\ \ldots\ +(r-1)+\ \ldots\ +(n-1)]g\tau^2$$
$$\text{and } [1+2+3+\ \ldots\ldots\ +r\ +\ \ldots\ldots\ +n]g\tau^2$$

or between

$$\frac{n(n-1)}{2}g\tau^2 \text{ and } \frac{n(n+1)}{2}g\tau^2$$

or (writing for τ its equivalent $t \div n$) between

$$\frac{n^2-n}{2n^2}gt^2 \text{ and } \frac{n^2+n}{2n^2}gt^2$$

$$i.e. \quad \frac{gt^2}{2} - \frac{gt^2}{2n} \text{ and } \frac{gt^2}{2} + \frac{gt^2}{2n}$$

The larger n is the smaller is the second term of each expression. But we may have n as large as we please, and so bring these two expressions as near to each other in value as we please. This means, of course, that the true value of each, when n is infinite, is

$$\frac{gt^2}{2}$$

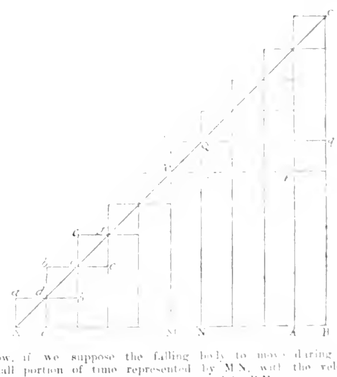
This, then, is the space traversed in time t by a falling body starting from rest, under the action of terrestrial gravity. That is, we have established the relation

$$s = \frac{gt^2}{2}$$

using for the purpose what may be regarded as an algebraical artifice—in reality, disguised integration.

Before showing how this process illustrates integration, let us examine Newton's geometrical way of dealing with a problem such as the above. *Note how cumbersome both processes are.*

Let the time t be represented by the straight line AB, and the velocity acquired at the end of time t (from rest), by the straight line BC at right angles to AB. Now suppose AB divided into a number of small equal parts, say into n parts, each equal to MN; and from all such points as M, N set up straight lines MP, NQ at right angles to AB, and each taken to represent the velocity at the end of the times represented by AM, AN, &c., respectively. Since the velocity is proportional to the time, it is obvious that all such points as P and Q will lie on the straight line AC (for, otherwise, we should not have PM : QN : BC, &c. :: AM : AN : AB).



Now, if we suppose the falling body to move during any small portion of time represented by MN, with the velocity at the beginning of that time, represented by PM, the space traversed by the body in that interval would be represented by the rectangle PN; whereas, if the falling body moves during this interval with the velocity acquired at the end of it, represented by QN, the space traversed will be represented by the rectangle mN [illegible] traversed lies [illegible] N. Thus the [illegible] less than [illegible] AB [illegible] $Ab'c'c$, &c., and [illegible] ABDA [illegible] $aged'b'c'$; [illegible] the sum of the small [illegible] Now [illegible] when n is made [illegible] very small, the [illegible] great, this by no means [illegible] For sliding the rectangle [illegible] and doing the like for [illegible] them finally covering the [illegible] rectangle becomes as small as we [illegible] please, AB becomes as [illegible] the triangle ABC, which [illegible] made to differ from either [illegible] assigned; and this is the same [illegible] represents the space fallen though [illegible] Now AB = t, and BC = gt.

[illegible] AB [illegible] 2 [illegible] 2

[illegible] mistake of supposing that we [illegible] AB represents a period [illegible] only, that the number of [illegible] in AB [illegible] supposed to correspond to the number of [illegible] as we get the right *number* for the [illegible] by multiplying the *numbers* representing [illegible] cannot be multiplied by feet to [illegible] correct [illegible] result, by using [illegible] numbers.

Now [illegible] processes, we have employed an [illegible] case, geometrical in another, to obtain [illegible] as the integral calculus obtains in a systematic manner.

We [illegible] that the velocity at the end of any time t [illegible] that the rate at which the space traversed [illegible] has elapsed from rest, is gt. Now, we [illegible] that the differential coefficient of $\frac{gt^2}{2}$ with respect [illegible] this to mean that the rate of increase [illegible] $\frac{gt^2}{2}$ with the variation of t is represented by gt.

[illegible] that, in dealing with the fall of a body under gravity [illegible] velocity at time t from rest,—or the rate of increase [illegible] space traversed, at this time,—to be gt, and also [illegible] differential coefficient of $\frac{gt^2}{2}$ with respect to t—we [illegible]

$$s = \frac{gt^2}{2} \pm \text{some constant}$$

[illegible] yet shown that two quantities can only [illegible] coefficient when they are either equal or [illegible] but for the present this is assumed, [illegible] the nature and use of differential [illegible] as when $t = 0$, $s = 0$, the constant must be [illegible] that we [illegible] simply, $s = \frac{gt^2}{2}$.

[illegible] knowledge that $\frac{gt^2}{2}$ is the quantity having [illegible] with respect to t, we are at once [illegible] whose velocity at time t is gt, will in [illegible] space $\frac{gt^2}{2}$. The notation employed for [illegible] that what we have to determine is [illegible] in the infinitely small intervals of [illegible] t is supposed divided; in other words [illegible] small spaces, each represented by $gt.\Delta t$ [illegible] the time. This sum, which we should [illegible] spaces not infinite, is in the [illegible] represented by $\int gt\, dt$ when the number is infinite [illegible] Δt [illegible] and we write

$$\int gt\, dt = \frac{gt^2}{2} + \text{constant.}$$

H[illegible] corresponding to particular limiting values [illegible] will be shown further on.

Of course, we have here selected a case where we knew beforehand [illegible] of which the simple expression we were dealing with is the differential coefficient. In other cases, we might have more or less trouble to determine this; but a great number of differential coefficients are known, and in every such case we can at once write down the expressions of which they are the differential coefficients—or, in other words, we can at once solve our problem. For other cases there are methods by which either an exact or approximate solution can be readily worked out.

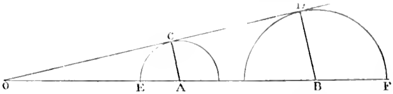
To sum up the elementary points thus far illustrated:—*When there is a quantity which depends on some variable, the differential coefficient of the quantity with respect to that variable represents the rate at which the quantity varies as the variable changes in value.*

When we know the rate at which a quantity depending on some variable changes with change of the variable—in other words, when we know the differential coefficient of the quantity with respect to that variable—we can determine the quantity itself, if only we know what quantity it is which has that differential coefficient.

When we have indicated how the differential coefficients of a number of expressions can be determined, the importance of these points will be recognised.

(*To be continued.*)

PROBLEM 11. We prefer to solve this problem in the following general form, as more instructive than a special case:—



Let AC, BD, *the radii of two drums, be respectively* a *and* b ($b > a$); *and let* AB = d, *required the length of belting necessary for them.*

Let OCD be a common tangent meeting BA produced in O. Then,

$$OA = \frac{a}{b-a} \cdot d = p \text{ say}$$

and

$$CD = \frac{OC}{OA} d = \frac{\sqrt{p^2-a^2}}{p} \cdot d$$

$$\text{arc EC} = a \sin^{-1}\left(\frac{a}{p}\right)$$

$$\text{arc DF} = b\left[\pi - \sin^{-1}\left(\frac{a}{p}\right)\right]$$

Hence length of belting required = 2 (arc EC + CD + arc DF) is known.

THE POISONOUS CONSTITUENTS OF TOBACCO-SMOKE.—A series of experiments has been recently conducted by Herr Kissling, of Bremen, with the view of ascertaining the proportions of nicotine and other poisonous substances in the smoke of cigars. His paper, in *Dingler's Polytechnisches Journal*, gives a useful *résumé* of the work of previous observers. He specifies, as strongly poisonous constituents, carbonic oxide, sulphuretted hydrogen, prussic acid, picoline bases, and nicotine. The first three occur, however, in such small proportion, and their volatility is so great, that their share in the action of tobacco-smoke on the system may be neglected. The picoline bases, too, are present in comparatively small quantity; so that the poisonous character of the smoke may be almost exclusively attributed to the large proportion of nicotine present. Only a small part of the nicotine in a cigar is destroyed by the process of smoking, and a relatively large portion passes off with the smoke. The proportion of nicotine in the smoke depends, of course, essentially on the kind of tobacco; but the relative amount of nicotine which passes from a cigar into smoke depends chiefly on how far the cigar has been smoked, as the nicotine-content of the unsmoked part of a cigar is in inverse ratio to the size of this part, *i.e.*, more nicotine the shorter the part. Evidently, in a burning cigar, the slowly-advancing zone of glow drives before it the distillable matters, so that in the yet unburnt portion a constant accumulation of these takes place. It would appear that in the case of cigars that are poor in nicotine, more of this substance relatively passes into smoke than in the case of cigars with much nicotine; also that nicotine, notwithstanding its high boiling point, has remarkable volatility.—*Times.*

Our Chess Column.

By Mephisto.

VIENNA INTERNATIONAL TOURNAMENT.

Complete Score List.

	Bird	Blackburne	Englisch	Fleissig	Hruby	Mackenzie	Mason	Meitner	Noa	Paulsen	Schwarz	Steinitz	Tschigorin	Ware	Weiss	Winawer	Wittek	Zukertort	Total
Bird	—	01	00	01	10	01	½½	10	½1	½0	00	00	00	11	10	00	½0	00	12
Blackburne ...	10	—	½½	11	10	01	½½	11	01	0½	1½	01	11	11	01	01	10	1½	21½
Englisch	11	½½	—	½1	½½	½0	½½	01	11	11	½½	½½	0½	11	½½	00	½0	1½	19½
Fleissig	10	00	½0	—	00	00	½0	00	½0	½0	00	00	10	00	00	10	00	10	6
Hruby	01	01	½½	11	—	00	10	11	01	½0	½½	10	10	10	1½	00	10	00	16
Mackenzie.....	10	10	½1	11	11	—	½0	11	11	1½	01	½0	01	1½	11	1½	½0	½½	22½
Mason	0½	½½	½½	½1	01	½1	—	1½	01	11	½1	½½	11	11	10	11	11	0½	23
Meitner	01	00	10	11	00	00	0½	—	01	½0	½1	00	11	01	1½	00	½½	00	19
Noa	½0	10	00	½0	10	00	10	10	—	½0	10	00	10	10	00	00	½0	00	9
Paulsen	½1	1½	00	½1	½1	0½	00	½1	½1	—	½1	00	11	11	½1	01	½½	00	18½
Schwarz	11	0½	½½	11	½½	10	½0	½0	01	0½	—	00	0½	½1	1½	00	½½	10	15½
Steinitz	11	10	½½	11	01	½1	½½	11	11	11	11	—	10	01	1½	1½	01	0½	24
Tschigorin ...	11	00	1½	01	01	10	00	00	01	00	1½	01	—	1½	00	00	0½	10	13
Ware	00	00	00	11	01	0½	00	10	01	00	½0	10	0½	—	11	00	0½	00	10
Weiss	01	10	½½	11	0½	00	01	0½	11	½0	0½	0½	11	00	—	0½	½1	11	16½
Winawer	11	10	11	01	11	0½	00	11	11	10	11	0½	11	11	1½	—	01	1½	24
Wittek	½1	01	½1	11	01	½1	00	½½	½1	½½	½½	10	1½	11	½0	10	—	00	18½
Zukertort	11	0½	0½	01	11	½½	1½	11	11	11	01	1½	01	11	00	0½	11	—	22½

Second Game of the Tie Played on June 24.

White. Winawer.	Black. Steinitz.	White. Winawer.	Black. Steinitz.
1. P to K4	P to K4	35. R to QRsq	K to K4
2. KKt to B3	QKt to B3	36. P to KR3 (o)	R to R5 (p)
3. QKt to B3	P to KKt3	37. P to B3	B to B5
4. P to Q4	P takes P	38. B to B2 (q)	R to R3
5. Kt takes P	B to Kt2	39. P to KKt4 (r)	P to R5
6. Kt takes Kt	KtP takes Kt	40. P to R4	R to Kt3
7. B to Q3	Kt to K2	41. R to QKtsq (s)	R takes R
8. Castles	P to Q3	42. B takes R	B to B8
9. Q to Ksq (a)	Castles	43. K to B3	P to Kt4 (t)
10. P to B3	P to KR3	44. B to R2	P to B3 (u)
11. B to K3	K to R2	45. B to B7	B to Q6
12. Q to Q2	P to KB4	46. K to B2 (v)	K to B5
13. QR to Ksq	P takes P (b)	47. P to R5	B takes P (w)
14. P takes P	R takes R (ch)	48. B to B4	P to Q4
15. R takes R	B to K3	49. B to R6	P to B4
16. Kt to K2	P to B4	50. B to B8	P to B5
17. Kt to B4	B to Ktsq	51. P to R6	K to K4
18. P to QKt3	Q to Q2	52. B to Q7	P to Q5
19. R to B3	R to KBsq	53. P takes P (ch)	K takes P
20. R to R3	B to B2 (c)	54. K to K2	B to Q6 (ch)
21. Kt to Q5 (d)	P to R4 (e)	55. K to Ksq	P to B6
22. Kt takes Kt (f)	Q takes Kt	56. B to B8	K to K6
23. R to B3	K to Ktsq (g)	57. K to Qsq	K to B7
24. QB to Kt5 (h)	Q to K4 (i)	58. B to B5	B takes P
25. B to R6	R to Ksq (j)	59. K to B2	B to B8
26. B takes B	K takes B	60. K takes P	B takes P
27. Q to B4 (k)	Q takes Q	61. K to Q4	B to Kt7
28. R takes Q	P to B5 (l)	62. K to K5	P to R6
29. P takes P (m)	R to K4	63. K to B6	P to R7
30. R to Bsq	R to QB4 (n)	64. K takes P	P to R8Q
31. K to B2	B takes P	65. K to Kt6	K to B6
32. K to K3	B to K3	66. P to Kt5	K to B5
33. R to QKtsq	K to B3	Resigns.	
34. P to QR3	R to R4		

Notes by Herr Steinitz, from the *Field*.

(*a*) Not a good post for the Q. Herr Winawer probably intended to support his Kt, in order not to be subjected to the doubling of his QBP, while reserving the choice of squares for his QB.

(*b*) He isolates the adverse P, but he exposes himself to an attack which he afterwards finds somewhat troublesome, and which subsequently required the greatest care in defending.

(*c*) Probably the only move. It makes room for his K, and liberates his Kt for action; the latter could not move at once; for White would have sacrificed the Kt for the KtP, which Black could not venture to retake with the K, on account of the rejoinder, P to K5 (dis. ch).

(*d*) White is not to be tempted into sacrificing the Kt, whereupon the game might have proceeded thus:—

White.	Black.	White.	Black.
21. Kt takes P	Kt takes Kt	22. B takes RP should win.	R to KRsq, and

(*e*) Again the only move; if Kt to Kt sq, White could still take off the RP, for if the B retook, the reply R takes B(ch) would win since the Kt could not retake, on account of Kt to B6(ch); if, however the Kt then took the B, White would mate in a few moves commencing with Kt to B6(ch).

(*f*) White judiciously gives up all attack which he could not sustain; for instance, by P to KKt4—since Black would then pin the P by B to K3, and afterwards Q to Q2.

(*g*) First part of a plan for inducing the opponent to exchange pieces and to bring about an ending.

(*h*) With the view of driving the Q to K4, and in order to be enabled to oppose Queens at KB4 subsequently.

(*i*) She cannot retreat to Q2, as the B would be opposed at B6 with advantage.

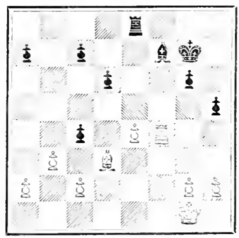
(*j*) It would have been very unwise to check with the Q at R8, and then to take the QRP; White would interpose the R, followed by B takes B, Q to B3(ch), and R to Rsq, with an excellent game. The move in the text is another preparation for this game in the ending, as will be seen on Black's 28th and 29th move.

(*k*) The offer of exchanging Queens is ill advised; White would have had a perfectly even game otherwise. Herr Winawer subsequently admitted that he had ignored the effect of Black's next move after exchanging.

(*l*) This move exercises a most important effect on Black's prospects in the ending, for it forces the separation and isolation of White's Pawns on the Q side.

Steinitz.

BLACK.



WHITE.

Winawer.

(*m*) He could not evade the unpleasant necessity of capturing, for, if he moved the B to K2, Black would still answer R to K4; threatening R to QR4, and also to win a P at once by P to KKt4.

(*n*) Stronger than R to QR4, *e.g.*:—

White.	Black.	White.	Black.
30.	R to QR4	34. R to QB7	R takes P
31. R to Ktsq	K to B3	35. P to K5	P takes P
32. R to Kt7	P to B4	36. B to K4, with a strong attack	
33. R to Q7	K to K3		

(*o*) Not a good move; P to QB3 was better.

(*p*) Black threatens now to bring the B round to QB3 *via* Q2.

(*q*) Obviously he could not afford to exchange, as his separated Pawns would soon fall, one by one.

(*r*) This compromises the position of his Pawns on the K side, too; as, after the exchange of Rooks, which is soon inevitable, they are all placed on squares on which they can be attacked by the hostile B.

(*s*) He could not afford to allow the R to reach Kt7, as his two pieces and the K would be too much confined, and an unfavourable exchange of Bishops could be easily forced, after which the R would gain access at KR7, taking the KRP.

(*t*) Better than taking the P, whereupon White would have blocked in the B by B to Q3.

(*u*) Necessary in order to prevent the adverse B from reaching Q5, and then defending alternately by B to B6, Kt5, or Q5 accordingly.

(*v*) Perhaps in the hope that Black might take the P with the K.

whereupon White would win a piece by B to Kt6(ch). He could, [illegible] the P if B to Kt6, Black could advance P to Q4.

(c) Black has it [illegible] own way after this, and rests easy.

ANSWERS TO CORRESPONDENTS.

. *Please address Chess-Editor.*

T. G. [illegible] — Problem 45. If 1. R to R3, 1. P takes B, and there is [illegible].

A. A. F. [illegible] will appear as soon as possible.

Problem 45 correctly solved by Moleque. Senex. Solitarius. Francis J. Drake.

Our Whist Column.

By "Five of Clubs."

RETURNING PARTNER'S LEAD.

THERE is scarcely any more obnoxious rule at Whist than that which many good players of their own hands insist upon, that partner's lead should almost always be at once returned. The player who always returns your lead at once is more annoying even than the one who, when the right time has come for returning it, insists on keeping to his own suit. I would even take exception to Cavendish's rule that "with only moderately strong suits, which you open to a disadvantage, you do better to return your partner's original suit, or to lead up to the weak suit of your right-hand adversary, or through the strong suit of your left-hand adversary," than to open your best suit,—*unless* by the words, "which you open to a disadvantage," he means to qualify the expression, "moderately strong suits," and not (as it seems) to make a statement respecting such suits. It is clear that, with only weak three-card suits outside trumps, you do better to return your partner's suit than to lead one of your own. On the other hand, with a tolerably strong three-card suit, headed by a sequence, you do better to lead your own suit. With a four-card suit headed by anything below a Knave, you might return him his suit; but with such a suit as Knave, nine, eight, three, you ought in my opinion, to show your own suit before returning his—especially if you have good cards in your short suits, so as to have a good chance of an opportunity to lead again to him. This is always to be considered, for if you have only a moderately good long suit, and weak cards in the other suits, you may have but one chance of returning his lead, while it may be of great importance [illegible] led to, and not have to lead himself. Besides, he may have a strong suit, which may be established if he gets a return, and he may then lead trumps, and make a great game; [illegible] if you lead your own moderately strong suit, you [illegible] will play into the adversaries' hands.

There are some cases, however, where, even when you have a strong suit, you should at once return your partner's lead. Thus, if after [illegible] you remain with the leading card in his suit (which his play shows to be strong), you should play out that card at once to clear his suit. Again, if you held originally only two cards in his suit and are weak in trumps, you should return his lead, so that he may lead the suit a third time for you to trump; [illegible] you help him to clear his suit, while using a trump which would probably fall uselessly.

When the player to your left has shown great weakness in your partner's suit, as by failing to head a nine, ten, or Knave of [illegible], it is generally unsafe to return the [illegible] must be between your partner and the player [illegible] you are probably leading up to strength. [illegible] lead under not very favourable conditions, as [illegible] so that the player to your right [illegible] much as fourth player usually [illegible]. But he will not be quite so badly off as when you lead to him [illegible] played by you third in hand may be the [illegible] the player to your right can [illegible].

The [illegible] rule in returning partner's lead, and one of the most [illegible] general rules at Whist, is to return the highest of two remaining cards, the lowest of three or more. The only exceptions to this rule are that (1) with the winning card and two others (left after first round) you lead the winning card, and (2), with [illegible] and another (after first round), you lead the [illegible], not the small one. With these exceptions (and [illegible] two, perhaps, where your partner is utterly weak [illegible] to deceive the enemy), this rule is imperative, and [illegible] throughout the whole range of the suit. Thus, with 4, 3, left after first round, the return of the 3 would be a gross Whist blunder, as would be the play of the 4, if, besides the 4 and 3, you hold the 2 also. In these cases nothing is directly gained or lost by the lead of 4 or 3. Yet the rule had its origin in considerations of play. For with such cards as Queen and a small one, or Knave and a small one (after first round), the lead of Queen or Knave is manifestly good policy; for thereby you strengthen your partner: you are numerically weak in the suit, and most probably lose nothing yourself; whereas with Queen and two small ones, or Knave and two small ones (after first round), you do well to keep back the Queen or Knave, being numerically strong, and having a fair chance of not only making the honour, but remaining with the best card in the suit after three rounds.

In trumps, this rule is even more important than in plain suits. The whole strategy of the game may be ruined by your telling your partner (as you do in returning his lead wrongly) that you held originally only three trumps when you really held four, or that you held four when in reality you only held three.

A player who neglects this general rule, of which, of course, no Whist player is ignorant, can only be regarded as a very poor player indeed. Scarcely inferior is the player who, when this signal is given him, fails to notice it, or who overlooks it when it occurs in the play of his adversaries. Omitting to notice the signal for trumps either in partner's or adversaries' play is in comparison a small offence.

DOUBLE DUMMY PROBLEM.—Lieutenant-Colonel Drayson gives the following ingenious little double dummy puzzle:—Give the adversaries four by honours in every suit; give yourself and partner any of the other cards you choose, and win five by cards against them, you to have the lead.

VALUE OF GOOD PLAY.—A correspondent, as a further proof that good play must tell, gives us his experience, which was carefully taken down. In two years' play, he tells us that the first year he played 2,069 rubbers, winning 1,097 and losing 972, leaving a balance of 125 to the good, and, counting points, he won 5,893 and lost 5,233—a balance of 660 to the good. And in the next year he played 1,626 rubbers, winning 855 and losing 771, or a credit of 84 rubbers, the points being 4,701 wins, 4,159 losses—showing balance of 552 to the good. In the previous year he played 2,029 rubbers, winning 1,107 and losing 922, leaving 185 balance on the winning; but that year he did not keep a record of points. This is, of course, a much higher winning average than Cavendish's; but, as our correspondent admits the inferiority of his player compared to Cavendish, probably the element of luck steps in here. He adds that, in his long experience of play, there was never a week, scarcely even a sitting, that he did not see at least one rubber lost by bad play or won by good.

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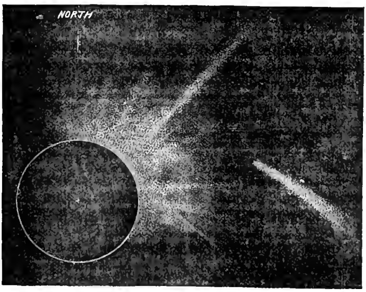
THE COMET SEEN DURING THE ECLIPSE.

By A. C. RANYARD.

THE accompanying sketch gives the position of the comet, as shown on my photographs, with some of the more marked rays of the corona stretching out from the sun's limb on the side towards the comet; but no attempt is made to indicate the smaller structure of the corona. The scale of the wood-cut nearly corresponds with



the largest of the photographs. It will be seen that the head of the comet is situated at about a solar diameter from the sun's limb, and that the tail is greatly inclined to the line joining the head of the comet with the sun's centre. There is a slight curvature of the comet's tail; but its general direction is such that if a medial line, which we will call the axis of the tail, were produced, it would not pass through the moon's disc. It is evident that this inclination of the tail cannot be merely due to an effect of perspective, the tail of the comet being really radial, and the nucleus situated on this side of the sun's centre, or on the opposite side of the corona—for a straight line can only be projected into a straight line or a point; and if the sun's centre lay upon the axis of the comet's tail produced, the tail, from whatever position it was viewed, would always appear as radial to the sun's limb. A little consideration will show that the inclination of the tail to the line drawn from the sun's centre to the head of the comet may have been greater than it appears in the photograph, but it cannot have been less.

Though the fact that the tail of the comet was greatly inclined to the radius vector struck me on first examining the photographs, the probable significance of the fact has only recently occurred to me. Small jets issuing in various directions from the nuclei of large comets have frequently been observed, but these jets do not extend to any great distance from the nucleus; and, as far as I am aware, they have not been observed extending beyond the outer envelopes of the head of the comet; while the chief tail into which the envelopes of the head merge streams away in a direction opposite to the sun. If the comet were moving freely in space (that is, not in a resisting medium), and a repulsive force from the sun was the only force acting upon the matter of the tail, we should expect to find the tail either straight, or curved in the plane of the orbit of the comet, when the velocity with which the matter of the tail is driven away is very great, compared with the orbital velocity of the nucleus, we should expect to find a straight, or very nearly straight, tail stretching away from the sun; but if the velocity of the matter of the tail is not very great, as compared with the orbital velocity of the nucleus, we should expect to find a curved tail, with the part in the immediate neighbourhood of the nucleus directed away from the sun, for the matter of the tail on leaving the head of the comet would have an orbital velocity which would carry it onward equally with the nucleus, if undisturbed by a resisting medium, and the small particles of the tail would only drop behind as the motion of the nucleus and particles of the tail were changed by the central forces acting upon them. But if the comet were moving in a resisting medium, the small particles of the tail would lose their orbital velocity more rapidly than the matter of the nucleus, and the tail would have the appearance of being blown backwards by a wind.

Having regard to the direction of the curvature of the tail, which is slightly concave towards the south, and to the inclination of the general axis of the tail to a radial line drawn from the sun's centre to the nucleus of the comet, we may, I think, assume that the comet was moving in an upward direction, but whether towards us or away from us, and whether it was nearer or more distant from us than the sun's centre, or whether it was coming up to or had passed perihelion, must, I fear, remain a mystery.

The comet observed by Sir I. Newton in 1680, and the comet of last year which was referred to by Mr. Proctor as having not improbably had its period shortened by the resistance of the corona, both, probably, passed within a third of a radius of the sun's surface. From general reasoning one would suppose that under the influence of solar gravity the density of the gaseous atmosphere of the corona would increase rapidly as we descend from the outer limits of the corona towards the photosphere, but our want of knowledge with respect to the temperature of the coronal area and the behaviour of dust particles and gaseous matter at such high temperatures prevents our making any useful assumption with respect to the law of increase of density of the solar atmosphere. It is known that in the chromosphere at the base of the corona, hydrogen, and many of the terrestrial elements, give a spectrum of narrow lines similar to the spectrum given in terrestrial laboratories under very small pressures; but, whatever the density of the gaseous matter of the chromosphere may be, there are facts which render it probable that there is a resisting medium within the coronal area which increases in density as we descend from the outer limits of the corona towards the photosphere. The structures in the lower parts of the corona are more curved than the rays which extend into the outer parts of the corona, as if they had been acted upon and bent by currents in an atmosphere, and the contorted forms of some of the eruption prominences also indicate the existence of a resisting medium. Definite evidence with respect to the existence of such a resisting atmosphere has been deduced from observations made by Professor Young with respect to the rate of projection of irruption prominences. See a paper by Mr Proctor, published in the *Monthly Notices* of the Royal Astronomical Society for December, 1871.

The comet observed during this eclipse is not the only cometary body which has been observed in the neighbourhood of the corona during an eclipse. The photographs taken by Mr. Davis and Col. Tennant, during the eclipse of 1871, show an opaque nucleus, with dark concentric structures partially surrounding it, which cut out the light of the bright parts of the corona, and seem to have been due to a small comet situated between the earth and the corona. An account of these dark structures is given in the *Monthly Notices* for June, 1871. Professor Winnecke, in describing the corona, observed during the eclipse of 1860, also speaks of a dark body which appears to have been unconnected with the corona: he describes it as a parabolic dusky arc, which looked as if it was drawn with sepia upon the brighter background of the corona. A drawing of this curious body is given in the memoirs of the Imperial Academy of St. Petersburg, 7th Series, Vol. IV.

THOUGHT-READING.

By the Editor.

In the cases last considered, the explanation may be suggested that some code of signals may have been arranged by which the proper answer was communicated to those questioned. The following cases are free from this objection:—

"It will be well to give," writes Prof. Barrett, "a group of results obtained when no member of the family was aware of the selected object. Eleven times running we chose a card at random, and on six of these occasions one of the children named the selected card (giving both suit and pips, or fully designating the court card) correctly at the first trial; twice the card was named correctly on the second trial; and three times were failures. On none of these occasions was it even remotely possible for the child to obtain by any ordinary means a knowledge of the card selected. Our own facial expression was the only index open to her; and even if we had not purposely looked as neutral as possible, it is difficult to imagine how we could have unconsciously carried, say, the two of diamonds written on our foreheads. The outcome of results during the present investigation, which extended over six days, stand as follows:—Altogether, 382 trials were made. In the case of letters of the alphabet, of cards, and of numbers of two figures, the chances against success on a first trial would naturally be 25 to 1, 51 to 1, and 89 to 1, respectively; in the case of names they would, of course, be indefinitely greater. Cards were far most frequently employed, and the odds in their case may be taken as a fair medium sample; according to which, out of the whole series of 382 trials, the average number of successes at the first attempt by an ordinary guesser would be 7⅓. Of our trials, 127 were successes on the first attempt, 56 on the second, 19 on the third, making 202 in all. On most of the occasions of failure, 180 in number, second trials were made; but in some cases the guesser professed inability, and declined to make more than one, and in others we allowed three; no trial beyond the third was ever allowed. During the last day or two of trial, after it had occurred to us to notice the point, we found that of the failures to guess a card at the first trial, those wrong both in suit and number were a small minority. Our most striking piece of success, when the thing selected was divulged to none of the family, was five cards running, named correctly on a first trial; the odds against this happening once in our series were considerably over a million to 1. We had altogether a good many similar batches, the two longest runs being eight consecutive successes, once with cards, and once with names; where the adverse odds in the former case were over 142 millions to 1, and in the latter something incalculably greater. If we add to these results others obtained on previous visits, it seems not too much to say that the hypothesis of mere *coincidence* is practically excluded."

"The exceptional nature of this inquiry," proceeds Professor Barrett, "goes far to invalidate arguments founded on character and demeanour; and, on this head, we will only state our conviction that any candid critic, present during the whole course of the experiment, would have carried away a far more vivid impression of their genuineness than the bare printed record can possibly convey. Of more real importance is the hypothesis of exalted sensibility of the ordinary sense organs. We could discover no indication of this in any of its known forms; but by way of precaution, as has been already stated, we commonly avoided even whispering any word, number, or name that we had selected; and the position of the excluded child, when the door was opened, would in every case have satisfied the most exacting critic. The explanation which might be sought in unconscious indications given by the sitters, and especially in the movement of the lips, has been already adverted to. Coming as we did to this investigation with considerable previous experience of the same kind, we were throughout strictly on our guard against giving such indications ourselves; the possibility of their being given by the family was, of course, excluded where the family were ignorant of the selected word or thing; and on the remaining occasions our perpetual vigilant watch never detected a trace of anything of the kind. The absolute docility of the children—both the guesser and the others—in taking any position in the room that we indicated, was naturally an assistance to our precautions. It may be further mentioned that, on a previous visit made by one of us, the child called the required name through the shut door, or from an adjoining room, having thus been completely isolated from the very beginning to the very end of the experiment."*

Other evidence of this sort will be considered further on. At this stage it may be well to note the objection raised by Professor Donkin. "The matter in question,"

* "Among the friends above referred to as having taken part in these inquiries are Professor Balfour Stewart and Professor A. Hopkinson, of Owen's College. A communication lately received by us from them, embodying the results of their visits, and written without any knowledge of the contents of this paper, states facts and instances criticisms as to the possible (or impossible) relation to those facts of *coincidence*, *collusion*, *sight*, and *hearing*, precisely similar to those we have given. Their experience was that 'in about half the cases the first guess was right, and in most cases of mistake there was some marked point of similarity between the object proposed and the thing guessed.'"

he says, "has obtained a somewhat undue prominence of late; but if it is as simple and intelligible as it appears to be to most who have investigated it with care, and with minds free from mystical bias, any aid towards the extinction of what must then be regarded as an *ignis fatuus* of pseudo science carries with it its own justification." Passing over cases in which there was actual contact between the persons guiding and guided, Professor Donkin remarks that in cases where there was no actual contact, "common sense demands that every known mode of explanation of facts should be exhausted before the possibility of an unknown mode is considered." "It is equally obvious that in all scientific inquiries the good faith of individuals concerned should form no part of the data on which the conclusion is to rest. We can never call on science to put deception out of court by a belief in any one's integrity. Half of the evidence which has propped up the spiritualistic craze is based on the results obtained through mediums of "unblemished character" in private families, whose virtuous reputation has been largely sustained by the fact that they did not take money for their trouble; no regard being paid to innumerable other motives and tendencies to deception." (This is very well put.) He then considers the "code of signals" explanation, which "fully serves to cover all the facts in question," though it is only by straining the evidence that the cases in which no members of the family were present when an object was selected, that Professor Donkin makes out this point. "From the only rational point of view," he says, "that of scientific scepticism, and, therefore, with total disregard of the personal factor, this consideration seems in no way to invalidate the line of comment here taken. It is not clear to how many of the three observers the pronoun 'we' in the passage [above] refers, but, at any rate, we miss entirely in the paper any specific quotation of results obtained in the latter set of circumstances. But even if this evidence had been forthcoming, no mere *ipse dixit* on such a matter could for one moment be admitted. Reason would require us to entertain the great probability of mental bias in some, at least, of the observers, or to discredit the accuracy of their memory, rather than to allow that anything has been adduced in this account of what (to say the least) must be regarded as superficially-conducted experiments, to warrant a recognition of any novelty, or by consequence to stand in need of explanation by a theory of 'brain-waves.'"

The spirit of extreme caution here indicated is altogether sound; the objection to novelty, as such, is as entirely unsound. *Nothing* could prove that mind acts on mind if Professor Donkin's principle were accepted in its full extent. The theory might be established so far as he himself was concerned, by an experience of his own, but no one else would be bound to accept it, and it cannot possibly be proved to each person separately and individually.

Professor Donkin seems unaware of the fact that Dr. Carpenter, who has dealt with such subjects more closely perhaps than any living man of science, and always from the sceptical side, admits all that, as I conceive, even Professor Barrett and his colleagues consider proved. In the following passage the reader will note the distinction between what Dr. Carpenter has been led to suspect, and what he regards as beyond question:—

"Everyone who admits that 'there are more things in heaven and earth than are dreamt of in our philosophy,' will be wise in maintaining a 'reserve of possibility' as to phenomena which are not altogether *opposed* to the laws of physics or physiology, but rather *transcend* them. Some of my own experiences have led me to suspect that the power of intuitively perceiving what is passing in the mind of another, which has been designated as 'thought reading,' may, like certain forms of sense perception, be extraordinarily exalted by that entire concentration of the attention which is characteristic of the states we have been considering. There can be no question that this divining power is naturally possessed in a very remarkable degree by certain individuals, and that it may be greatly improved by cultivation. So far, however, as we are acquainted with the conditions of its exercise, it seems to depend upon the unconscious interpretation of indications (many of them indefinable) furnished by the expressions of the countenance, by style of conversation, and by various involuntary movements; that interpretation, however, going, in many instances, far beyond what can have been learned by experience as to the meaning of such indications."* "Looking at nerve force as a special form of physical energy, it may be deemed not altogether incredible that it should exert itself from a distance, so as to bring the brain of one person into direct dynamical communication with that of another, without the intermediation, either of verbal language, or of movements of expression. A large amount of evidence, sifted with the utmost care, would be needed to establish even a probability of such communication. But would any man of science have a right to say that it is *impossible?*"

(To be continued.)

A STUDY OF MINUTE LIFE.

BY HENRY J. SLACK, F.G.S., F.R.M.S.

A SPECIMEN of bottom yeast—the *unterhefe* of the Germans—taken from a vessel in which fermentation had been arrested for some time, showed, under a magnification of 200 linear, that the little plant cells had been starved. All of them were much too small, and instead of being approximately globular, many were sausage-shaped, some like thin cylinders, and amongst them many minute beaded rods, which would be ranked amongst the *Bacteria*. Any further fermentation carried on under such circumstances would give rise to products not wanted in any process of brewing or wine-making, and, if nothing worse happened, a good deal of vinegar would be formed at the expense of the alchohol which resulted from the action of the true yeast cells. Beer or wine in that condition is popularly said to be pricked. Pure diluted alcohol has no tendency to undergo a fermentation into the vinegar condition, but if any of the microfungi of the vinegar-plant sort are present, and also some easily oxidable vegetable matter, the acetic change soon occurs. One of the best modes of making vinegar on a large scale is to cause a fluid containing alcohol and sweet-wort to trickle slowly over wood shavings or birch twigs. A slimy substance forms in a few days all over the shavings or twigs, and this modifies the alcohol into acetic acid. If the slimy stuff is examined under the microscope, it is found to contain, besides yeast-like cells, millions of small beaded rods—a kind of bacterium. Both brewers and wine-makers are much troubled through

* Dr. Carpenter then mentions some very curious examples related in the autobiography of Henrich Zschokke, who (according to his own statement) possessed this power in a very remarkable degree, frequently being able to describe, not only the general course, but even many particulars, of the past life of a person whom he saw for the first time, and of whose history he knew nothing whatever.

these and various microfungi they do not want intruding into their fermentations, and giving their liquids a bad flavour. In other very numerous cases the beer or wine seems all right at first, but will not keep. Whether in cask or bottle, some of the intrusive ferments continue in operation, either producing vinegar, or some other substance with an objectionable flavour. To minimise the danger, brewing should be carried on in pure air, and with the greatest regard to cleanliness. Fermenting the wort in a warm temperature, as is common in this country, is more favourable to the growth of the undesirable organisms than the cooler process so much employed in Germany. If beer, made by "high fermentation," that is at a warm temperature, and with the yeast cells rising to the top, is intended to keep for a length of time, or to stand a sea voyage, it must be strong and well hopped, the aromatic oil of the hop being unfavourable to the growth of microferments. Besides getting sour, beer and wine are liable to turn ropy and putrid, through the action of special ferments whose germs are very widely diffused. Slender beaded organisms, straight, curved, or spiral, some quiet, others in quick motion, preside over these changes, producing what Pasteur calls various "maladies" in the fluids they attack. The "low fermentation" goes on slowly at low temperature, and the yeast falls to the bottom of the vessel. The temperature should be about 45° F., and great quantities of ice are used in the German breweries to enable the process to be carried on during the warmer months. The beer is also kept in cool cellars, and Pasteur states that nearly 2 cwt. of ice is consumed in getting 22 gallons of beer ready for sale. If well made and carefully bottled, this kind of beer will keep without being of great alcoholic strength, or highly hopped.

If wine is likely to be affected by the intrusive ferments, Pasteur recommends bringing it near the boiling point after it is put into bottles. This kills the microferments, and, if carefully performed, leaves the wine with a good flavour, but it is said that when so treated it does not improve with age.

It is interesting to let a saccharine fluid spontaneously pass into the acetous fermentation and examine the organisms under the microscope. If a little yeast is used to start the alcoholic fermentation, and the liquid is then left for some time in a warm place and exposed to the air, it is pretty sure to turn sour. From a wide mouthed bottle containing an ounce or two of a saccharine fluid so treated a little ropy mass is taken from the bottom and found to be composed of vast multitudes of minute beaded threads thickly interlaced. Sometimes a leathery mass is found — the so-called "mother of vinegar," or vinegar plant. Many families make their own vinegar by its means. They put it into a pretty strong solution of coarse brown sugar, and in a few weeks find it is turned to good vinegar, and the plant greatly increased in thickness. It is then like a stout piece of wet buff leather, and easily split horizontally. If a small piece is placed in a bottle such as is used for Preston salts, in a solution of lump sugar, a growth is soon obtained transparent enough for convenient examination. After viewing it with a low power, one of 100 or more diameters should be used. A number of yeast-like cells, associated with multitudes of beaded, rod-like cells, are then seen to be immersed in a mass of tough, gelatinous matrix. If a vinegar plant is taken out of a vessel, with a sufficient depth of fluid to keep its under surface and part of its thickness completely submerged, and placed in a shallower one, so that it is much more exposed to air, it does not continue to carry on the acetous fermentation, but is soon covered with crops of blue mould. The sugar disappears, gets slowly burnt up, but neither vinegar nor alcohol is obtained. In some experiments by the writer, published in 1865 by the Microscopical Society, it was found that vinegar plants dried in an oven, at a temperature too low to burn them, were reduced to a state like dry gelatine, which clicked when thrown upon glass. Exposed to the air they absorbed moisture, and when thoroughly wetted the various cells appeared uninjured, but most of them no longer produced the acetous fermentation. In one case, the butyric fermentation occurred in a saccharine solution, evidenced by the peculiar and very nasty smell of highly rancid butter. In another case, after six months' immersion, a dried piece of the plant began to form vinegar, and produced loosely aggregated cells which carried on the process.

The same kind of cells may produce quite different effects under varying conditions. They may take the oxygen they want from the air, or, if that is excluded, obtain it by decomposing some substance present. The number of new combinations that may be produced by partial decompositions and oxidations is indefinitely large, and may give rise to "maladies" of beer, wine, butter, &c., and in the human organisms, to various diseases.

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

By AMELIA B. EDWARDS.

IV.—THE CONSECUTIVE AND SYNCHRONOUS THEORIES.

IT is difficult to make even the roughest historical calculation without some use of dates; but, as I have already said, no dates that can be applied to this early epoch of Egyptian history are other than approximate. We may estimate the number of years which elapsed between one given event and another given event, and we may thence calculate our way to a third event, and all three conclusions may be relatively accurate; but to label any one of the three with a positive date B.C. is, in the present state of our knowledge, impossible. Still it is necessary, if only in order to be intelligible, temporarily to accept a fixed date of some kind; and for this purpose I propose to accept Mariette's date, B.C. 1462, for the beginning of the XIXth dynasty. Mariette, it should be said, founded his chronological system on the historical lists compiled by an Egyptian historian named Manetho, who was high-priest of the Great Temple of Heliopolis and Keeper of the Archives, under Ptolemy Philadelphus, B.C. 281–246. Manetho, though a native Egyptian, wrote in Greek, which was the language of the Ptolemaic court (just as Turkish, and not Arabic, is now the language of the court at Cairo); and in Greek he composed his famous "History of Egypt," which was either a direct translation of ancient historical papyri, or an original narrative based upon those early chronicles. This invaluable work has perished; but some precious quotations from it are found in the writings of Josephus, Eusebius, and George the Syncellus before-mentioned. Above all, the great chronological list of dynasties and kings from Mena to Alexander is preserved entire in the works of several Christian chronologists. Following this list, Mariette places the XIXth dynasty between B.C. 1462 and B.C. 1288. The first three Pharaohs of this dynasty were Rameses I., Seti I., and Rameses II. Tabulated according to the number of their regnal years, as recorded on the monuments, they stand as follows:—

Rameses I. reigned 6 years.
Seti I. reigned 51 years.
Rameses II. reigned 67 years.

To calculate these reigns would, at first sight, seem straightforward enough. If Rameses I. began the dynasty B.C. 1462, must not Seti I. have succeeded B.C. 1456, and Rameses II. B.C. 1405? And would not the sixty-seventh and last year of Rameses II. have fallen in B.C. 1339? And if we cast up the three reigns, shall we not produce a sum-total of 124 years?

Unfortunately, this is precisely what we may not do; and for the reason that Egyptologists, although agreeing as to the length of these various reigns, differ *in toto* as to whether they were consecutive or synchronous. If consecutive—each Pharaoh succeeding to the throne upon the death of his predecessor, in regular order—then the three reigns would undoubtedly represent a period of 124 years; but if synchronous—that is to say, if one Pharaoh began to reign during the lifetime of his predecessor, and counted his first regnal year from that date, instead of from the year when his predecessor died—then an entirely new calculation, resulting in a much-abridged total, will have to be made.

Fairly stated both ways, the question stands thus:—

1. The XIXth dynasty began with Rameses I., who reigned six years, and who may, or may not, have shared his brief authority with Seti I., his successor. But Seti I., who reigned for fifty-one years, undoubtedly shared his throne with Rameses II. for many years before he died; and Rameses II., more than half a century later, as certainly took his own successor, Menephthah, into the same kind of royal partnership. Now, according to the synchronous theory, which is Brugsch's theory, Rameses II. dated his regnal year from the time of his association with Seti I.; at which time Brugsch supposes him to have been about twelve or thirteen years of age. Some thirty, or thirty odd, years of his long reign of sixty-seven years would thus, it is maintained, be counted in with the reign of his father. If, therefore, accepting B.C. 1462 for the commencement of the XIXth dynasty, we allow, in round numbers, thirty years for the joint sovereignty of Seti I. and Rameses II., we bring the beginning of the younger Pharaoh's reign to B.C. 1435; his accession to the undivided crown to B.C. 1405; and his death, at the close of a reign of sixty-seven years, to B.C. 1368. Total of three reigns, from B.C. 1462 to B.C. 1368—94 years.

2. The advocates of the consecutive theory, as opposed to the advocates of the synchronous theory, found their argument upon the details of certain military campaigns which are chronicled in the form of sculptured bas-reliefs and graven inscriptions upon the walls of various temples in Nubia and Upper Egypt. Here, at battles and sieges distinctly dated as having taken place in the fifth and eighth years of his reign, Rameses II. is represented accompanied by several of his sons, who, though evidently mere youths, are at all events old enough to take part in the thickest of the fight. That the king is himself depicted in these tableaux as a man in the prime of life, cannot be accepted as evidence either way, since the artist would, of course, so represent him, no matter how old or how young he might be. But that a youth of seventeen or twenty should be the father of sons ranging from, at least, twelve to fifteen years of age, would be somewhat miraculous. If, however, we suppose the monumental dates of the reign of Rameses II. to be counted from the year of the death of Seti I., then Rameses II. would be thirty five or forty years of age in the fifth year of his reign, and old enough to be the father of a large grown-up family. This, at all events, is the opinion of Maspero, of Lenormant, and of the majority of French and English Egyptologists. Starting, therefore, with B.C. 1462, for the beginning of the XIXth dynasty, the consecutive theory brings up the reigns of Rameses I., Seti I., and Rameses II. to a total of 124 years.

Beginning, as before, with the synchronous hypothesis, and holding fast to B.C. 1462, for the commencement of the XIXth dynasty, we will next see to what extent these dates correspond with the era of Nubti and the Hykshos calendar.

(*To be continued.*)

ENGLISH SEASIDE HEALTH-RESORTS.

By Alfred Haviland, M.R.C.S., F.R.M.C.S. Lond.

CLASSIFICATION (*Continued from page 92*).

II.—As to their Position on the Seaboard; whether they enjoy the warm moist Air from the Gulf Stream, the bracing Air of the North Sea, or an Atmosphere brought by the Winds after it has lost its Sea character by passing over thousands of square miles of Continent.

The Gulf Stream, which has such a powerful influence on the climate, not only of our seaboard, but of the whole of the British Isles, must naturally claim the attention of all who really desire to acquire a sound knowledge of the cause of the exceptional high air temperature of our country within the interlatitudinal zones, described above, compared with that of other parts of the northern hemisphere lying within the same zones, but between different degrees of longitude to our east and west.

For the sake of clearness we may draw a distinction between the winter and summer temperatures of our atmosphere, inasmuch as their causes are distinct, although both are originally due to one grand cause—the sun. Our *winter heat* is an exotic, begotten by the sun-heat that pours down on the waters of the Gulf of Mexico, a large portion of which, as well as their point of issue, the Straits of Florida, lie under the tropic of Cancer. This sun-heat, thus conceived by the sea, is transported in a north-easterly direction, by the vast marine current of the Atlantic, which owes its origin to the south westerly anti-trade winds (our *true* south-west winds), to the Arctic regions, where, as it crosses the 80° of North latitude, its influence is still so great upon the atmosphere above it, between 70° E. and 10° W. long., as to create a mean annual temperature of 11° 22 Fahr., or an excess of 8° 96 over that of all other longitudes crossing the same parallel. This same sun-heat, of which the Atlantic is delivered along the whole course of the Gulf Stream, gives life, health, and vegetation to a large area of land, where, without its benign influence, the winter cold would kill, or make life difficult to the weak and diseased.

This vast volume of warm water, *the North-eastern* branch of which, after its separation from the *South-eastern* at 47° N. lat., and 25° W. long. flows to the north and east along the coasts of Ireland, Scotland, and Norway, between Europe and Iceland, and, as Haughton remarks, probably extends beyond Spitzbergen. The same author is of opinion that "this portion of the Gulf Stream owes its momentum to the *South-west antitrades*; while the other, or *South-eastern* portion, is deflected by the earth's rotation to the south east and south, and flows southwards along the coasts of Spain and Africa until it rejoins the north equatorial current caused by the *North east trades*."

If we take the mean of the different estimates of the magnitude of the Gulf Stream, as given by Maury, Herschell, Colding, Croll, and Thompson, we shall find, according to Haughton,* that nearly 38 (37·834) *cubic* miles of warm sea-water are transferred from the tropics to the north temperate zone per hour. This vast mass of sea water leaves the tropics at a temperature not less than 65° Fah., and is cooled down to at least 40° Fah. in the temperate zone. Maury estimates the rate of movement at five knots an hour, Sir John Herschell at four, Croll at four miles, and Sir Wyville Thompson† at three knots an hour.

We have seen that this enormous volume of sea-water transfers heat from the tropics to the north temperate zone, and then gives forth 25° of the 65° F. which it contained at its point of issue from the Straits of Florida.

By the warmth thus brought from the southern latitudes, the British climate is upwards of 20° *warmer*, writes Buchan,‡ in *winter* than it otherwise would be.

Haughton,* in his paper on the effects of Oceanic currents upon climates, published in the Report of the British Association for 1881 (York Meeting), has given much interesting matter on this subject. He there insists that the effect of the Gulf Stream upon our climate is limited to the winter, and that its effect on the summer temperature is *nil*.

For instance, he shows that the mean temperatures of January and July, the coldest and hottest months of the year, are as follows, taking the 50° N. latitude, which runs through the Land's End, Cornwall: The *mean January* temperature at *Gulf Stream longitudes* is 40·00° F., whilst *at all other longitudes* it is 18·28° F., or 13·72° *below* freezing-point. The *mean July* temperature at *Gulf Stream longitudes* (Lat. 50° N.) is 63·80° F., whilst *at all other longitudes* it is 65·77° F., or lower by 1·97° F.; and he concludes that the Gulf Stream adds nothing to the July temperatures of the localities affected by it, but rather, on the whole, has the effect of slightly diminishing the summer heat. The general climatal effect of the Gulf Stream is, therefore, to make the *annual range* of temperature less; (the climate more insular), but it has no effect whatever upon summer heat or upon the fruiting of plants and trees that require a given July temperature for reproduction.

The effect of the Gulf stream on the winter temperature of our Seaside Health-Resorts is most marked, and by the kind permission of Mr. Alexander Buchan, M.A., F.R.S.E., whose able works on meteorology are now so well known and appreciated, we shall be able to illustrate this most important part of our subject by giving his charts of Isothermals, together with those promised in our last. It will then be clearly seen how each Health Resort is affected, not only by the *winter warmth* of the sea, but by the *summer heat* of the sun, the one temperature being *exotic*, whilst the other is *indigenous*.

[illegible].—It is proposed by the Crystal Palace authorities to organise an exhibition in the coming autumn and winter which shall include both gas and electric lighting. This is an excellent move and one in the right direction. The great difficulty with which the authorities will have to contend will, doubtless, be the mutual jealousies now so openly paraded.

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* Op. cit.

† "The Voyage of the *Challenger*: the Atlantic," vol. i., p. 371. (Macmillan, London.) 1877.

‡ "Introductory Text Book of Meteorology," by Alexander Buchan, M.A., F.R.S.E. (Blackwood, Edinburgh.) p. 15[illegible].

HOME CURES FOR POISONS.*

VEGETABLE POISONS.

WE may leave mineral poisons for the present, to consider some which at the present season and during the next few months are more likely to be mischievous,—viz., vegetable poisons.

The most dangerous of these are the Hemlocks, including Hemlock Dropwort (*Œnanthe Crocata*), Water Hemlock (*Cicuta Virosa*), and the Common Hemlock (*Conium Maculatum*), Fool's Parsley (*Æthusa Cynapium*), Monkshood (*Aconitum Napellus*), Foxglove (*Digitalis Purpurea*), Black Hellebore or Christmas Rose (*Helleborus Niger*), Buckbean (*Menyanthes Trifoliata*), Henbane (*Hyoscyamus Niger*), Thorn Apple (*Datura Stramonium*), and Deadly Nightshade (*Atropa Belladonna*), to which may be added, though unlikely to be taken in the same way, Cocculus Indicus (*Menispermum Cocculus*), and Tobacco (*Nicotiana Tabacum*).

The Hemlocks and Fool's Parsley are *Umbelliferæ*, and belong to the same order as carrots, parsley, celery, and parsnips. They owe their danger chiefly to their resemblance either in root or leaf to these kitchen-garden plants. Fool's parsley in particular has often been eaten by mistake for common parsley, from which, however, it may be readily distinguished by the black and shining surface of the under leaves, and their unpleasant smell when rubbed. All these four plants produce similar symptoms (Hemlock Dropwort in the most dangerous degree), viz., confusion of ideas, often terminating in delirium or stupor, coldness of the extremities, and occasionally nausea and vomiting.

Monkshood is a well-known garden plant, distinguished by its dark-blue, cap-shaped flowers, growing in clusters on a stem about three feet in height. The leaves are deeply divided, the upper surface dark, glistening green, the under surface pale-green. The symptoms produced are vomiting, convulsions, delirium, and stupor. There is generally noticeable swelling of the tongue and face, and tenderness of the stomach. The poison acts chiefly on the nervous system. According to Orfila, the juice of the leaves causes death in a short time; the root is still more energetic in its action.

Foxglove, though a wild plant, often finds a place in our gardens. Everyone knows its tall stems, and the purple flowers, shaped like a glove-finger (whence its German name, *fingerhut*). The leaves are dark-green, and rough. The symptoms of poisoning by this plant are lowering and intermission of the pulse, faintness, giddiness, and cold sweats, with hiccough and convulsions. The effect on the circulation is characteristic of the action of Digitalis; it has been known to lower the pulse from 120 to 50 in a few minutes. It also has a diuretic effect.

Black Hellebore is a dwarf plant, with deep-green leaves springing from the root. The flowers resemble those of the dog rose in the number and shape of their petals. The symptoms are vomiting, giddiness, cramps, and convulsions.

Buckbean, which is often gathered with the common watercress, may be easily distinguished by the leaves, which are always trifoliate, whereas the leaves of watercress are divided into five or seven segments. Buckbean produces vomiting and colic, but seldom any serious mischief.

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* It is perhaps hardly necessary to point out that for decoction of tincture of Quinine in our last paper on this subject (p. 71, line 7), decoction or tincture of *Cinchona* (or Peruvian Bark) should be read. The correction should be made *in situ*, as also a few lines further on, where Quinine is again, by a printer's error, substituted for Cinchona. The decoction may be taken in doses of a wine-glassful, at intervals of from half an hour to an hour, or the powder itself may be used.

Henbane is common in hedges and by the roadside. The young shoots have sometimes been dressed for salad, and the roots have been mistaken for wild parsnips. The symptoms produced by this poisonous plant are dilation of the pupils, vomiting, purging, giddiness, delirium, and sometimes stupor.

Deadly Nightshade is commonly seen in our hedges, and known by its lightish green leaves, brownish purple flowers, and dark purple berries. The berries often prove attractive to children, and have been eaten with fatal consequences; but the leaves and roots are also poisonous. The following case, described by Orfila, gives a good idea of the usual symptoms: "One child ate four ripe berries of the *Belladonna*, and another six; an hour after, both committed such extravagant actions, that their mother was astonished; the pupils of their eyes were dilated, their looks were altered, and they appeared labouring under a cheerful delirium, accompanied by fever. The medical man called in found them in a state of great excitement, talking at random, running, jumping, and laughing convulsively, with purple countenances and accelerated pulse." Nausea and vomiting, generally without stomach pains, are noted; they seem to be caused by the gorged condition of the blood-vessels of the brain. Dryness of the throat is another characteristic symptom. But the most marked feature of poisoning by *Belladonna atropa* is dilation of the pupils of the eyes. The stomach is insensible to the action of ordinary emetics.

The same general treatment is to be adopted in all cases of vegetable poisoning; but in all serious cases it is essential that medical assistance should be obtained. Emetics (the sulphate of zinc, if procurable, but if not, the mustard emetic already described) should be used at once; the back of the throat tickled with a feather, and copious draughts of tepid water taken to excite and promote vomiting. Where these measures fail, the stomach-pump must be used. Neither ipecacuanha nor tartar emetic should be used to cause vomiting, as during the nausea they produce before vomiting is excited, the poison is more readily absorbed. Vinegar must not be given until the poisonous matter has been removed; but afterwards, it may be given in doses of a wineglassful, one part vinegar to two parts water, once every two hours in mild cases, but oftener—to half-hourly doses—in cases of greater severity. Where there is stupor, the patient should be kept walking about, and if the stupor is great cold water may be dashed over the head and chest. Strong coffee may be used where the narcotic effect of the poisoning is very marked. But as we have already mentioned, it is all-important that in cases of vegetable poisoning a medical man should at once be sent for; the messenger should be enjoined to tell the doctor the nature of the case, lest haply, instead of antidotes and stomach-pump, he should come mainly provided with surgical instruments. In the excitement of a sudden case of poisoning, a messenger is often simply sent for Doctor So-and So, without being able to say for what purpose the doctor is so suddenly wanted.

(*To be continued.*)

ONE OF THE FIRST FRUITS. The Markland Electric Light Company announce that the shares offered to the public not having been fully subscribed, the deposits paid on application will be returned at once without deduction.

UNDERGROUND WIRES IN NEW YORK. The sub-committee appointed at Albany to report upon the practicability and feasibility of laying wires underground in cities in New York State have made a report in which they strongly urge the Legislature to pass a law compelling telegraph and telephone wires to be run underground.

JULY FLOWERS.

MIDSUMMER is a good time to master the plantains, for they may all be found now both in flower and in fruit together; and they are a curious family of plants, well worthy of close consideration. Probably everybody knows the typical plantain form by sight—in the rough at least; but as it is well to take nothing for granted, one may begin by saying that any roadside weed with a tall spike of minute flowers, each consisting of four greenish sepals, four thin, transparent, and colourless petals, united into a short tubular corolla, four stamens, and a pistil, is perfectly sure to be a plantain. They are all more or less exclusively wind-fertilised, and so they have long stamens hanging out to the breeze, and feathery styles to catch the pollen; and the styles always come to maturity first, being fertilised by the pollen blown from another head before the stamens uncoil themselves. We have five English species. Three of them have leaves about three times as long as broad, namely, *Plantago lanceolata*, *P. major*, and *P. media*. Of these, *P. lanceolata*, common ribwort, is by far the most abundant. It may be known by its long, narrow leaves, which rise from the ground nearly erect, as well as by its yellow stamens, and by the fact that each of its small, cup-like capsules contains only two seeds. When ripe, it divides in the middle, the top falling off like a cover, and shows the two little kernels within. This is the most degraded of our inland English species, having completely accommodated itself to wind fertilisation; its petals are a dingy grey or brown, and are tucked away inconspicuously behind the calyx. *P. media*, the hoary plantain, is far less abundant, and much prettier. Though also mainly designed for wind-fertilisation, it has not entirely ceased to attract insects; and so its petals are still a faint whitish lilac, its stamens are tinged with pink or purple, and it has a slightly fragrant almond perfume. It may be known by its close rosette of broad, silvery white leaves, pressed tight against the ground in a bunch, so as to kill off the grasses beneath it: as well as by the fact that its capsule usually contains four seeds, at least in the young state, though one or two of them sometimes wither away before ripening. This is by far the prettiest of our English species. *P. major*, the large plantain, is frequent along waysides. Its leaves are very broad, tapering into a stalk at the bottom, and less upright than in the ribwort. But the best distinctive mark is afforded by the capsule, which contains a number of very small seeds, as well as by the length of its spike, which is lower and longer than in the other species. This is also a very degraded kind, with small and very inconspicuous flowers, mostly concealed beneath their large green masking bracts. It is often given as food to canaries. The other two plantains are mainly seaside weeds. *P. coronopus*, the buckshorn plantain, has leaves which sub divide into tines or branches, like a stag's antler, from which rough resemblance it gets its English name. Its tufted stock, with a ring of narrow, much-branched foliage, is familiar to everybody on cliffs and pastures by the seashore, as well as on sandy places inland. Its leaves lie flat against the earth, showing off their tracery work most delicately on the pale background of a sand patch. The flowers are very inconspicuous, with brownish stamens, and the calyx is fringed with minute hairs. There are four cells or divisions in the capsule, but the seeds seldom all ripen. *P. maritima*, sea plantain, is the least interesting of any. Its leaves are long and slender, but very fleshy, something like thick green cords; and its flowers are almost as minute as those of the buckshorn plantain. The capsules have only two seeds. This is the most degraded species of all, its flowers being quite unnoticeable, owing to their greenness or brownness, and it is apparently always wind fertilised. Nevertheless, all of the plantains are originally descended from ancestors with bright petals and honeyed nectaries, as may be seen by their united corolla, which invariably points back to an earlier stage of insect fertilisation. *P. media* shows us best what is the sort of type from which these degenerate little weeds are ultimately derived. The others should be carefully compared with it, and their differences noted and accounted for. The key will be found in the relative adaptation of each kind to wind fertilisation.

RISTORI'S LADY MACBETH.

ALTHOUGH the plan and purpose of KNOWLEDGE are inconsistent with regular dramatic criticism, the appearance of a great actor or actress in an important Shakespearean part may well be regarded as a matter within our scope; for if the actor should "hold the mirror up to Nature," as Shakespeare tells us, our great dramatist has depicted Nature herself, and the study of Nature is the aim of KNOWLEDGE.

If we study the work of great actors, and consider the secret of their success or failure, it will be seen how deep a truth underlies the trite saying quoted above. Just in proportion as the actor, granting him intellect to see what is natural, holds the mirror up to Nature, does he move his hearers. Each touch of Nature makes the whole audience akin with him. The gamut of feeling may extend beyond the range of most of them, just as the music assigned to a *primo tenore* runs beyond the range of ordinary singers; but even in scenes such as scarcely any can estimate from actual experience, truth to Nature can be as certainly recognised as the truth of a great singer's voice outside the ordinary range. Thus, if we analyse the feelings with which we follow a great actor or actress, we find that we are pleased or offended (for the best and greatest of them offend at times), just in proportion as they present truthfully or the reverse the action and character entrusted to them. This is true, despite what is also true, that on the stage the lights and shades of character must be intensified, in order that they may seem as strong as in real life. The scene-painter does not paint as a Claude Lorraine would paint; he uses devices such as a great landscape painter would reject: yet if he is a master of his art he aims at producing true effects as certainly as a Turner or a Claude. So it is, or so rather it should be, with the actor.

Yet so little is this recognised by the general run of actors, who, unfortunately, must always take a large part in the representation of every play, that, as a rule, it is painful to the real lover of Shakespeare to see any of his noble dramas acted. We believe that this, rather than any want of appreciation of the true value of Shakespeare's work, is the reason why, as an actor and manager of the day has said, Shakespeare "spells bankruptcy to the manager." It is, indeed, certain that all the Shakespearean plays require modification before they can suitably be represented on the modern stage; for the simple reason that many accessories which were valued in his time, and therefore suitable, are now useless, or even ridiculous. For example, although the witch scenes in Macbeth are inextricably interwoven with the plot, and, rightly arranged, might still be effective, it is certain that in their details they are now utterly unsuitable. No one is impressed when the first witch remarks that, "Like a rat without a tail, he'll do, she'll do, she'll do;" or when the three witches put into the cauldron a number of unpleasant ingredients. The more solemnly these scenes are given, the more do they detract from the effect they are intended to produce; so that, by the time Macbeth enters, we are very ill prepared to be affected by his powerful conjuration. But in this and similar cases the fault is not Shakespeare's, but that of managers and actors, who cannot see how, with changing ideas, such scenes have become unsuitable. It was not here and thus that Shakespeare wrote "not for an age, but for all time." Where, however, his real power is shown and should be felt, nine actors out of ten fail to impress us with any feeling but a sense of incongruity. They address the audience, where speech and action should be addressed to each other; they mouthe, where they should speak "trippingly on the tongue"; they rant and rave, where they should be grave and reflective; they are violent, where they should be deeply moved; and in scenes where passion and fire are needed, they produce no effect on an audience already tired of their meaningless violence.

Madame Ristori, during the week ending last Saturday, brought into strong contrast the right and the wrong ways of presenting great Shakesperean parts. To begin with, she is a woman of intellect; and she has applied her intellect, in the first place to the study of Shakespeare's Lady Macbeth, and in the second to the adaptation of her own powers to the part. She has neither forgotten, on the one hand, that it is Shakespeare's conception she has to deal with, nor, on the other, that she can only in so far carry out his conception as nature has fitted her for the part. We do not say that her view of the part is, in our judgment, altogether correct. Occasionally she seemed to merge the ambition, resolution, and subtlety of Lady Macbeth, into an actually murderous temperament, of which there is no indication in Shakespeare's Lady Macbeth. On the contrary, Lady Macbeth shows early, and this indeed Madame Ristori represented admirably, that the effort by which she had compassed the thought of murder, had been too much even for her resolution. The anguish expressed by the actress while Macbeth tells her of his fears ("We have scotched the snake, not kill'd it," &c.) was admirably conceived, and justified, despite the resolute "But in them nature's copy's not eterne," by the tone in which Macbeth speaks of his plans. "Be innocent of the knowledge," he says, "till thou applaud the deed;" and again, "Thou marvell'st at my words; but hold thee still." The sleep-walking scene can only be rightly understood or rendered, when these subtle indications of Lady Macbeth's real character, and of Macbeth's recognition of it, are adequately noted.

There was one fault in Madame Ristori's presentation of the part, which seemed to us a grave one. Lady Macbeth has half persuaded her husband, in the speech beginning, "O, never shall sun that morrow see," to what he had half resolved on already. "We will speak further," is all he says; and seeing his face change into suspicion-breeding gloom, she answers—

"Only look up clear;
To alter favour ever is to fear.*
Leave all the rest to me."

Madame Ristori closes this scene by a singular walk with Macbeth across the stage, in which nothing is said by either; but Macbeth, by repeatedly raising his hand, suggests that he is not convinced, while Lady Macbeth warningly raising hers, as often suggests that he must yield to her. This might do fairly well—though we doubt it—on a small stage; but continued across more than half

* Not "to be afraid," but to "cause fear," to "affright."

the width of such a stage as Drury Lane's, it has a decidedly ridiculous effect. We believe the close of this scene would be far more impressive if Macbeth retired moodily and doubtingly, watched by Lady Macbeth, as, anxious but resolute, she slowly follows him.

In all the remaining scenes Madame Ristori's acting, apart from somewhat too stately and Italian action in the banquet scene, was superb—the sleep-walking scene even more terrible, because more natural, than a death-scene by Bernhardt.

Madame Ristori speaks English singularly well, though with occasionally incorrect emphasis. Like all really great actors she knows when and how to speak quickly, reserving slow utterance for greater effect in the more impressive passages. Those around her on the stage, from the best to the worst, or rather from the worst to the least bad, seemed to regard the words belonging to their parts as opportunities for fixing upon themselves the attention of the audience, opportunities to be made the most of by dragging out the words as slowly as possible, emphasising every third word, and shouting or shrieking every third line. The effects of changes of modulation, of varying tones and rates of utterance, they seemed to think not worth trying. And that they were wise in their generation was shown by marked applause from the gallery. In most cases they followed tradition as to action and emphasis—where they departed from it they reached a lower depth. Macbeth's "Fill full," *soto voce*, as a hint that he wanted his own goblet well filled, is regarded we see by the *Athenæum* as a good idea, not as an absurdity. Macduff's despairing cry, "He *has* no children," becomes a feeble, rhythmless, explanatory remark, when emphasized "*He* has no children." But why note flaws, such as these, in what was full of faults? All that followed Madame Ristori's retirement after the sleep-walking scene (including her recall, by the way), was simply farcical—the fight between Macbeth and Macduff unworthy of Richardson's Booth.

BUTTERFLIES AND MOTHS.

BY W. J. H. CLARK.

A LARGER number of butterflies and moths are out this month than was the caso in June, and most of those that were in full force then, still continue on the wing.

The Purple Emperor (*Apatura Iris*) is to be seen in the southern counties of England, and most of the "Fritillaries," the Red Admiral (*Vanessa Atalanta*), Painted Lady (*V. Cardui*), Marbled White (*Arge Galathea*), Greyling (*Satyrus Semele*), Small Copper (*Polyommatus Phlæas*), Green, Purple, and Black Hairstreaks (*Thecla Rubi*, *T. Quercus*, and *T. W.-Album*), and several of the "Blues" may now be found.

Among the moths, we may still find most of the "SPHINGIDÆ" mentioned last month, and the Speckled Footman (*Eulepia Cribrum*), Four-Spotted Footman (*Lithosia Quadra*), and Common Footman (*L. Complanula*) are now on the wing.

The six Belted Clearwing (*Sesia Ichneumoniformis*), Wood Swift (*Hepialus Sylvinus*), Short-cloaked Moth (*Nola Cucullatella*), Muslin Moth (*Arctia Mendica*), Cinnabar (*Euchelia Jacobææ*), Brown Tail (*Liparis Chrysorrhea*), Gold Tail (*L. Auriflua*), Satin Moth (*L. Salicis*), Gipsy (*L. Dispar*), Black Arches (*L. Monacha*), Lackey (*Bombyx Neustria*), and Oak Eggar (*B. Quercus*) should all be sought for during the course of the month.

Among the GEOMETRÆ, we may expect to find the Swallow-tailed Moth (*Uropteryx Sambucata*), Bordered Beauty (*Epione Apiciaria*), Little Thorn (*E. Advenaria*), Early Thorn (*Selemia Illunaria*), Dotted Carpet (*Cloria Glabraria*), Mottled Beauty (*Boarmia Repandata*), Common Wave (*Cabera Exanthemaria*), Common White Wave (*C. Pusaria*), Clouded Magpie (*Abraxas Ulmata*), July Highflyer (*Ypsipetes Elutata*), Common Carpet (*Melanippe Subtristata*), most of the "Emeralds," and the Scalloped Oak (*Crocallis Elinguaria*).

The NOCTUÆ that fly this month are far too numerous to mention, but amongst others we may expect to find the following:—The Buff Arches (*Gonophora Dedrasa*), Peach Blossom (*Thyatira Batis*), Marbled Beauty (*Bryophila Perla*), Brown-line Bright-eye (*Leucania Conigera*), Common Wainscot (*Leucania pallens*), Dark Arches (*Xylophasia polyodon*), Bordered Gothic (*Neuria Saponariæ*), Straw Underwing (*Cerigo Cytheria*), Dot Moth (*Mamestra persicariæ*), Garden Dart (*Agrotis nigricans*), Gray Arches (*Aplecta nebulosa*), Marbled Clover (*Heliothis dipsaceus*), Golden Y (*Phisia Iota*), Burnished Brass (*P. chrysitis*), Broad Bordered Yellow Underwing (*Tryphæna fimbria*), Large Yellow Underwing (*T. pronuba*), and the Old Lady (*Mania Maura*).

On the 28th ult. I had a Death's Head Moth (*Acherontia atropos*) brought to me by a farm labourer, but I am sorry to say it was in a very damaged state, though still alive. Have any of our readers heard of this insect appearing so early in the summer?

FIRE RISKS FROM ELECTRIC LIGHTING.

THE following rules and regulations for the prevention of fire risks arising from electric lighting have been recommended by the Council of the Society of Telegraph Engineers and Electricians, in accordance with the report of the committee appointed by them on May 11, 1882, to consider the subject:—

The members of the committee were—Professor W. G. Adams, F.R.S., vice-president, Sir Charles T. Bright, T. Russell Crampton, R. E. Crompton, W. Crookes, F.R.S., Warren De la Rue, D.C.L., F.R.S., Professor G. C. Foster, F.R.S., past president, Edward Graves, J. E. H. Gordon, Dr. J. Hopkinson, F.R.S., Professor D. E. Hughes, F.R.S., vice-president, W. H. Preece, F.R.S., past president, Alexander Siemens, C. E. Spagnoletti, vice-president, James N. Shoolbred, Augustus Stroh, Sir William Thomson, F.R.S., past president, Lieutenant-Colonel C. E. Webber, R.E., president.

These rules and regulations are drawn up not only for the guidance and instruction of those who have electric lighting apparatus installed on their premises, but for the reduction to a minimum of those risks of fire which are inherent to every system of artificial illumination. The chief dangers of every new application of electricity arise mainly from ignorance and inexperience on the part of those who supply and fit up the requisite plant. The difficulties that beset the electrical engineer are chiefly internal and invisible, and they can only be effectually guarded against by "testing" or probing with electric currents. They depend chiefly on leakage, undue resistance in the conductor, and bad joints, which lead to waste of energy and the production of heat. These defects can only be detected by measuring, by means of special apparatus, the currents that are, either ordinarily or for the purpose of testing, passed through the circuit. Bare or exposed conductors should always be within visual inspection, since the accidental falling on to or the thoughtless placing of other conducting bodies upon such conductors might lead to "short circuiting," or the sudden generation of heat due to a powerful current of electricity in conductors too small to carry it. It cannot be too strongly urged that among the chief enemies to be guarded against are the presence of moisture and the use of "earth" as part of the circuit. Moisture leads to loss of current, and to the destruction of the conductor by electrolytic corrosion, and the injudicious use of "earth" as a part of the circuit tends to magnify every other source of difficulty and danger. The chief element of safety is the employment of skilled and experienced electricians to supervise the work.

I. THE DYNAMO MACHINE.

1. The dynamo machine should be fixed in a dry place.
2. It should not be exposed to dust or flyings.
3. It should be kept perfectly clean and its bearings well oiled.
4. The insulation of its coils and conductors should be perfect.
5. It is better, when practicable, to fix it on an insulating bed.
6. All conductors in the dynamo-room should be firmly supported, well insulated, conveniently arranged for inspection, and marked or numbered.

II. THE WIRES.

7. Every switch or commutator used for turning the current on or off should be constructed so that, when it is moved and left to itself, it cannot permit of a permanent arc or of heating, and its stand should be made of slate, stone ware, or some other incombustible substance.

8. There should be in connection with the main circuit a safety fuse constructed of easily fusible metal which would be melted if the current attain any undue magnitude, and would thus cause the circuit to be broken.

9. Every part of the circuit should be so determined that the gauge of wire to be used is properly proportioned to the currents it will have to carry, and changes of circuit, from a larger to a smaller

conductor, should be sufficiently protected with suitable safety fuses, so that no portion of the conductor should ever be allowed to attain a temperature exceeding 150 deg. F.

N.B.—These fuses are of the very essence of safety. They should always be enclosed in incombustible cases. Even if wires become perceptibly warmed by the ordinary current, it is a proof that they are too small for the work they have to do, and that they ought to be replaced by larger wires.

10. Under ordinary circumstances complete metallic circuits should be used, and the employment of gas or water pipes as conductors for the purpose of completing the circuit should in no case be allowed.

11. Where bare wire out of doors rests on insulating supports it should be coated with insulating material, such as india-rubber, tape, or tube, for at least two feet on each side of the support.

12. Bare wires passing over the tops of houses should never be less than 7 ft. clear of any part of the roof, and they should invariably be high enough, when crossing thoroughfares, to allow fire escapes to pass under them.

13. It is most essential that the joints should be electrically and mechanically perfect. One of the best joints is that which is whipped around with small wire and the whole mechanically united by solder.

14. The position of wires when underground should be efficiently indicated, and they should be laid down so as to be easily inspected and repaired.

15. All wires used for indoor purposes should be efficiently insulated.

16. When these wires pass through roofs, floors, walls, or partitions, or where they cross or are liable to touch metallic masses like iron girders or pipes, they should be thoroughly protected from contact with each other or with the metallic masses, by suitable additional covering; and where they are liable to abrasion from any cause, or to the depredations of rats or mice, they should be efficiently encased in some hard material.

17. Where wires are put out of sight, as beneath flooring, they should be thoroughly protected from mechanical injury, and their position should be indicated.

N.B.—The value of frequently testing the wires cannot be too strongly urged. It is an operation, skill in which is easily acquired and applied. The escape of electricity cannot be detected by the sense of smell as can gas, but it can be detected by apparatus far more certain and delicate. Leakage not only means waste, but in the presence of moisture it means destruction of the conductor and its insulating covering by electric action.

III. LAMPS.

18. Arc lamps should always be guarded by proper lanterns to prevent danger from falling incandescent pieces of carbon, and from ascending sparks. Their globes should be protected with wire netting.

19. The lanterns and all parts which are to be handled should be insulated from the circuit.

IV. DANGER TO PERSON.

20. To secure persons from danger inside buildings it is essential so to arrange the conductors and fittings that no one can be exposed to the shocks of alternating currents exceeding 60 volts; and that there should never be a difference of potential of more than 200 volts between any two points in the same room.

21. If the difference of potential within any house exceeds 200 volts, whether the source of electricity be external or internal, the house should be provided outside with a "switch," so arranged that the supply of electricity can be at once cut off.

By order of the Council,

F. H. WEBB, Secretary.

[illegible] 4, The Sanctuary, Westminster,

A THEORY OF FORESIGHTS.

THOSE of our readers who take any interest in rifle-shooting know that the [illegible] Match rifle is fitted with a wind-gauge, [illegible] screwed a foresight [illegible] to the vision of the marksman. These sights vary according to fancy, those most in use being the [illegible], the [illegible] and the hollow bead or ring. By means of the wind-gauge it will be understood that the bull's-eye [illegible] be in alignment with the sights.

I propose to call attention to a [illegible], [illegible] advantage attending [illegible] which [illegible] are not generally taken [illegible].

The bull's-eye at the long ranges (800, 900, and 1,000 yards) is 3 feet in diameter, and the rings are made of different sizes. If we take one ·1 inch diameter and use it at all three ranges, the eye being say 4 feet from the foresight, the effect is roughly as follows:—

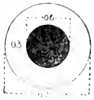
And it is obvious that, to obtain the perfect alignment necessary, the bull's-eye must be geometrically centred in the ring. As we get to the longer ranges, the bull's-eye fitting smaller, this geometrical centering becomes more difficult, a very slight error at 1,000 or 1,100 yards, in all probability, causing the shot to miss the bull; we should, therefore, use a smaller ring as the range increased.

In the use of rings of different sizes I have made the following observation:—

Let us take the range at 800 yards, the bull's-eye 3 feet in diameter, the distance of the eye from the foresight (in the back position with the back-sight on the heel-plate) 4 feet: the apparent size of the bull at the end of the barrel will be found to be ·06 inch. Now, if we take a ring ·06 inch, the effect produced is this,

a portion of the black being hidden by the diffraction fringe caused by light passing through the small aperture; it is inexpedient therefore, to use a ring the exact size of the bull, on account of the impossibility of detecting small errors. Although the measurement of diffraction fringe involves a somewhat extensive use of integrals and differentials, it may be practically measured in this instance, and becomes of very great importance. Let us take a ring double the apparent size, that is ·12 inch. (I may here state that gunmakers make these foresight rings accurately to the hundredth of an inch, and that Mr. Gibbs of Bristol has made me several for experimental purposes to thousandths; for all practical purposes, however, hundredths will be found sufficient.)

The effect is this (the diagram being drawn accurately):—



The diffraction fringe has all the appearance of, and acts in the same manner as, a solid ring, and, holding the bull exactly, the effect of a slight vibration or inaccuracy is this:—

By using such a ring the trouble of geometrically centering the bull is got rid of, and we may centre it optically; when the bull is seen perfectly it is centred, and the alignment of the sights is accurate. This centering cannot be mistaken, for the bull suddenly seems to expand to a great size.

On this theory, and with the data given above, the rings for the different ranges will be as follows:—

Eye 4 feet from Foresight.

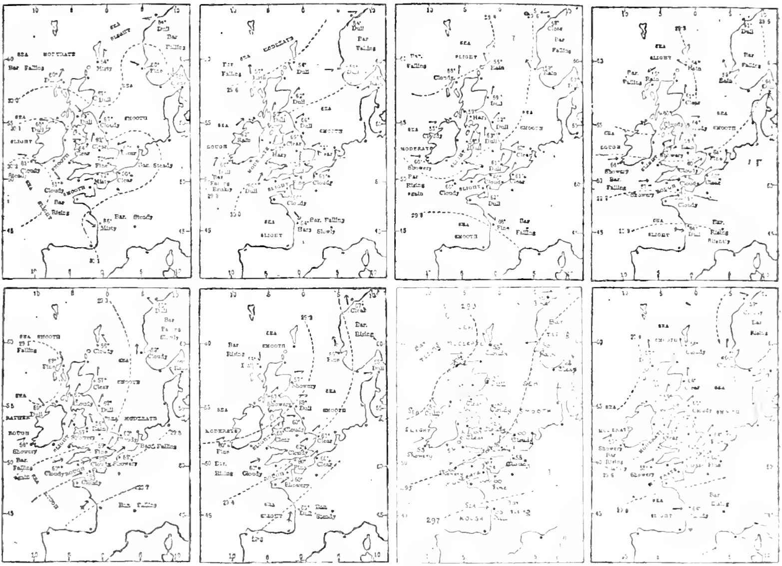
800 yards		·12
900 ,,	·106 or roughly	·11 or ·10
(the smaller ring, I think, is preferable.)		
1,000 yards	·096 or roughly	·10 or ·09
1,100 ,,	·087 ,,	·09

Eye 3 ft. 6 in. from Foresight.

800 yards	·105 or roughly	·10
900 ,,	·093 ,,	·09
1,000 ,,	·084 ,,	·08
1,100 ,,	·078 ,,	·08

WEATHER CHARTS FOR WEEK ENDING SUNDAY, JULY 9.

SUNDAY, 2ND. MONDAY, 3RD. TUESDAY, 4TH. WEDNESDAY, 5TH.



THURSDAY, 6TH. FRIDAY, 7TH. SATURDAY, 8TH. SUNDAY, 9TH.

In the above charts the dotted lines are "isobars," or lines of equal barometrical pressure, the values which they indicate being given in figures at the end, thus—30·4. The shade temperature is given in figures for several places on the coast, and the weather is recorded in words. The arrows fly with the wind, the force of which is shewn by the number of barbs and feathers, thus:— ⟶ light; ⟶, fresh or strong; ⟶, a gale; ⟶, a violent gale; ⊙ signifies calm. The state of the sea is noted in capital letters. The * denotes the various stations. The hour for which each chart is drawn is 6 p.m.

Eye 3 ft. from Foresight.

800 yards		·09
900 ,,		·08
1,000 ,,	·072 or roughly	·07
1,100 ,,	·064 ,,	·06

I have tested all these rings in practice, and have found the theory true in all cases, the requisite conditions being, of course, good eyesight and good light; in very hazy, bad lights, nothing but the most open sights will allow the bull even to be seen; but in strong lights, with a heavy mirage, I have found the rings equally serviceable, the diffraction fringe hiding the image as effectually as it does the bull's-eye when it gets behind it. F. T. P.

THE STAMPING OUT OF SMALLPOX.—An important experiment, which is exciting the greatest interest in medical circles, is being made at Leicester, under the care of Dr. William Johnston, medical officer of health. There are more cases of noncompliance with the compulsory vaccination laws in Leicester than in all the other towns of the kingdom put together. Hence the past six months have witnessed very serious outbreaks of smallpox of a very virulent kind in the midlands, and at Leicester a very considerable number of cases have been imported from London, Birmingham, Nottingham, and other towns. Every one of these outbreaks was stamped out by the following method:—The corporation have powers under a local Act of Parliament compelling, under a heavy penalty, medical men and householders promptly to report the outbreak of infectious diseases, including smallpox and fever, the medical men receiving a small fee for each report. In the event of a case of smallpox being reported at the sanitary offices, which are directly connected with the fever and small-pox hospitals by means of the telephone, an officer at once communicates with the institution, the removal van is placed in readiness, and beds are prepared for the requisite number of patients. The medical officer of health and an inspector at once visit the house where the outbreak has occurred, explaining the nature of the disease to the inmates, and invariably succeed in inducing not only the patients to be removed to the hospital, but what is of equal importance—in inducing every one who has come into contact with the sufferer, and every one living in the same house, to occupy quarantine rooms at the hospital. The telephone is again brought into requisition, and the removals take place with the least possible delay. Those in quarantine are provided with every comfort and means of recreation until the period of quarantine has elapsed, and meantime, the house where the outbreak occurred is thoroughly disinfected, at the expense of the local authorities.—*Times.*

TO CORRESPONDENTS.

Letters to the Editor.

[*The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.*]

All Editorial communications should be addressed to the Editor of KNOWLEDGE; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

⁂ *All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

TERRESTRIAL MAGNETISM.

We have received an important communication from Professor Tromholt of Bergen, of which the following is a translation.—ED.

I beg to announce to you that next autumn I intend to propose to the Norwegian Government the formation of an establishment for investigating and observing the Aurora Borealis and other phenomena of terrestrial magnetism. With your permission, *M. l'Astronome*, in communicating this project to you and requesting your counsel, I will indicate in few words the motives which have led me to seek the realisation of this idea, in many respects a new one.

The theory of terrestrial magnetism is one of the problems which offers to natural science the strongest claims to examination. If science has not been able as yet to solve more than a small portion of the numerous problems belonging to this field of research, it has nevertheless been able at each step to prove more and more clearly the enormous importance of the phenomena of terrestrial magnetism in regard to the physical relations of our earth. By the discovery of a connection existing between these phenomena and events on the sun's surface, the question has acquired cosmical importance.

It would be useless, *M. l'Astronome*, to recall to you the great and important part played by the forces of terrestrial magnetism in the whole physical life of the earth, in their changing course and their various periods, whether they present themselves in the bewildering play of the polar light, or whether they speak in the restless movements of the magnetic needle, or by their influence on the telegraphic network of whole countries.

No country in Europe, perhaps in the whole world, offers such favourable conditions as Norway for the study of these phenomena. Lying between the fifty-eighth to the seventy-first parallels of north latitude, she extends farther north than any inhabited country. She is nearer the seat of magnetic disturbances than any part of the European continent. The maximum zone of the aurora crosses the north and north-west portion of the country. A continuous network of telegraphic wires extends from the northern to the southern extremity. The telephonic lines of Drontheim and Bergen are nearer the pole than any on the whole earth.

This is, therefore, the country to which the duty of taking an energetic part in the study of the mysteries of terrestrial magnetism should naturally present itself.

In view of all these numerous advantages, neglected till now, I have tried, during the few past years, to undertake, myself, and at my own expense, a part of the great work which still remains, and which is as yet scarcely touched. In the autumn of 1878, I [illegible] to be distributed in all parts of Norway, and [illegible] (Acte de la Société des Sciences of Christiania, 1880, No. 6), the contribution of 839 observations of 154 auroras taken between September, 1878, and April, 1879, from 132 stations in Norway.

[illegible] enabled me to prove that the aurora is a phenomenon occurring much more frequently, even outside the Polar regions, than is supposed at present, and that in a territory like Norway it never fails to occur even in a year of minimum frequency.

Counting from this modest beginning the plan has developed itself rapidly. Not only Sweden and Denmark, but Finland, England, Greenland, and Iceland, are now included in the field of observation. The complementary work relating to the observations of the winter of 1879-80, although long since finished, has not yet been published. This series is much more extended and complete than that of the former winter, and contains 1,600 observations of 260 auroras (boreal) taken from 357 stations. The material obtained during the winter of 1880-81 is much richer even than that of the preceding winter; it includes 5,200 observations of about 300 auroras taken at 675 stations. The result for the winter of 1881-82 will probably be still vaster. I correspond, at this present time, with from 1,000 to 1,500 observers of all the northern countries of Europe.

As a supplement to these observations of the aurora borealis, I have been able to get records at some fifty telegraphic stations, Swedish and Norwegian, of all disturbances occurring on the lines, with note of the time, the force, the direction, &c. From this work, material as vast and as astonishing as that from auroral observations has been obtained, the telegraphic disturbances showing themselves as frequent as the auroras; scarcely a day passes in Norway without some disturbance on the lines. As soon as I shall have received the observations of an entire year, I will publish them, with an atlas showing carto-graphically the telegraphic disturbances of each day, the auroras, and the storms observed the same day, noting time and place, as well as the extent of night cloud over the whole field of observation.

I have succeeded in constructing an apparatus, which, when placed in connection with a telegraph wire, notes graphically all the disturbing currents, according to their time, force, and direction. This Rheograph will soon be in communication every night with a telegraphic line, extending north and south, to a distance of about 1,400 kilomètres (870 miles) which is not employed at night in telegraphic work; during the day it will be connected with a special telephonic line.

I may add that I shall pass next winter (September to April) at Kautokeino in Finmark (lat. 69° 1′ N., long. 21° 0′ East of Paris), to make there, in connection with the Norwegian polar station, Bosekop, situated 100 kilomètres (62 miles) further north, observations with respect to the parallax of the aurora borealis.

Although I have received all possible support and encouragement from the Government and scientific institutions of the Northern nations, it is evident that an organisation so extended and so complete must end by exhausting the energies of one man alone, especially as I am obliged to devote the greater part of my time to other labours. It is also clear that an enterprise arising only from individual initiative cannot be pursued with as much exactness and perfection as when supported by a public institution.

[Professor Tromholt proceeds to describe the nature of his plan in so far as it depends on such support as he hopes to obtain from the Swedish Government. A magnetic institution is to be established at Drontheim, and will contain all suitable instruments, &c., &c. Professor Tromholt hopes to make it the central point for all observations of auroras in Europe. It will also take charge of all observations of telegraphic disturbances. "I am persuaded," proceeds Professor Tromholt, "that an observatory such as this will be able to render important services to science, and I hope that the realisation of this idea will be received with joy by the scientific world."]

I address this communication to you, *M. l'Astronome*, and to other recognised authorities in this department of science, that the question may be submitted to your judgment. I beg that you will communicate to me your opinion of the merits of such an institution, so that the weight of your name may help to support me in my efforts to realise my project. If (which I do not doubt) the idea should meet with your approbation I shall also be much obliged to you if you would be kind enough to give me your opinion and advice as to the organisation of the Institution.

Hoping to be honoured by an early reply, which may be expressed in any language you may prefer, I have the honour to be, *M. l'Astronome*, &c., &c.

Bergen, *June*, 1882. SOPHUS TROMHOLT.

FIGURES OF FLUID-MOTION.

[463]—I hope you, like your renowned neighbour, *Mr. Punch*, keep a regular staff of young men, to whom you turn over, like Mr. F.'s aunt to Clennam, all the crusts of your daily toast. For you, like all men of the Fifth Imperial potentiality (you like these fine terms, Sir—so easy to read out loud, and so full in the mouth, you know—"scientifically wrong and mathematically to be misunderstood," as you beautifully express it in the gorgeous shine of "our" KNOWLEDGE's first-page); you, Sir, I say, are doubtless as much toasted as you care for. Let the young men, then, make a

note of one of the simplest and prettiest demonstration of the still-hidden laws that govern the movements of "liquids in motion," and tell us all about them.

It is this: Into a two-pint porcelain mortar, break a (really) new-laid egg, and see to the proper levelling of the mortar, then procure a "Double Dover Egg-beater," and add a tea-spoonful of finely levigated white sugar. Now drive the egg-beater, first slowly and then extremely fast, and after a few minutes you will get your reward; for you will see a lovely illustration of some of the exquisite figures in moving fluids which the treatise of Mr. W. F. Stanley has so exquisitely taught to us, although I don't think he has, in any instance, observed the charming demonstration here named. The bowl is of full golden, shining bubbles of softest look and most tender lines. It is not one of my gifts to be able to lucidly describe all that I have seen in this homely experiment. But, after catching your new-laid egg, let one of "your young men" tell your readers all that this humble pen of mine fails to narrate, and, if he can, tell us "how it is done."

A "double," not a "single" beater is desirable for producing the varying shapes that dance in this golden tide. In proportion to the rapidity of the revolving arms do the shape, size, and behaviour of the changing lovely forms and figures follow. At a high velocity, the outline of a heart shows itself, the regular "Valentine" heart, none of your lumpy and unromantic anatomical hearts. It is impossible (but, doubtless, only so to myself) to reveal the life and sensitiveness of these figures, and their strange mobility. To me, they seem to set before us a science door through crack of which we may behold a vista of fascinating and important truths, waiting the resolute hand that will draw back the reluctant gate, that we may enter in. Alas! that hand belongs not to your faithful servant, ROBERT ELLIS,

Raven Spring, Mitcham.

PROF. HUXLEY AND MARCUS AURELIUS.

[464]—Amongst the "pithy sayings" which the writer of the Review in KNOWLEDGE on Prof. Huxley's "Science and Culture and other Essays" justly considers as well worth quoting and remembering, there is one in particular to which I wish to draw attention. Prof. Huxley says, "Do what you can to do what you ought, and leave hoping and fearing alone."

Probably in all ages the thought of doing that which ought to be done, without hope and without fear, has been common to great minds; but I believe that it is to the Stoics, and to Marcus Aurelius especially, that we owe that noble lesson. I quote in full, and it can scarcely be too often quoted, one of the passages from "The Thoughts of Marcus Aurelius," which most resembles the modern rendering of Prof. Huxley.

"If thou workest at that which is before thee, following right reason seriously, vigorously, calmly, without allowing anything else to distract thee, but keeping thy divine part pure, as if thou shouldst be bound to give it back immediately; if thou holdest to this, expecting nothing, fearing nothing, but satisfied with thy present activity according to nature, and with heroic truth in every word and sound which thou utterest, thou wilt live happy. And there is no man who is able to prevent this." E. C.

IMITATIONS OF VOLCANIC FORM AND ACTION.

[465]—In a letter of mine to the editor of the *Athenæum*, some years since, I described a mode by which, accidentally, I had produced a surface similar to that presented by the moon. Having nearly filled the basin of a large Arnot stove with sand, I poured the water, for the purpose of moistening the atmosphere of the room, upon it till it became saturated sand mud; when the stove got hot, an effect similar to that described in the pages of KNOWLEDGE, with regard to the plaster of Paris, was produced. But I found that I could also realise miniature volcanoes, craters, and eruptions, by pouring a moderate quantity of water in at the side of the iron basin when the sand was dry and the stove excessively hot. W. CAVE THOMAS.

THE POTATO.

[466]—With regard to "Farmer's" "five experiments," I have to inform him that his results do not now surprise me, for he should so *pluck* the blossoms that all rising sap may be checked, throwing it back into the roots—*e.g.*, increasing the weight of tuber.

"Farmer" still adheres to his opinion about the "frosted potato." If "Farmer" will inform me how to reconvert starch once formed into sugar back again to starch, then, and not till then, can I believe that it is the "frost going out which makes the change." However, I should like to point out to "Farmer" that the alkali of the wood-ash, besides the perfect manner of preparing the food, might, and does, make an unpalatable potato palatable. Who can eat a potato cooked in the ordinary way after a glorious "spud" (so-called)? I cannot. Living all my life in the North, and amongst farmers, I was well aware of "Farmer's" remarks on the "large quantity of decomposing matter," therefore I made that "as an undeniable statement." The results obtained on the sandy ground are remarkable, but nevertheless true.

Farmer (329) asked me to give him my authority *re* "peat." I gave it, but in letter 405 he again says my statement is nonsense. I prefer to take "Biedermann's Centralblatt fur Agricultur-Chemie" account of a genuine experiment before "Farmer's" opinion to the contrary. It would have been otherwise had "Farmer" been able satisfactorily to show that I had been talking nonsense by bringing forth data to prove my statements incorrect. "Farmer" has reminded me of a saying of Agassiz's through most of this discussion, "that whenever a new and startling fact was brought to light in science, people first say 'it is not true,' then that 'it is contrary to religion,' and, lastly, 'that everybody knew it before.'" Not that my statements are so very new or startling, for I believe that the question, whether blossoms or no blossoms yield the best results, has been before agriculturists for the last forty years at least. It seems a pity that it takes "Farmer's" body so many years to solve such a simple problem. F. C. S.

TOBACCO AND CONSUMPTION.

[467]—After a talk on the subject with me, a friend, who had one of his young chickens very ill with the "gapes," thought he would try as a last resort the influence of tobacco smoke on the disease.

Placing the chick under a bell glass, he blew the smoke from his pipe into it until the fumes had made the chick unconscious; then, removing the glass, he allowed the youngster to come round, it exhaled smoke for a second or two and was sick, but no symptom of gapes has been seen since and the bird is as well as ever it was.

If Koch or any other leader in germ research would try in a similar manner the effect of smoke on animals, now under their treatment, we might soon hear if this cure would hold good with respect to animals suffering from the inoculation of tuberculous matter; it would, in all probability, be necessary to make the animal unconscious many times before arriving at satisfactory data on the subject.

Since I first began to inhale—and I have inhaled nearly every kind of tobacco, from New Orleans perique to the finest Turkish from pipe, cigar, and cigarette—I have never been troubled with a single chest complaint.

Would—as suggested by "W. O. Prosser"—some of our medical contributors, who have been abroad, please inform us if consumption is prevalent amongst the following nations:—Mexicans, and the nations of the South American Continent, the Southern States of America; and if the custom of inhaling is carried on further north than New York in the colder parts of North America? We might in this way gradually find out whether the influence of tobacco inhalation has the effect of warding off or destroying consumption irrespective of climatic influence. P. C. S.

A VERY COMMON MIND TROUBLE.

[468]—The following, which appeared in the *Manchester Courier* of the 7th of this month, will, I trust, not prove inadmissible to the columns of your magazine:—

"In a large proportion of instances persons who live sedentary lives, and labour habitually with their brains to the neglect of the other parts of their bodies, suffer more or less annoyance from a mind-trouble, which, under favouring conditions, may readily become a disease. It consists of an uncontrollable and all-pervading feeling of doubt—not suspicion in the technical sense of that term, but doubt as to the commonest facts and acts of ordinary life and experience. At first the victim of this strange distress tries to compel his self-consciousness to rest. He resolves that he will not think of the act. It shall be performed instantly, or if it has been done it shall be forgotten. He goes away; presently the thought suggests itself that, after all, perhaps he has not accomplished what he intended, or that he has done it badly. He puts away this suggestion, but it returns with fresh force and overwhelms him. All sorts of evil consequences will, or may, ensue from his omission to lock that door or drawer, to turn off that gas-burner, or to place some ornament firmly enough on its pedestal! The demand, or impulse, to return and verify the underlying belief that all is well, will brook no denial. The creature of a craze like this may go to bed and try to sleep, but he will toss restlessly on his pillow, and at length he must—or he f[illegible] from any distance, at any pains, he returns, generally to find that his fears have been wholly groundless. Only those who have either themselves experienced this [illegible] or repeatedly watched its growth or witnessed its effects in others, can imagine how terrible in itself, and what a prolific source [illegible] mischief, so seemingly small a matter may prove. It is, in fact, the first and warning symptom of many a grave, and—because neglected—afterwards incurable case of mind disease."—J. Mortimer Granville, M.D., in Good Words.

From observation I think that the more thoughtful and intelligent persons are generally the victims, and indeed, after reflection, it seems natural it should be so. I should like to see this subject [illegible] in your columns, and to know the cause of it and the [illegible]. W. M. M.

VARICOSE VEINS AND CYCLING.

[illegible] I have heard it said that medical men attribute the great [illegible] of varicose veins to the use of bicycles and tricycles. [illegible] glad to know if there is any truth in such a statement.

A TRICYCLIST.

THE DOUBLE STAR, CASTOR.

470.—May I be permitted to suggest with regard to your reply to "Excelsior," on p. 83 of KNOWLEDGE, No. 35, that the fact that [illegible] sensible change has taken place in the relative position or [illegible] of the principal star and the [illegible] one since the year 1823" (1829: H. and So.'s results are confessedly not very accurate here), [illegible] is rather to imply a physical connection than an optical one. I think you will find that the system is *not* "universally regarded [illegible] astronomers as being simply binary," because this small companion shares in the proper motion of Castor in the same way as the little pairs μ Boötis or Σ 518 share in the P.M.'s of μ^1 Bootis [illegible] Eridani; all three being probably ternary. H. SADLER.

[F.R.A.S. wrote the reply in question, *not* THE EDITOR.]

MEDICAL WORKS.

471.—"Enquirer" would be glad if any of the readers of KNOWLEDGE would inform him if any societies similar to the "New Sydenham," etc., societies which issue works on medicine and allied [illegible] to subscribers, and terms of subscription. MEDICUS.

AN ARTISTIC DOG.

472.—I send you the following instances of what may be called artistic appreciation in a dog. My dog, on whose ambiguous descent [illegible] "have undoubtedly operated, pointed in a [illegible] manner at a Japanese figure of a cat, in which the monstrous was blended with the life-like. It stood on the floor inside a shop, and I had to call the dog off just as I might had the creature been genuine, not before the dog had evinced more than curiosity. Again, the same dog came unexpectedly upon a life-sized plaster bust of a man standing on the pavement. This aroused his attention, then surprise and ultimately fear, or indignation; in fact, he barked in a way that reminded me of the late Frank Matthews as Quince [illegible] Bottom "translated."

[illegible] the dog's sense of form alone was appealed to, as neither object was coloured in at all the natural tints of the respective figures. Yours, &c., J. POWER HICKS.

CHANGE OF COLOUR IN BLOWPIPE BEADS.

473.—The [illegible] beads before the blowpipe is to be attributed [illegible] or vibratory motion, in the beads themselves [illegible] light rays.

[illegible] good bead, the molecules become condensed [illegible] the period of vibration, and causing [illegible] the gamut of colour. So in [illegible] the free path of the molecules [illegible] period and the light runs down the [illegible].

[illegible] string, when stretched, will [illegible] harmony of sound, and respond to [illegible] other word, with the colour [illegible] the harmony of light?

AUG. W. ORR.

TELEGRAPH [illegible] BEHRING'S STRAITS.

474.—[illegible] practicable to build a telegraph line as far north as Behring's Straits and then a cable to America? There is one to [illegible] of Norway, as far north. Such a route would have [illegible] of a short cable, which could be multiplied [illegible] at [illegible] and would I presume, work quicker than a long one owing to the less induction. J. P.

Answers to Correspondents.

*** *All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded; nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

LIEUT.-COL. ROSS. Your opinion that "KNOWLEDGE" is "the best twopennyworth that England ever had" is very gratifying; but I am obliged to decline further Green Beam and Blowpipe papers. Your views on the former subject I know to be incorrect: of the latter subject, so far as practical blowpipe work is concerned, I know nothing; but space will not permit of further articles on a subject in which few, I fear, take interest.—STELLARUM VOX. (1) The astronomical views of Tycho and Kepler were not without tincture of astrological fancies natural enough in their time. (2) Astrology has no basis whatever in scientific facts; one cannot say it is not "a correct science," for it is not a science at all. (3) As held by the earliest Chaldaean observers, it may have been associated with a flat-earth theory; but the later Chaldaean astronomers recognised the earth's rotundity. (4) It is *not* "worthy of any credence whatever."—T. R. A. You do not seem to have noticed that an account of the mastiff Kepler's arithmetical feats is given in the series of articles on Intelligence in Animals. The work you mention is in hand for review.—R. ELLIS. Your poetical account of medical story suggests something rather "dreadful." If you will kindly consider that among our readers are many of tender souls and sensitive nerves, and so "do your spiriting gently," I have no doubt the story would be very acceptable. The returned proof is suggestive of a liveliness of imagination provoking to constant improvements. But printers have a pleasing way of introducing the letters, L, S, and D, in connection with such changes. If every column of KNOWLEDGE were treated that way, I fear it would be improved off the face of the earth. Thanks all the same.—ANXIOUS FRIEND. Exceptional care is taken about such advertisements as those. In the case you mention a sample packet was ordered, which proved quite unobjectionable.—JAS. DEAS. I do not remember anything in your communication which was similar to the very striking achievement of Casenenve. As far as I remember, your account related only to parlour experiments, which may always be "got up" by the invention of simple signal codes. I think, however, it was the part suggesting animal magnetism which seemed to me to render your communication which was rather long—unsuitable. Pray believe, however, that there was not the least intentional disparagement. Many other letters reached me on the same subject about that time. It requires rather careful discrimination to draw the line between what may be useful as scientific evidence, and what may not. Of course, H. M.'s evidence by itself may be open to exception. His friend may have been also a friend of the conjurer's. He himself may have forgotten some details. And so forth. But his amount accords well with the evidence given by Dickens. (I believe it was the same conjuror in both cases.) On the other hand, general accounts of thought-reading at evening parties, where the narrator "is sure there was no deception," are really of no value from a scientific point of view. An exact account of precautions to prevent deception should be given. (They were unnecessary in H. M.'s case, which depends solely on his own veracity and the trustworthiness of his friend.)—H. W. FAWCUS. There can be no doubt that when large masses of aqueous vapour are suddenly condensed into the cloud form, or large masses of cloud still further condensed by the gathering together of minute water-drops or vesicles into large rain-drops, electricity is generated and *vice-versâ*. It can also be shown experimentally that when oxygen and hydrogen in due proportion are converted explosively into water, electricity is generated. But the theory that lightning and thunder are caused by the explosive change of oxygen and hydrogen in the air into water is quite inadmissible. Hydrogen and oxygen nowhere exist in the air in the right, or anything like the right, proportions.—W. M. M. Thanks. Your letter shall appear shortly. POSTCARD. You certainly have entirely misunderstood our notes "On Some of Our Critics." We wish *every* reader who sees any mistake, or thinks he does, to call our attention to it. We have been rather careful to show this. It is only the *way* of making corrections which is in question. Compare the two following corrections on the same subject, and you will see that while one is not only admissible, but useful, the other is not so well.

(1.) "It appears to me that Dr. Wilson's use of the term quadruped as synonymous with mammal may mislead some of your younger readers, though, of course, no biologist could for a moment misunderstand him. They might imagine that all four-footed animals are mammalian, or that all mammalians have either four legs, or (like man) four chief limbs."

(2.) "Dr. Wilson seems to imagine that all four-footed animals are mammals, and all mammals four-footed. Will he permit me to inform him that this is not the case. A crocodile has four feet, but Dr. Wilson will find, on further examining the subject about which he writes, that a crocodile is not a mammalian. Man, on the other hand, is a mammalian; but man cannot be said to have four feet, although during a portion of his existence he goes on all-fours. Nor can the whale, though a mammalian, be properly called a four-legged animal;" and so forth.

"Post-card" seems to think the writers I mentioned have complained to me of such patronising communications as the last. This is not the case. In only two cases (I introduced Mr. Grant Allen only by way of illustration—no one has yet explained botanical matters to him) have contributors had occasion to make what I consider the right sort of answer to letters of the kind. This they did, without any reference to the matter in writing to myself. But then came letters to me from the carpers, angrily denouncing me for poking fun (which I had not done) at writers so thoroughly acquainted with "the quartile character of two-fold duality." I may add that, in his imaginary illustration of Mr. Grant Allen "attacked by a critic," "Post-card" speaks as if the article on Hesperornis, &c. ("Birds with Teeth") in No. 2, were from Mr. Allen's pen. I feel able to assert the contrary, having, to the best of my recollection, written that article myself. To "Post-card's" conclusion, that only professors should correct the statements of professors, I entirely demur; that is just the sort of thing against which KNOWLEDGE sets itself,—the cant and humbug of specialism and officialism (specialism being, however, an excellent thing in itself and when free from cant, officialism necessary, and not bad when free from humbug).—IGNORAMUS. Cold weather of June may be capable of explanation, but it certainly has not yet been explained.—W. BENSON. We saw many other objections, quite as serious, to your theory; but the one we quoted came first to hand. How would you explain multiple tails, curved tails, side tails, cross streaks, and the like?—LIEUT.-COL. ROSS. Regret to find you have in so short a time entirely changed your views. You think that (1) KNOWLEDGE is diminishing in circulation (oddly enough, only three days before your letter came, "the largest weekly sale since we started" was announced to me); (2) that it ought to diminish in circulation; (3) that its so failing is due to the delay or omission of your articles (you do not say so in so many words, but imply it plainly enough). You point to the Exchange and Sixpenny Sale notices of volumes of KNOWLEDGE for sale as proof of this. The proprietors were flattering themselves that these notices resulted from their own announcements, though they want rather the first seven back numbers to make up volumes than to buy back complete volumes, which our new subscribers will willingly do. It may interest you to learn that all the volumes originally in stock have been sold, and that of others made up with numbers bought back, only seven remained in stock a few days ago.—A STUDENT. You rather surprise us; for Mr. Hume's view has been expressed even more strongly by medical men of experience.—SCIENTIA. Medical men would probable advise you not to sit up reading till one. Whether you can do so or not, without injury to your eyes or body, depends on circumstances which only those who know you well personally can be acquainted with, on your constitution, habits, eyesight, &c. If you neither drink nor smoke, and your food is usually plain, reading till one should not hurt you. But if you find it necessary to take strong coffee or tea, or to bind your head with wet cloths or the like, you may rest assured you are injuring yourself. I cannot myself advise you, quite in the dark as I am, nor allow anyone else to advise you through these columns, to what might be very good for A, B, C, F, and G, but very bad indeed for D (yourself, let us suppose). On the other point, I do not know; but I fancy that no societies meet on the dates you mention.—ALLARD. The solution would run somewhat as follows, I suppose.—

$$\frac{1}{8}+\frac{4}{8^2}+\frac{6}{8^3}+\frac{3}{8^4}+\frac{1}{8^5}+\frac{4}{8^6}+\&c.$$

(1,4,6,3, recurring)

$$=\left[\frac{1}{8}+\frac{4}{8^2}+\frac{6}{8^3}+\frac{3}{8^4}\right]\left[1+\frac{1}{8^4}+\frac{1}{8^8}+\&c., \textit{ad inf.}\right]$$

$$=\frac{8^3+4.8^2+6.8+3}{8^4}\left(\frac{1}{1-\frac{1}{8^4}}\right)$$

$$=\frac{819}{8^4}\left(\frac{8^4}{8^4-1}\right)=\frac{819}{4095}=\frac{1}{5}$$

A. McD. Have forwarded your question to Mr. Grant Allen. I quite agree with you that the handkerchief shows on a London fog day, that it is better to breathe through the nostrils; but not that blowing the nose is a bad habit. The mucus does not act as an air filter. The irritating action of the matter which has been filtered out of the air causes the flow by which mucus is formed, and so the particles of carbon, &c., get in the way of being removed, preferably by the process you think objectionable.—W. SOUTHALL. Thanks; but the mistake is tolerably obvious. Our contributor wrote "Decoction or tincture of Cinchona," which was misprinted "Decoction of tincture," &c. He added on proof a marginal note, the last word of which was "quinine," but struck it out; unfortunately the last word seemed to remain unscored out and was taken as a correction for Cinchona. We have forwarded your note. There is, of course, no objection to your correction; on the contrary we thank you; still, you should hardly have supposed that anyone could be ignorant of the fact that "decoction of tincture of quinine," and "decoction or tincture of quinine" would equally be nonsense. A correction of an obvious "printer's error" would have been more acceptable than one implying a simply ridiculous, and, in fact, impossible blunder.—T. MORGAN. A number of correspondents object to the blowpipe articles, which for that and other reasons have now come to an end. But, as I learn from Lieut.-Col. Ross that you are in correspondence with him about a pyrological society, you can readily find other and better ways of announcing the plan to pyrologists.—EYE-WITNESS. We will convey to Mr. Allen and the author of "The Amateur Electrician" your suggestions about illustrations, but you must consider our small price and the absolute necessity that expenses should be kept down till the growth of our circulation has continued some time longer. We might at once do what you suggest if we made the price threepence per number. We prefer waiting till we can make such improvements without increasing the price. Already we have gone, in the way of expense (especially for original matter) far beyond what our price and present circulation justify, encouraging though the latter certainly is. It is *not* very encouraging to find our efforts in the way of cheapness altogether ignored as in your letter.—B. M., F.R.C.S. Some singular experiences in my own family circle confirm that view. But I do not care to cite them. —B. M., F.R.C.S., wishes to know where the mild tobacco mentioned at p. 79, letter 445, can be obtained.—ECONOMIST. Suggestions noted.—W. PEDDIE. Thanks.—J. R. C. Thanks; but we have given general solution for case of belts not crossing—understood in the problem. When they cross, solution is similar, so far as geometrical principles are concerned. H. C. FLOYD. The geological structure of that spot is well known, and will probably be referred to by Mr. Harrison in the course of his papers.—F. COWLEY. No; you cannot multiply money by money. In the case of feet by feet, all you can say is that the number of feet in the length multiplied by the number in the breadth of a rectangle, gives the number of square feet in the surface. This is not multiplying feet by feet, however.—J. B. SHIPLEY. Thank you; but that way of doing the Fifteen Puzzle would not be of use to our readers.

CHEMICAL ANSWERS.

QUERIST.—Pure quartz does not lose weight by being heated alone (hydrous varieties lose water); in a current of steam, however, it slowly volatilises. If the mineral be powdered and fused, its *specific gravity* is altered; that of crystalline quartz is 2·6, after fusion it becomes 2·3. The same change takes place without fusion if the mineral is kept for some hours at a temperature of about 2,000° C. This lighter form is also found naturally, but only rarely occurs in crystals. When it does so it receives the name of "tridymite." These differ in shape from the crystals of quartz, and belong to another crystallographic system.

MEDICAL.

"A READER OF THE SAME" had better go where he can get plenty of exercise on elevated ground—the Yorkshire Wolds, the Sussex Downs, Firth Hill, &c.—avoiding valleys for residence. He should have a *pursuit*, whether it be geology, botany, or any other study, which will necessitate out-of-door exercise. He should clothe so as to avoid *chills*, and leave off all *spirits*. As to the Turkish bath, he should consult his medical man. A dose of Carlsbad salts every other morning will help him.

IMPROVEMENTS IN THE RUBBERS OF ELECTRIC MACHINES.—By G. J. A[illegible]ostini. Very fine charcoal-powder is rubbed up with petroleum to a tough liquid, and spread with a brush upon thin cotton paper. The surface of the ordinary rubbers is covered with strips of this paper. They are not hygroscopic; give a good development of electricity, and cleanse the disc.—*Wiedemann's Beiblatter.*

Our Mathematical Column.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

No. III.

By the Editor.

THE [illegible] we adopted in Lesson I. to obtain the differential [illegible] of the expression $\frac{1}{2}gt^2$ with respect to the variable [illegible] the differential co-efficient of many other variable expressions.

[illegible] be well to try one other case, giving also an illustration [illegible] such processes, before proceeding to obtain the differential co-efficients of various familiar functions.

Suppose, for instance, that

$$x = ay - y^2 \qquad \text{(i.)}$$

Increase x by Δx, and y by Δy; then

$$x + \Delta x = a(y + \Delta y) - [y^2 + 2y\,\Delta y + (\Delta y)^2] \qquad \text{(ii.)}$$

so that, subtracting (i.) from (ii.),

$$\Delta x = a\Delta y - 2y\,\Delta y - (\Delta y)^2$$

$$\text{and } \frac{\Delta x}{\Delta y} = a - 2y - \Delta y.$$

Now make Δx and Δy infinitely small, calling them dx and dy. Then we get

$$\frac{dx}{dy} = a - 2y - 0 = a - 2y.$$

This process would be very cumbrous if applied to complex expressions. Therefore, the first matter considered in treatises on the differential calculus, is the determination of rules by which a differential co-efficient may be readily obtained. In the next paper on the subject I shall give some of these rules, without dwelling at any great length on the reasoning by which they are established. Much of this reasoning, indeed, would be beyond those for whose special service these papers are written. The advantage derived from the practical application of the differential calculus to problems not easily solved in other ways, will encourage the student to discuss after awhile the reasoning by which the rules of the calculus have been established. The great difficulty has hitherto been that this reasoning, coming before the student has learned the power of the calculus, has, by its length and complexity, prevented many from pursuing the study of the subject.

But even at this stage, it will be well to illustrate the application of the differential calculus.

Suppose we had this problem given:—

The length of the line AB is A; where must a point P be taken in

A y P B

order that the rectangle under AP, PB may be as great as possible?

Since AP is y, PB is $(a-y)$, and the rectangle under AP, PB (which call x) is $y(a-y)$; that is

$$x = ay - y^2.$$

We want x to be as great as possible. Now the differential co-efficient of x with respect to y, is the rate at which x increases with increase of y (from 0 to a); and so long as x is increasing, x is not as great as possible. We must find then when x ceases to increase, or when its rate of increase (or its differential co-efficient) is reduced to nought. Now we have seen that when

$$x = ay - y^2,$$

$$\frac{dx}{dy} = a - 2y.$$

Putting this equal to nought, we have the equation

$$a - 2y = 0,$$

$$\text{or} \qquad y = \frac{a}{2}.$$

So that P must bisect AB in order that the rectangle under AP, PB may be a maximum.

Here is another problem:—

A [illegible] cylinder [illegible] to fulfil the condition that its height AB added to AO, the radius of a circular face, is equal to a

[illegible] Required the height of the cylinder in order that the curved surface may be as great as possible.

Put AB = y, so that AO = $a - y$.

Then the curved surface, which call x, is represented by the rectangle under the height and the circumference of a circular face. That is (representing the ratio of the circumference to the diameter as usual by π),

$$x = 2\pi\,(a-y)\,y = 2\pi\,(ay - y^2).$$

Here, as before, we must have the rate of increase of x with increase of y (or the differential co-efficient of x) *nought*. But if we went through the process for determining the differential co-efficient as above, we should readily get

$$\frac{dx}{dy} = 2\pi(a - 2y),$$

and the equation

$$2\pi(a - 2y) = 0$$

gives

$$y = \frac{a}{2},$$

or the height of the cylinder must be equal to the radius of its base.

(*To be continued.*)

Our Whist Column.

By "FIVE OF CLUBS."

DEAR FIVE,—I have been studying Whist since KNOWLEDGE came out, having formerly played a good deal, but without much knowledge of the principles. I see you are working your way (for us learners) through the leads, play second and third in hand, return leads, and so forth. But I have a question to ask about matters you have not yet reached—illustrated in the following game, which forms the first example in Pole's lucid treatise on the "Theory of Whist." Will you kindly give some notes on the game. I do not express my own opinion as to particular points of play; but speaking generally, I may say that it seems to me the play on both sides (not of all four players, however,) is decidedly bad.—Faithfully yours, DEUCE OF HEARTS.

In the game referred to by "Deuce of Hearts," as given by Professor Pole, the score, on which in reality the play would greatly depend, is not given. We assume that it is "love all;" but if it were *A B* love, *Y Z* three, *B*'s play would be better justified than it is under the assumed actual conditions, because then *nothing could save A B* (if honours against them) *but the possession of such cards, or at any rate such a long suit* by *A*, as *B* ought, under ordinary conditions, to hold himself,—to justify his signalling from five trumps one honour. On the other hand, if the score were *A B* four, *Y Z* three, *B*'s play would be about the best he could follow to *lose* the game. The play of *Y Z* also would depend much on the score. The game is as follows:—

THE HANDS.

A.
Hearts—10, 7.
Spades—A, K, 10, 9, 4, 3.
Diamonds—5, 4.
Clubs—K, 8, 6.

Y.
Hearts—A, Q, Kn.
Spades—8, 7, 5.
Diamonds—A, 10.
Clubs—Q, Kn, 10, 5, 3.

	B	
		Dealer
Y		Z
	Trump Card, Nine of Hearts.	
	A	

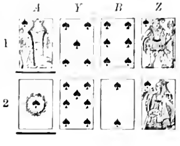
B.
Hearts—K, 8, 6, 4, 2.
Spades—6, 2.
Diamonds—9, 6, 3, 2.
Clubs—A, 7.

Z.
Hearts—9, 5, 3.
Spades—Q, Kn.
Diamonds—K, Q, Kn, 8, 7.
Clubs—9, 4, 2.

Score (probably):—*A, B,* = 0; *Y, Z,* = 0

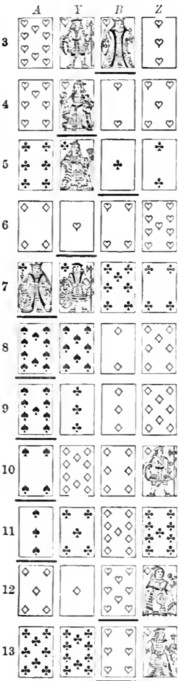
THE PLAY.

NOTE.—The card underlined wins the trick, and card below leads next round.



REMARKS.

1. *A* leads correctly (see leads). The Two not falling, he knows someone is signalling. *B* commences the signal. At the assumed score, *B* plays very badly in signalling, though if the lead had been with him he would have been right in leading trumps. When a player leads trumps he says to partner, "I am strong enough to play a forward game if you have



strength:" but when he signals he says, "I am strong enough to play a forward game even without your support, if you only bring in trumps. *B*, in this case, has only three probable tricks in trumps and one in diamonds.

2. *B* completes the signal; *A*'s suit is established. *Z* has no more spades.

3. *A* rightly leads his best trump. *Y*, from his own hand, knows that *B*, in all probability, has the King; for if *A* had the King he would not have led the Ten, and if *Z* had the King, besides the trump card, *B* would only have had small trumps, headed by 8, from which he would hardly have signalled. *Y* should therefore have put on the Ace. He gains nothing by this tenace being led up to, for if he had played the Ace, he would still have been sure of the third round of trumps as eventually played. Meantime he could have forced his partner in Spades.

5. Here *Y* plays very badly. It is useless to lead from a long suit at this stage of a game, in which strength of trumps has been declared against you. *Z* is not likely to attribute strength to *Y* in any other suit but Clubs, even if any harm could come, at this critical part of the game, from such a mistake. Leading Ace of Diamonds to save the game would have been sound play enough though this might suggest length in Diamonds: unless *Z* himself is very strong in them, as *Y* knows to be probable. But the force is the correct play to save the game. Of course *Y* knows that *Z* can trump, the trump card not having been played.

7. Even now, leading the Diamond Ace would save the game. (As a matter of fact it would do much more, as *B* holds four Diamonds; but of this *Y* cannot be assured. All he knows about Diamonds is that *A*, who has discarded one, is short in that suit; so that *B* is almost certain to have one at least). But *Y* blunders on with his long suit, on the chance that *Z* holds the King, and that *B* cannot ruff. *B* is much more likely, so far as *Y* can judge, to be able to ruff Diamonds than Clubs, for *Y* has two Diamonds and *A* is short in them, leaving at least eight between *B* and *Z*; whereas *Y* holds five Clubs, *A* from his discard certainly had at least three Clubs originally, while *B* and *Z* have already played one each, leaving only three to be accounted for between *B* and *Z*. Besides this, it is an even chance that *A* holds the King, not *Z*.

8, 9, 10, 11, 12, and 13. Of course nothing can now be done. *A* and *B* make five by tricks, against *Y Z*'s two by honours.

If at trick 5 *Y* had played properly, the game would have proceeded thus:—

	A	*Y*	*B*	*Z*		*A*	*Y*	*B*	*Z*
5.	S 10*	S 8	C 7	H 9	10.	S 9	H A	H 4	D 7
6.	D 4	D A	D 2	D K	11.	C 6	C Q	C A	C 2
7.	D 5	D 10	D 3	D Q	12.	C 8	C 10	H 8	C 4
8.	S 3	C 3	D 6	D Kn	13.	C K	C Kn	H 6	C 9
9.	S 4	C 5	D 9	D 8					

A B only making the odd trick.

NEVER BE TOO SURE.—"I once lost five by cards when I held Ace, King, and four small trumps, King and one Diamond, King and one Spade, and three small Clubs. It was my lead, and I led a small trump. Arrange the cards in the various hands so as to see how this happened, and could not be prevented after I had led. My partner had one trump only."—Drayson's "Art of Practical Whist."

* The best, to show partner he has entire command of the suit.

Our Chess Column.

By MEPHISTO.

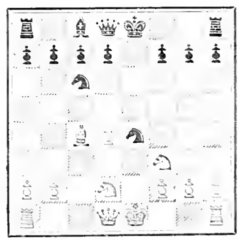
GAMES BY CORRESPONDENCE.

THESE games have an advantage not possessed by ordinary play, in that the exhaustive analysis each move is subjected to, can be recorded on paper actually as the game proceeds; and at the finish of the game, provided both players do the same thing, we obtain a more complete commentary upon a game than can be furnished by analysis, although the latter might be deeper. We herewith give such a game, and hope its perusal will be interesting to our readers.

Since the publication of the games between our Chief Editor and Chess Editor in our columns, two more games have been played "even:" with the result that each won a game. The first of the above games was a Guioco Piano, in which Chess Editor had the attack, and Chief Editor the defence. The former opened, as usually in this opening, with

	White	Black
1.	P to K4	P to K4
2.	Kt to KB3	Kt to QB3
3.	B to B4	B to B4
4.	P to B3	Kt to B3
5.	P to Q4	P takes P
6.	P takes P	B to Kt5ch
7.	B to Q2	B takes Bch
8.	QKt takes B	Kt takes KP

BLACK.



WHITE.

Here Chess Editor halted, as, for the sake of interest, he wished to examine into the merits of 9. P to Q5, which latter move is also mentioned in our analysis of the Guioco Piano, p. 112. The continuation given there is—

	White	Black
9.	P to Q5	Kt takes Kt
10.	Q takes Kt	Kt to K2
11.	P to Q6	P takes P
12.	Q takes P	Kt to B4

And for White's 13th move Q to Q5. The sacrifice of the Bishop here looks promising, and the following are a few results of its examination:—

13.	B takes P(ch) / K takes B		
14.	Kt to K5(ch) / K to K(sq)	Q to Q5(ch) (best) / K to Kt3	K to B3
15.	Q to Q5 / Q to Q2	P to KKt4 / Q to K2(ch)	P to KKt4 / Q to K2(ch)
16.	Castles KR / P to Q3	Kt to K5(ch) / K to B3	K to B(sq) / Q to K3 (best)
17.	Kt to Kt6	Castles QR / P to Q3	
18.	Threatening R to K(sq)	P to Kt5(ch) / K takes P	
19.		R to Kt(sq)(ch) / K to B3	
20.		Kt to Kt4(ch) / K to Kt3	
21.		QR to Q(sq)	

Being convinced that White could follow up that line of play, although in the last variation Black has a valid defence, Chess

Either determined to make this the subject of further investigation, and the game proceeded 9. $\frac{\text{Kt takes Kt}}{\text{P to Q4}}$ 10. $\frac{\text{KKt to Kt5.}}{}$

This move is of an attacking nature. Black, of coarse, cannot take the Knight. P to KR3 would also be weak, on account of Kt takes P, and if K takes Kt then Q to R5(ch) would give White a fine attacking position. Chief Editor says in his note: "An ugly move; [illegible]. The two Knights and the Queen threaten [illegible] on my King's side. However, I take the Bishop;" [illegible] 10. P takes B.

(*To be continued.*)

Note on the Steinitz-Winawer game, p. 86.

Dear Mr. Mephisto,—I have been so backward with my work the last few weeks, owing to (what is unusual with me) ill health, that I have had no time to open a chess-board. Looking, now, over the [illegible] game (for a great match) between Herren Steinitz and Winawer, on Friday, June 23, pp. 85, 86, I note that the ingenious variation suggested by you on move 16, while effecting a certain draw, if Black moves K to Kt(sq), gives White (at least, I think [illegible]) a win, if Black moves K to K2. Your continuation is—

16. Q to KR5	16. Kt to Kt3
17. Q to R6(ch)	17. K to K2
18. Q to Kt7(ch)	18. K to Qsq
19. Kt to B7(ch), and perpetual check follows.	

But if after—

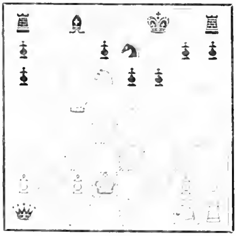
18. K to Qsq

White plays 19. Q takes P(ch)

I cannot see how Black can avoid mate in a few moves. Some of the variations are very pretty, but I see none in which mate is not [illegible]. Is it not so?

About what follows I feel more doubtful, having only considered the suggested line of play in passing, when running through the game, as actually played. It seemed to me that if at move 14, White, instead of playing Kt to K2, giving the position shown in the diagram at p. 86) should play P takes P, and after P takes P, which seems forced, should play Kt to KB3 (sacrificing Rook), and after Q takes R, Kt to KR4, he wins by force. Black's best move seems to be to return his Q to QR8; but White can then play Q to KR5, and if Black Queen checks, move K to K2, safe from further check. What, then, can Black do?—In haste, faithfully yours, R. A. PROCTOR.

BLACK.



WHITE.

[illegible] of these excellent remarks, we give [illegible] of the position after Black's thirteenth move. [illegible] second part of Mr. Proctor's letter, [illegible] asks whether in the position given above, White would [illegible] better to play

14. P takes P	14. P takes P
(14. Q takes P would be [illegible] on account of B to Kt5)	
15. Kt to B3	15. Q takes R
16. Kt to R4	

[illegible] looks promising, and Black would probably lose if he [illegible] to play Q to QR8. He has a better move at his disposal, [illegible], which is

16. Q to KB8.

W[illegible] continue with

17. B to R6 (ch)	17. K to Kt sq

B[illegible] there is nothing to be done of a determined character. [illegible] 18. Kt to K4 Black replied with 18. K to B2, in which case White would do best to draw by Kt to Q6 (ch), for should the Queen check on R5 Black can with advantage cover with the Knight. Or if 18. Q to KR5, Black can also play 18. Kt to Kt3, for in reply to 19. Kt takes Kt there follows 19. Q takes P (ch). 20. K moves. 20. Q takes Kt with an advantage.

In reply to 16. Q to KB8 White could also proceed with 17. P to Kt3 or B to K3, which would be met (we think effectually) by Black with 17. P to KR4. Finally, in reply to 17. Q to Q4. 17. Kt to K4. 18. B to R6 (ch). 18. K to K2. 19. P to B4. 19. K takes Kt. 20. P takes Kt. 20. K to K2, &c.

As regards the first part of Mr. Proctor's letter, he is quite right in saying that Black must accept the draw by moving the K to Kt sq. We were so elated at our analytical success in finding out the draw, that we overlooked that if Black plays K to K2 White will win. Resuming the position of the diagram, the variation proceeds thus:—

14. Kt to K2	14. Q takes R
15. P takes P	15. P takes P
16. Q to KR5	16. Kt to Kt3
17. Q to R6 (ch)	17. K to Kt sq
18. Kt to K8	18. K to B2
19. Kt to Q6 (ch)	

If Black now plays 19. K to K2, instead of K to Kt sq, White will win as follows:—

	19. K to K2
20. Q to Kt7(ch)	20. K to Qsq
21. Q takes BP(ch)	21. K to B2
22. Q to B3(ch)	22. K to Qsq or (*a*) or (*b*)
23. B to Kt5(ch)	23. Kt to K2
24. Q to R5(mate)	

(*a*) 22. K to Kt(sq). 23. Kt to Kt5(ch) and mate next move.

(*b*) 22. K to Kt3. 23. Q to Kt4(ch). (If K to B2, proceed as before.) 23. K to B3. 24. Kt to Q4(ch). 24. K to Q4. 24. Q to B4(mate).

Contents of KNOWLEDGE *No.* 36.

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LONDON: FRIDAY, JULY 21, 1882.

CONTENTS OF No. 38.

OUR NATIONAL GAME.

ROBERT FERGUSON, Monmouth's follower, used to say:—"Let me make the ballads of my country, and I care not who makes the laws." In like manner it might be said that sports and pastimes are factors as important in the making of a people as their more serious avocations. Wellington, we know, considered that Eton—that is football, and cricket, and school sports generally—made the fighting men of England, with a reservation in favour of fox-hunting as making our British cavalry; and, although there are pursuits better befitting the dignity of man (outside the savage state) than fighting, Wellington there, speaking of what he understood best, expressed the general truth, that the sports of a race largely influence their character as a people. We may therefore fitly take for a subject of inquiry, even in a magazine chiefly devoted to science and art, a game which, like cricket, is essentially the national game of England, and—except in America—of English-speaking races.

Cricket deserves, it seems to us, the position it holds as a national sport, though chiefly for reasons which perhaps the most ardent cricketers leave out of account. Considered with regard to the amount and kind of exercise it involves, cricket is open to many objections; while the kind of skill which constant cricketing practice engenders is not exceptionally serviceable in ordinary life. Americans maintain, indeed, that, regarded as a scientific sport, baseball is superior to cricket—about which view, knowing base-ball only from without, not from actual practice of the game, the writer can hardly venture an opinion. Certainly, if all that is said of base-ball be true, some parts of the game—pitching for instance*—must require an enormous amount of practice, and thus to acquire something of a scientific character. But, apart from any comparison between cricket and base-ball, it is certain that skill in driving, cutting, drawing, and so forth (or such skill in placing the ball as W. G. Grace and a few other players possess in marked degree), the mastery of various bowling devices, and quickness and correctness in the field or behind the wicket, are acquisitions of very little real value in life, while the quickness of eye and limb which these cricketing qualities indicate, might be acquired in others ways more directly advantageous. Again, the exercise obtained in the cricket field is intermittent and uncertain, and of doubtful value in developing muscle and expanding the chest (so, at least, says the writer of "How to Get Strong," in KNOWLEDGE, No. 35). But while in such points as these, cricket, delightful and fascinating though it is to players and bystanders alike, is imperfect as an exercise, as a sport it has qualities which render it exceedingly valuable. It is better morally than physically. The good cricketer has constantly to put self on one side. He has to keep the interests of The Eleven, not of Number One, continually before him. Even the most brilliant bat has, in the interests of his side, to exercise self-control, not only in reference to his partner at the moment, but to the whole progress of the innings so long as he is at the wickets. Bowlers must do their work as the captain directs, the captain must direct their work, or take part in it himself, as is best for his eleven, not as may best suit himself. The field must work together in due subservience to the captain's plans. And while thus men are taught discipline, self-control, and self-sacrifice (where need is), they are taught also moderation in times of prosperity, caution in times of difficulty, courage and resolution when defeat seems to stare them in the face. But defeat also has its good influence; and the cricketer who takes defeat pleasantly, not making false excuses for obvious shortcomings, but resolving hereafter to correct them, not angry with the victors, but determined to face them again as resolutely as ever, and perhaps with better success, has gone through a moral exercise which cannot but be of service to his character as a man. It is in this way, and not from any special value which cricket has as a physical exercise, that the discipline of the cricket-field tells on the character of a nation. When we consider that (outside absolute pauperdom) there is probably not one able-bodied man in ten thousand in this country who has not at some time in his life played in the cricket-field, the importance of the game as our chief national sport will be fully recognised.

Yet, we must confess, it appears to us that of late—during the last quarter of a century, perhaps—cricket has taken a position not altogether desirable. When, in former times, professional cricketers almost invariably defeated amateurs (we reject the utterly ill-chosen names Players and Gentlemen), things were more nearly as they should be, we take it, than they are now, when men who are to be lawyers, doctors, clergymen, statesmen, and so forth, give so much time to cricket during their younger days, as to acquire a skill rivalling and surpassing that of men who get a large part of their living from the practice of the game. We doubt even whether the devotion of so much time to cricket is not mischievous from the mere loss of opportunities for other games cricket being decidedly imperfect as the sole or chief form of exercise. But it is a much more serious question how far study, and even mental development, are influenced by the excessive devotion to cricket which is now found not only at great public schools but all over the country. It may seem at a first view as though only a few were affected in this way; for people hear only of the few at each public school, or at the universities, or the like, who acquire very great proficiency in batting, bowling, and fielding. But those who come near the best, and those who, just because they have never had any chance of coming near the best, have given more time to vain efforts than a Steel or a Studd to successful practice

* It is said, and we have been assured by American men of science that it is truly said, that a good "pitcher" can cause the ball to change its course when in the air, so intense is the "spin" he can give to it!

[illegible] And the question arises [illegible], even in the case of those who can afford so much [illegible] the years when they should be fitting themselves for [illegible] duties of life, the game is altogether worth the sacri[illegible] for it. Cricket was a splendid game, though not so [illegible] when a strong and clever lad, working [illegible], could gain enough skill with the [illegible], to take a good place in his school or [illegible] but now, when we see Marlborough turn[illegible] Rugby a Leslie, and so forth, who, almost [illegible] the day of leaving school, are good enough to play [illegible] eleven of All England, it is tolerably [illegible] the standard of school cricket is too high to [illegible] approached, without much more time [illegible] to the game than perhaps the wiser lads themselves, and certainly the parents, should altogether [illegible]. "All work and no play" is as bad as "All play and no work;" but "too much play and too little [illegible], too much Stodd and too little Study, must have [illegible] effects in the long run; and unless we mis[illegible] all that we have heard on such matters, a very strong [illegible] begins to be entertained in certain quarters [illegible] but not wholly, parental) that this is so.

Yet of cricket, as a school or college game, we have a far higher [illegible] than of cricket as developed in our great three days' matches. Here all the faults of cricket are exaggerated. It is always full of uncertainty: the ball which takes a wicket may come early or late, a few steps to right or to left in taking up his place may enable a fielder [illegible] to reach a catch or cause him just to miss it, and so forth *ad infinitum*. But the chance and uncertainty inevitable in cricket are increased by uncertainties of weather (affecting the condition of the ground), by luck as to time of going in (who has not seen three or four of the best men lose their wickets when a side has had to go in during the last half hour or so of bad and uncertain light), and by other causes, not necessarily belonging to the game, though made to do so by laws as unchangeable as [illegible] (as some of) the laws of the Medes and Persians. Then how many matches end in a draw! Three of the most interesting during the last fortnight (Australians and Marylebone, Australians and Yorkshire, and Eton and Harrow) have so ended. It is, indeed, [illegible] unsatisfactory that every game except one, in which the Australians seemed to have met their match this season, has ended in a draw. How many games, [illegible], are finished long before the allotted time is up, to the [illegible] of spectators and to the loss of many worthy professional cricketers!

The [illegible] at any rate, might easily be corrected. We [illegible] next a plan (which will certainly [illegible], but that does not matter) by which no game [illegible] end in a draw, or need ever be finished [illegible] an hour or so of the end of "time;" by which [illegible] play under equal conditions as to weather, [illegible] of ground, and so forth; by which the [illegible] would be kept idling about, as often happens [illegible] while yet a match played out to the [illegible] would be played under precisely the [illegible] as at present, and a match [illegible], or requiring more than two [illegible] the three days, would still be played [illegible] during the whole time that it continued.

[illegible]

FOUND LINKS.

By Dr. Andrew Wilson, F.R.S.E., F.L.S.

(Concluding Paper.)

I PURPOSE in this concluding article to direct attention to the very interesting, and at the same time astonishing, facts in favour of evolution which recent researches amongst extinct and fossil *Mammalia* (or Quadrupeds) have brought to light. The quadruped class presents us with a large and varied array of animal forms; and it is therefore needful that at the outset we should endeavour to gain some plain ideas respecting the arrangement of the class into "orders." These latter are the subordinate groups into which every "class" of animals is primarily divided. To begin with, the quadrupeds themselves, as a class, are capable of being divided into two distinct series. Of these, the first, as mentioned in a previous paper, contains the kangaroos, wambats, opossums, and their neighbours, along with the *Ornithorhynchus*, or duck-billed water-mole of Australia, and its near neighbour, the *Echidna*. These animals form collectively a division, which may be named that of "Lower Mammals," inasmuch as, in respect of many points in their anatomy, they exhibit a decided inferiority to our common quadrupeds, and to the other members of the class. All other quadrupeds may be named "Higher Mammals," since they exhibit among themselves an agreement in structure which places them above the kangaroos and their kith and kin. Tabulating the great class of quadrupeds, we find that the following arrangement gives a brief sketch at once of the characters of the various "orders," and their chief representatives.

Order the first is called the *Monotremata*. It includes the Ornithorhynchus and Echidna, both denizens of the Australian region. These animals exhibit bird-like characters, as has been shown in a previous paper. They possess "Marsupial bones," like the kangaroo races; and in many respects present us with a peculiar and special, but still low type of quadrupeds. The second order is that of the *Marsupialia*. These are the kangaroos, wombats, phalangers, and opossums; the latter alone being found outside the bounds of the Australian province. Here the bird characters have disappeared, although the included animals are of low structure as compared with such forms as the dogs, horses, seals, &c., of higher orders. The "Marsupials," as their name implies, usually possess a "pouch," supported on the "marsupial bones" that rise from the front of the haunch (see Knowledge, page 532, Vol. I.). Even if the "pouch" itself be wanting (as in some opossums), the bones supporting it are developed.

The Higher Mammals introduce us to order the third, that of the *Cetacea*, or Whales. A fish-like body, one fully developed pair of limbs (the fore limbs) assisting in the shape of swimming-paddles, a horizontal tail-fin, and nostrils forming "blow-holes," are the characters of which the whales, dolphins, porpoises, and the like are characterised. The fourth order is that of the *Sirenia*, represented by two genera of animals—the Manatees, or Sea Cows and Dugongs—long classified with the whales. Here the body is again fish-like, and the fore limbs, which are alone developed, form swimming-paddles; but the nostrils do not form "blow holes," and the skin is sparsely covered with bristles. The *Edentata*, or Ant-eaters, Armadillos, Sloths, and Pangolins constitute the fifth order, whose head-quarters exist in South America. There is only a single set of teeth in these animals, and the teeth are further destitute of distinct roots, whilst they want enamel. Scales or bony plates, as in the Armadillos, often cover the body.

An order of immense extent, that of the *Ungulata*, or "hoofed" quadrupeds, forms the sixth division. Here the largely-developed nails, called "hoofs," are met with, and all four limbs are always developed. The rhinoceroses, horses, pigs, ruminant animals (sheep, deer, oxen, camels, &c.), hippopotamus, &c., represent this group. The seventh division is that of the elephants (*Proboscidea*), the characters of these animals requiring no special mention. The hyrax, or "coney" of scripture, represents the eighth group, and resembles the rodents or "gnawers" in some respects, whilst it is also allied to the rhinoceroses, if the form and structure of the molar or grinding teeth are considered. The *Carnivora*, or lions, tigers, wolves, dogs, bears, seals and walrus succeed, as order the ninth; and the *Rodents*, or gnawers, with chisel-shaped front teeth, growing from permanent pulps, and represented by the rats, mice, beavers, squirrels, porcupines, &c., form the tenth division. The bats, or *Cheiroptera*, with an elongated hand of four fingers (and a short thumb), adapted to support a flying-membrane, form the eleventh group. The *Insectivora* are the twelfth order, and present us with the moles, shrews, and hedgehogs as types. The *Primates* (including the *Quadrumana*, or monkeys, and *Bimana*, or man) bring us at once to the concluding order, and to the height of animal development.

(*To be Continued.*)

STIMULANTS AND STUDY.

By the Editor.

Mr. ARTHUR READE, described in *Les Mondes* as author of the *Litterary Soudth*, has recently elicited from my esteemed friend, M. l'Abbé Moigno, certain useful notes about the habits suitable for literary or scientific workers. Mr. Reade had remarked that men of letters are commonly supposed to sustain themselves by stimulants. It is to be feared, he says*, that fifty years ago there was somewhat too close a connection between stimulants and literature; but since then the habits of men of letters have, fortunately, undergone great changes. The inveterate smokers and wine-bibbers no longer exist: six bottle men have become as rare as the dodo. Still the question remains, are stimulants a useful auxiliary to intellectual work? The opinions of medical men as to the use of wine are too diverse to have much effect. Nor are they in much better agreement as to tobacco. That tobacco is a poison is certain; so are many things we use, not only in medicine, but in food. The influence of tobacco on brainwork has been the subject of interminable controversy, and the question has occupied all classes of society. One argument is that smoke helps men to think (to dream, rather), and it is asserted that the journalist smokes in writing, the man of science in solving a problem, the artist in painting, the clergyman in composing his sermon; that, in fact, every man great in science, in literature, in arts, climbs the ladder of fame with a pipe or a cigar in his mouth. Tennyson has composed, it is said, his sweetest idylls under the influence of nicotine. Carlyle has taught the world philosophy, smoking. Not the young only have these ideas. According to Andrew, Moltke is a great snuff-taker, and it was due to snuff (*la prise aurait tout fait*) that Napoleon was so pitilessly expelled from Belgium. Mr. John C. Murray, in his volume on smoking, undertakes to show when it is dangerous, neutral, or beneficial to smoke. He claims that Raleigh, Milton, Dryden, Newton, Picot (*sic*), Steel, Addison, Swift. Congreve, Bolingbroke, Pope, Johnson, Byron, Burns, Scott, Campbell, Moore, Dickens, spoke, wrote, and sang under the influence of *coffee*, that plant of mystic power. But for those who have recourse to tobacco, he adds, their genius is generally but a lightning-flash or a meteor. involving too great mental tension, likely to drag reason from her throne and plunge it in the night of chaos. (By my troth, these are very bitter words.) Another medical authority says that a moderate use of tobacco is as necessary to the brain-worker as moderation in the use of alcohol.

On the other hand, the adversaries of tobacco regard the idea that smoking helps sound thought as a most mischievous delusion; they maintain, on the contrary, that it renders men incapable of intellectual labours. Tobacco leads to physical and mental indolence.

Mr. Reade considers that the use of stimulants is a subject which should be examined in the light of the experience of poets, artists, journalists, men of science, authors, &c., in Europe and America.

M. l'Abbé Moigno makes the following remarks in reply to Mr. Arthur Reade's questions:—

"Though I cannot offer myself as an example, because my temperament is too exceptional, my experience may have some degree of usefulness.

"I have published already a hundred and fifty volumes, small and great; I scarcely ever leave my work-table: I never take walking exercise; yet I have not yet experienced any trace of headache, or brain-weariness, or constipation, or any form of urinary trouble, &c., &c.

"Never, in order to work, or to obtain my full clearness of mind, have I had occasion to take recourse to stimulants, or coffee, or alcohol, or tobacco, &c.; on the contrary, in my case, stimulants excite abnormal vibrations in the brain, unfavourable to its prompt and steady action (*exercice regulier*).

"Often during my life I have fallen into the habit of taking snuff. It is a fatal practice: foul to begin with, since it puts a cautery to the nose, filth in the pocket (*un fumier dans la poche*); unwholesome also; for he who takes snuff finds each morning his nose stopped up, his breathing difficult, his voice raucous or with a nasal twang, because the action of tobacco is, in reality, to draw humours to the brain; lastly, unfortunate (*néfaste*), because the use of snuff gradually destroys the memory,—this last effect being for me completely proved by my own experience and that of many others."

Abbé Moigno then gives the proof that—in this form, at any rate—tobacco injures the brain, but the account, which is too long to be given here in full, and too interesting to be abridged, must be reserved till next week, when we shall give it, along with his most remarkable experience of the effect of a wise *régime* on his powers and on his health. We believe all our readers will be interested to learn how this veteran scientific worker has accomplished his long-continued and arduous labours, while yet retaining not only good but wonderful health.

(*To be continued.*)

HOW TO GET STRONG.

FROM a much-valued correspondent, the following letter has been received through the Editor:—

"Before you leave the subject of chest expansion, I think it worth while to notice what has been vouched for by too many persons from personal experience to be dismissed

* What follows, up to Abbé Moigno's communication, is partly an abstract, partly a translation, of the version of Mr. Reade's communication given in *Les Mondes*.

as paradoxical merely because it looks so. Within the last dozen years there have been a multitude of letters from time to time in the *English Mechanic* and some other periodicals, from persons of all ages, including some medical men, describing the benefits which they or their friends have received from what is commonly denounced as tight lacing, but which may mean very different things, according as it is used to confine the chest or to expand it by contracting only the waist proper, which really is the stomach. I remember that drill sergeants used to tell us at school to 'draw in the *stomnick*, and throw back the shoulders' (pronounced not like *show* but *how*).

"The two points insisted on by those who have gone into particulars are that the chest or upper ribs should not be confined at all, and that when stays are worn (not a mere belt) they should be even larger than the natural size at the top; and secondly, that the busk or plate in front should be quite stiff, of either steel or wood, and as long as will lie flat when laced up which it is said that our ancestors understood better than we do. Several of the writers have said that this sometimes makes the difference between causing and curing indigestion, and that the sensation of a perfectly stiff busk at once convinces you that it is the right thing.

"One or two of them say that they find this treatment for only the first few hours of the morning sufficient for the improvement of their health and strength in standing and walking, and the permanent expansion of the chest quite as much as their waist has been permanently reduced; and in some cases for reducing corpulence, which is a kind of indigestion, and often a beginning of general weakness.

"These statements have been sometimes denounced by medical and other philosophers, who think they know what 'must be' better than those who have personal experience of what is, or is not. The philosophers certainly got the worst of it in all the discussions that I have read. And I am inclined to agree with the opinion that there must have been some better reason than mere vanity for the constant revival of this fashion or practice in every civilised country after many temporary declines of it during the last 1,000 years. And from my own observation I am convinced that, for every person who has ever been injured by excessive contraction of the waist (as, of course, some have), at least a hundred suffer from undue expansion of it, and from stooping and contraction of the chest, which judicious tight lacing would prevent, and often does prevent, as at least some doctors have written.

"An Observer."

When we consider that undue expansion of the waist implies, in reality, a diseased, because abnormal, condition of this part of the body, it is not perhaps to be wondered at that an abnormal remedy, like the modified "lacing," described by "An Observer," should in some cases produce good effects. We would not recommend one who wished to obtain strong and symmetrical legs to use crutches; yet, the use of crutches may produce a marked improvement in the case of a person, who, having diseased limbs, has for a long while injured himself by using them without artificial support. Remembering, however, how the abdomen moves in normal breathing, we should say lacing must in every case act injuriously on respiration. Women can in that respect stand lacing better than men, for with them the bosom rises and falls in breathing, whereas with men the abdomen moves, at least in normal masculine breathing.

I know several who have tried lacing, on the strength of the correspondence referred to by "An Observer," without any of the good effects described, and with some markedly bad effects—especially one, a threatening sense of fullness in the head.

Some correspondents write to ask how such a construction as was illustrated in No. 36 can be arranged. We wish it to be understood that in no case do we suggest the construction of special apparatus. We only meant our picture to illustrate the kind of exercise to be taken for carrying the arms well over the head, with suitable "hauling" work. A couple of stout hooks fixed in the wall, or two rings fastened to stout nails, or any such contrivance which would suit the room or the wall, would serve to carry the cords which bear the weights. And for the weights, almost anything can be used—a couple of pretty heavy volumes, dumb-bells, clubs, or anything giving about the right kind of work in hauling. Nor is it necessary to have the middle bar, or stick. A stout cord flung over the middle of the horizontal part of the rope will give the required hold for the bell pulling action. Or, almost all apparatus may be got rid of by hanging two "extensors" of vulcanised india-rubber to two pretty high nails, and hauling on them, either one in each hand (the hands well apart), or holding both together, as in pulling at a bell rope. In all these cases it is a great point to be ready to devise and use rough-and-ready contrivances—not to find, in the absence of pulleys or framework, an excuse for shirking some useful exercise.

With these notes, this week, we must be content. In another paper or two, the chest-expanding exercises will be done with, and then we shall proceed to consider exercises for strengthening arms, legs, &c., and giving symmetry to the various muscles of the trunk, which is of far greater importance to ninety-nine out of a hundred, than the exceptional development of particular muscles.

(To be continued.)

PHOTOGRAPHY FOR AMATEURS.

By A. Brothers, F.R.A.S.

PART XI.

The ability to take a photograph does not make the photographer an artist, and considered artistically, a collection of amateur photographs is sometimes not very satisfactory. The reason is not far to seek. The eye is attracted by a beautiful scene; the camera is at once placed; the miniature picture visible on the ground glass is charming in the extreme, and forthwith a plate is exposed. Possibly the camera is placed in the middle of a road, and the result on developing the plate is converging lines, leading to beautiful scenery, and a wonderful expanse of uninteresting road, with not a single object to vary the lines. However beautiful the scene may appear to the eye, consider carefully what is required to form a picture, and it may be possible, by changing the point of view, so to arrange the lines that the foreground will be made to form an important part of the picture as it ought to be. The change of position, by a few yards only, makes all the difference between a bad and a good picture. If figures are introduced, they should be made to appear to belong to the scene, and not interested in having their portraits taken. It is seldom advisable that a figure should be turned towards the camera. The straight lines of hedges and fences crossing the picture horizontally should be avoided as much as possible.

Another very important matter to observe is, that the principal object in the view should not, as a rule, occupy the *centre* of the picture. Much may be learned by studying the arrangement of lines in pictures and engravings.

It will seldom be found that a tree, a figure, or other prominent object, is placed centrally. But there are exceptions to this rule, which need not be considered here.

The use of the quick gelatine plates makes it possible to introduce cattle into the foregrounds of photographs, and these, if fortunately placed, make a most valuable adjunct, and considerably enhance the artistic value of the result.

For distant views, wide-angle lenses should not be used; the effect is to dwarf distant objects. The natural angle of vision is about 60 degrees; therefore, if much more of the subject be included, it cannot have an appearance true to nature. Such lenses are valuable for near views, as they enable us to bring into the picture points which assist to make it more complete; and the defect visible in distant views taken with such a lens is not apparent in the near view.

The beautiful atmospheric effects often seen in nature when there is a slight haze over the distant landscape, from an artistic point of view, is one of the most charming aspects of nature; but, unfortunately, is not always suitable for photography. The distant hills just visible through the haze may not be visible in the photograph, and we have only the foreground and mid-distance. On the other hand, the effect in a photograph is not good when the distance is as clearly defined as the foreground. Unfortunately, the amateur cannot always choose his light or time of day for taking his views. He is possibly merely passing through the scenery, and he must take just what he happens to see at the time: therefore, it must very frequently happen that a good picture comes by chance, and the majority of photographs are only of interest as records of what happened to be the effect at the instant the view was taken.

The charming photographs one sees occasionally are usually the result of much patient waiting. It often occurs that the best view of a place can only be obtained at a certain time of the day, and to obtain that view it may be necessary to wait many days so as to catch nature just at the favourable moment—the result may be worth all the waiting.

In photographing buildings (or any other object indeed) care should be taken that the camera be level. This can be done with sufficient accuracy by the eye, and to avoid too much foreground the lens may be lifted by the sliding front. When the camera is provided with a swing back, the defect arising from having to raise or depress the camera may be obviated.

In taking views it not unfrequently happens that the sun may be shining directly into the lens. Such being the case, the greatest care must be taken to shield the lens in some way, or the plate will certainly be fogged.

The most usual plan for carrying plates is to have a number of dark slides, each made to hold two plates, which, of course, must be numbered, or a changing box or bag may be used; and it is necessary, therefore, to be extremely careful to avoid exposing the same plate twice. This occasionally happens, and it is a source of serious disappointment. In order to avoid failure in this way, a book should be provided in which a record should be kept of each plate, stating number of plate, subject, time of day, the size of stop (or diaphragm), the lens used, and time of exposure.

We must not omit a few words about instantaneous photography. If really instantaneous effects are required, some kind of mechanical shutter must be used, and these can be had in a variety of forms. One of the most simple is a slide with an adjustable aperture, which is arranged to fall in front of the lens, on being released at the required instant. The time of the exposure can be regulated by the length of the aperture. Some very good effects may be obtained by merely using the hand to remove the cap of the lens, care being of course taken not to shake the camera.

FAIRY RINGS.*

> You demi-puppets, that
> By moonshine do the green sour ringlets make,
> Whereof the ewe not bites.

SCIENCE has been scarcely more explicit than Shakespeare concerning the identification of these mysterious demi-puppets, although many attempts at explanation have been made. In spite of this, I have a theory of my own, which, halting though it be, I here expound.

I occupied during a few years a house on the slope of the Hope Mountain, near Caergwrle, in Flintshire. The house is named "Celyn" in the Ordnance maps. It commands a fine view of the Alyn valley and country beyond. The most conspicuous of the pasture fields displayed below had no fairy rings during the first and second years of my residence in the Celyn: but on the third a large crop of them came into existence. They were arranged in orderly rows, and so conspicuous that they forced themselves continuously on my attention—were, in fact, almost irritating by their persistent appeals for explanation. They worried me thus every day from the September of one year to the July of the next, excepting when the snow was on the ground.

I walked down frequently to the field and examined the troublesome things, finding them always the same—viz., nearly true circles, and composed of coarser grass than that surrounding them, and at times with a crop of small fungi dotted over them. They varied very little in size, were about six feet in diameter—too small to have been the track of any tethered animal—but they evidently had received some kind of special manuring.

Suddenly, on one bright July morning, the mystery was solved. A crop of grass had been mowed, tossed, and winnowed, and was now in cocks ready for carrying to the stack. The circumference of the base of these cocks corresponded almost accurately with that of the fairy rings: their numbers and arrangements were nearly identical: some of the cocks actually covered the area enclosed by the ringlets of the demi-puppets.

Then I remembered the history of the last year's harvest on that particular field. A weary continuance of drenching rain commenced just when the grass was cocked as now, and it remained thus on the ground for several weeks, until almost black with fungoid rotting. Here, then, was the explanation. The juices of the rotting grass had been washed down the slopes of the cocks, and with these juices were the fungus germs that "soured" the ground.

There would thus be effected a sort of special or differential manuring of circles, having outside diameters corresponding to that of the base of the cocks, and a thickness of ring equal to the depth of penetration and drainage of the rain.

The last year's history of this field was impressed on my memory by a small triumph of *dilettante* science applied to agriculture. My own grass was cut at the same time as the grass of this opposite field, and both were cocked on Friday, in splendid weather; but I had observed a steady fall of the barometer, and accordingly employed extra hands, and made a great bustle to get my hay carried on Saturday—worked till midnight—thereby amusing considerably my neighbours, who were profes-

* By W. Mattieu Williams. From the *Gentleman's Magazine*.

local farmers. The fine weather continued through Saturday and on till Sunday night, when the rain began and continued, with the disastrous results above described.

I hope this Note may induce others to repeat my observations, by looking for these fairy rings, and, when they find them, inquiring whether any kind of heap of vegetable matter formerly occupied the area included within their circuit.

THOUGHT-READING.

By the Editor.

Supposing trickery eliminated by the various tests employed by Professor Barrett and his colleagues, the point to be determined would be, of course, the method by which the person questioned was led to a correct reply. It must be remembered that the necessity of guarding against trickery interfered to some degree with the prosecution of a systematic inquiry into the laws underlying the observed phenomena. It is unfortunate that in inquiries of the sort this difficulty always arises. Thus the real phenomena underlying so-called mesmerism are full of interest, and might be readily made the subject of scientific inquiry, were it not for the trickery practised by many professed mesmerists, who, to impress audiences, pretend to do what, in reality, is outside their powers. In fact, the most satisfactory experiments in mesmerism or hypnotism, or whatever we choose to call the mental phenomena involved, are actually those performed on animals, simply because animals cannot be persuaded to be tricky "subjects." That thought reading should in like manner be tested by experiments on animals may seem a wild and fanciful idea: yet the responses of the Mastiff Kepler, described in the series of papers on "Intelligence in Animals" (Vol. I.), show that a dog may possess a power of reading his master's thoughts akin to that which, on the Thought Reading hypothesis, is possessed by some of ourselves.

To return to Professor Barrett's inquiries:

"We endeavoured," he says, "to gather such indications as we could of the way in which the impression flashed on the mind of the child. The first question concerns the respective parts in the phenomena played by mental *eye* and mental *ear*. Among the experiments which we counted as *failures* were very many where the number or word selected was guessed, as it were, piecemeal. For instance, the number 35 was selected, and the guesses were 45 and 13. So 57 was attempted as 47 and 45. So with cards: the seven of diamonds being chosen, the guesses were five of diamonds and seven of hearts; the three of spades being chosen, the guesses were queen of spades and three of diamonds. These cases seem somewhat in favour of mental eye, the similarity in *sound* between three and thirty in 13 and 35, or between five and fifty in 45 and 57 not being extremely strong; while the *picture* of the three or the five is identical in either pair. A stronger argument on the same side is the frequent guessing of King for Knave, and *vice versâ*. On the other hand, names of approximate sound (also reckoned as failures) were often given instead of the true one: as 'Chester' for Leicester, 'Biggis' for Billings. Frogmore was guessed first as 'Fragmore.' Snelgrove was given as 'Singrore,' the last part of the name was soon given as 'grover,' and the attempt was then abandoned; the child remarking afterwards that she thought of 'Snail' as the first syllable, but it had seemed to her too ridiculous. One of us has, moreover, successfully obtained from the maidservant a German word of which she could have formed no visual image. The children's own account is usually to the effect that they 'seem to see' the thing; but this, perhaps, does not come to much, as a known object, however suggested, is sure to be instantly visualised. Another question would be as to the effect of greater or less distance between the sitters and the guesser, and of the intervention of obstacles. It will have been seen that, in the experiments conducted by one of us on a former occasion, the intervention of a door or wall seemed to make no difference. It would be interesting, again, to discover whether numerical increase in the observers increases the effect, and how far the presence of special persons is influential. In our experience the presence of the father—though by no means essential, and very often dispensed with—seems decidedly to increase the percentage of successes. A still more interesting and important question concerns such conditions of success and failure as may lie in the circumstances, disposition, general capacity, and mood of the subject, including such points as consanguinity and familiarity with members of the circle, and also in the temper and manner of the latter. We are dealing, not with chemical substances, but with childish minds, liable to be reduced to shyness and confusion by anything in the aspect or demeanour of visitors which inspires distaste or alarm. The importance of a 'childly way with children,' and the slightness of the differences of manner which will either paralyse them into stupidity or evoke unexpected intelligence and power, are commonplaces to anyone whose duties have lain among them; and attention to such points may be as prime a factor of success in these delicate experiments as any other. The delicacy of the conditions was illustrated in our own inquiry partly by the inexplicable fluctuations of success and failure affecting the whole household, partly by the wide difference observed in the capacities of particular members of it from day to day. The common notion that simplicity, and even comparative blankness of mind, are important conditions, seems somewhat doubtfully borne out by our experience; but of the favourable effect of freedom from constraint, and of a spice of pleasurable excitement, we can speak with entire assurance. The particular ill-success of a sitting which we held one close afternoon was attributed by the children themselves—and it seemed to us correctly—to inertness after their early dinner. We could find no resemblances between these phenomena and those known as *mesmeric;* inasmuch as a perfectly normal state on the part of the subject seemed our first prerequisite. Nor did we find any evidence that 'strength of will' has any particular effect, except so far as both subject and circle may exercise it in patient attention. On one or two occasions it seemed of advantage to obtain vivid simultaneous realisation of the desired word on the part of all the sitters; which is most easily effected if some one slowly and gently claps time, and all mentally summon up the word with the beats."

This last observation is significant, and if it could be confirmed by a sufficient series of experiments, would go far to establish the theory that mind can act on mind at a distance—that is, without actual contact by which mind impressions can be conveyed by a sort of unintended signalling.

On this point, and especially on the theory of brain-waves, which has been suggested in explanation of the numerous stories related of apparitions seen by friends at a distance at the time of the death of the persons so seen, or of some serious accident befalling them, we shall have a few words to say in our next.

(*To be continued.*)

MATHEMATICS AND SCIENCE.

By the Editor.

Mr. W. Mattieu Williams, in an interesting note upon the Origin of the Solar System, with special reference to my article on the "Birth of the Moon," in the *Gentleman's Magazine*, remarks (in the July number of that magazine) on the assumption, too often made, he thinks, by mathematicians, "that whatever has been demonstrated mathematically, must be infallibly true." He says very pleasantly of myself that I am as free from this form of scholastic dogmatism as any of my mathematical kind; yet, even in my case, "this mathematical self-righteousness crops out occasionally, as in the paper above-named, where, referring to Mr. Geo. Darwin, I say, "the reasoning relating to this part of Mr. Darwin's views does not belong to the sure domain of mathematics, but to speculation." "This reads oddly," proceeds Mr. Williams, "when closely following a description of how Adams, twenty years or so ago, discovered a notable flaw in Laplace's reasoning which was purely mathematical, and further, that both Leverrier and Pontécoulant have rejected (it should be "did for a while reject") Adams' results, the latter 'even denouncing Adams's method of treating the subject as analytical *legerdemain*.' All this was in 'the sure domain of mathematics' of the purest and highest order, and among mathematical giants; the difference of results was quantitive—*i.e.*, mathematical—and not a mere fractional percentage, the result obtained by Adams being 'only one-half of what Laplace had made it.' Such instances of error, to which mathematicians, like all other human beings, are ever liable, enforce the necessity of continual verification of mathematical conclusions, by comparing them with facts revealed by observation and experiment."

It appears to me that in the above passage Mr. Williams overlooks the distinction between mathematical reasoning and mathematical demonstration. A mathematical demonstration must be infallibly true, or it is not a demonstration; but mathematical methods of reasoning may lead to erroneous results—especially in problems of extreme difficulty and complexity. We do not regard the processes of addition, subtraction, multiplication, and division, as themselves unsound because they lead to incorrect results when incorrectly applied. Now, in the more difficult applications of mathematics, errors are not only more readily made than in simpler inquiries (just as mistakes are oftener made in long "sums" than in easy ones), but they affect quantitative, more readily by far than qualitative results. We may be quite sure, after our differential equations have been dealt with, that the answer is positive or that it is negative—in other words, that the physical result about which we are inquiring is of one or another kind, but we may find it very difficult, or even impossible, to determine what its exact value may be. It should be remembered that the quantity which Laplace endeavoured to estimate was itself a correction of a determination known to be approximative only. Certain terms in those with which the lunar theory has to deal had been neglected as not likely to appreciably affect the estimated motions of the moon. Laplace took them into account, and showed that they lead to a larger correction than had been supposed, and in fact account for an observed departure of the moon from her estimated course. But in dealing with them he thought he might safely omit certain dependent terms; and Adams showed, on the contrary, that these also must be considered or else the "correction" is nearly doubled. The reasoning by which he showed this, was so difficult, that Pontécoulant and Leverrier did not at first perceive its force, just as inferior mathematicians might fail to see the force of reasoning applied to the solution of ordinary problems in the Differential Calculus. They of course recognised after awhile the accuracy of Adams' reasoning, but at first they rejected it.

All this, while it shows excellently how delicate and difficult are inquiries in the higher branches of mathematics, by no means invalidates the general proposition that mathematical methods are sure and sound. On the contrary, the detection of Laplace's error shows that the processes he incorrectly applied are themselves altogether trustworthy. The use of logarithms in a long arithmetical process will lead to a correct result, if there is no mistake in the working; if an incorrect result appears, we blame the arithmetician, not the method. Albeit we cannot too cautiously test mathematically-obtained results by observation and by experiment. Now I think mathematicians deserve credit for doing this most thoroughly in astronomy. So far from dogmatising about the lunar theory, for example, they watch every movement of the moon's to see if they have worked correctly. They find out the errors resulting from the approximate, or in some cases, imperfect nature of their mathematical methods. Then again, mathematicians themselves announce the shortcomings of their methods. It was not an outsider or a non-mathematician who detected the mistakes of Laplace, and he detected it by mathematical methods, and actually against the evidence of observation—with which Laplace's results were in perfect accord.

ELECTROMANIA.

By W. Mattieu Williams.

Part II.

The real practical objection to all electric lights is the cost. That has been somewhat diminished, but still remains. With the voltaic battery the electric energy is obtained by the combustion of zinc, and the consumption of zinc and other materials is exactly proportionate to the amount of electric force expended. With the dynamo machine coal is substituted for zinc, but its action is more indirect. The calorific energy supplied by combustion has first to be converted into mechanical force by means of a steam-engine, and in doing this much power is lost. Then the mechanical force is converted into magnetic and electric energy with further sacrifice. Besides the waste by dissipation of energy, there are friction and other mechanical resistance to be overcome, in addition to the magnetic and electrical resistances.

In burning coal gas the light is a direct result of combustion, the only loss of power being that which is used in the distillation of the coal and the leakage of the gas pipes. The cost of the first of these, *i.e.*, of the fuel burned under the gas retorts, is repaid with abundant profit by the tar products, and the ammonia distilled over simultaneously with the gas. So valuable have these products now become that if we were all to go to bed at sunset, and rise at dawn, so that no gas should be required either in our streets or houses, the gas-works would not therefore be abolished. They would continue the distillation of coal for the sake of the liquid products, and could do this profitably, though throwing their gas into the air, or merely burning it in huge flambeaux to light the works.

As an example of the progress that has been made in the economy of gas manufacture, I may refer to the fact that the proprietors of the original Vauxhall Gas Works were sued by the flounder fishermen of the Thames for killing the fish by pouring their "gas water" into the river. The company was thereby compelled to cart this water away at considerable expense, with continually increasing difficulty in getting rid of the nuisance. Now it is the raw material of our largely-used ammoniacal salts, and an important source of revenue to the gas companies.

An account of the gradual development of the uses of the tarry products would fill a volume, and a very interesting volume it might be made.

Besides these, we have continually progressing improvements in the methods of refining the gas, one of the more recent being the use of red iron ore dug out of Irish bogs. The burners, as everybody knows, are being continually improved, and still want a [illegible] the direction already indicated [illegible] increases the [illegible] of the radiant wave- [illegible] a scientific effort that [illegible] towards the practical solu- [illegible] viz., its clear theoretical [illegible]

[illegible] gas-lighting must not be judged by the [illegible] which is disgraceful to all concerned [illegible] cost. This is amply proved by the [illegible] northern and midland towns that are now [illegible] with gas. If the prevailing electromania [illegible] approach to practical competition, it would be a [illegible] I fear that this is impossible, and know well [illegible] gas engineers thoroughly understand the [illegible]

[illegible] far exceeding that of ordinary gas-burners is [illegible] by electric arc or incandescence, is indis- [illegible] worked practically and studied theoretically [illegible] at the same conclusion as that of Starr, [illegible] in 1846, that the incandescent light in [illegible] that it is available for a variety of sensational [illegible] theatres, light-houses, &c.; but for ordi- [illegible] and street-lighting, its cost puts it [illegible] will practically discover when all the [illegible] have been paid up, and the joint-stock [illegible] from the field.

[illegible] the real age of this supposed infant I [illegible] facts.

[illegible] years ago three of the largest streets of St. Petersburg [illegible] Prospect, the Erbson Strasse, and the [illegible] were lighted by one lamp placed on the [illegible]. In 1854 the works for the con- [illegible] Docks at Rouen were illuminated with the [illegible] worked there during the night as in day- [illegible] cost at three farthings per man for [illegible] about 17s. per hour altogether. During the [illegible] electric lights have been used in light- [illegible] the French coast, and continue in use, the [illegible] in spite of the prospectuses of the [illegible] so successfully for investing victims. [illegible] fact is, that electric lighting has made [illegible] the last thirty or forty years than any other [illegible] practical existence. Gas-lighting, as already [illegible] in the primary matter of economy of [illegible] and tallow dips have been superseded [illegible] snuffers and snuffer trays are becoming [illegible] collectors. The modern paraffin [illegible] per pound are superior to the wax [illegible] that were used thirty years ago, and cost [illegible]

[illegible] the rushlights, the tallow dips, the [illegible] lamps, then the "solar" lamps, [illegible] the "camphine" lamp, the Carcel [illegible] all of which are now practically [illegible] and the triplex mineral oil [illegible]

[illegible] since 1846. Starr tried, [illegible] the arc principle, with a score of [illegible] he did remedy it more [illegible] on the Thames Embankment; [illegible] together. He did this [illegible] simply a result of [illegible] of carbon transferred from one [illegible] would be better to have a solid [illegible] or in carbonic acid [illegible] 21, 1845. A drawing [illegible] and in the *Mechanic's* [illegible] from myself drawing [illegible] electric light in the [illegible]

[illegible] like that of Edison, [illegible] first step with mean- [illegible] strip of platinum foil, [illegible] was loudly cried [illegible] Then [illegible] competition [illegible] other [illegible] "The Wizard [illegible] the shares of the [illegible] and of course [illegible]

[illegible] another [illegible] explained [illegible] Starr [illegible] in these days of im-proved commercial enterprise, it has "floated" its companies on both sides of the Atlantic. When it has done its work, we shall probably hear of a further improvement, another great inspiration, viz., the re-invention of Starr's final gas-coke carbon stick, which is incomparably superior to any of the incandescent devices at present flaunted in the joint-stock market.

Edison will not be able to patent this in America, seeing that he was refused a patent for the platino-iridium idea on the ground of Starr's previous inventions patented by King; but in this country anybody may repatent any invention, however old, and, therefore, when the now popular bits of thread are burnt out, more companies may be built upon the harder, and far more durable gas carbon.

I have already heard of patents for a slight modification of this, which is formed not by burning away the hydrogen compounds from solid vegetable matter, such as wood, coal, card, bamboo, &c., but by *precipitating* carbon from a gaseous compound of hydrogen and carbon. In the gas retorts this is effected by the hydro-carbon gas coming in contact with the red-hot walls of the retort. In the forthcoming improvements on the incandescent electric light it will be done by filling the electric lamp glass with hydro-carbon vapour, and then precipitating its carbon on the thread of carbon rendered incandescent by the current.

Our old experience of 1845-6 proved that this will be a real step in advance, as the carbon thus precipitated is so much more durable than any of the forms at present in use.

The above was written about three months ago, and I have held it back hoping that the electromania would have died a natural death ere this, but it has now attained such a magnitude, and some of the prospectuses of new companies and extensions are so atrocious, that to remain silent when one has anything to say, and an opportunity of saying it, is almost equivalent to passive co-operation in the conspiracies.

One more appeal to the common sense of intending investors in these companies. Granting, as we all fairly may, that the electric light is admirably suited for lighthouses, for theatres, for fêtes, for such works as those of the Napoleon Docks, for tunnel-excavators, for the British Museum Reading-room, and other special purposes where cost is not an object, do we require companies with hundreds of thousands of capital to light these places? Do we require any companies at all?

The nature of the practical requirements for electric lighting prove that we do not. All that is needed is a steam-engine, a "dynamo" machine, the lamps, and connecting wires. These can be supplied by private firms, and can be worked on the premises far more economically than from a distance by any great central machine distributing its power to various places. Such distribution demands expensive arrangements of conducting wires, and is accompanied with an amount of loss proportionate to the distance of transfer and the number of subdivisions.

At the Polytechnic we had an engine that pumped the water, worked the fountains and models, and, whenever we required the electric light or worked the electric railway, we simply connected with it the dynamo (a little machine by the side of the engine) and the wires for the light, &c., by means of their proper binding screws. The like may be done on board of steam-packets, in factories, mines, &c., or wherever steam-engines are in use. Those who believe that electricity is to make such progress, that it shall supply the light and power of the future should be sufficiently logical to perceive that this progress must supersede all existing inventions, and therefore that the four millions that have been recently paid for the shares and the patent rights, and for the promotion of existing companies has been all thrown away. Ninety-nine per cent. of the patents that have recently been specified at the rate of ten to twenty per week are worthless repetitions of old inventions or delusions altogether.

Luxurious people who choose to pay for lighting their drawing-rooms by electricity may easily do so by means of a little gas-engine and dynamo, worked in the back kitchen or butler's pantry. They have no more need to apply to a company with a capital of £800,000 for such a purpose than has a hairdresser to do so for supplying the motive power to his rotatory hair-brushing machine.

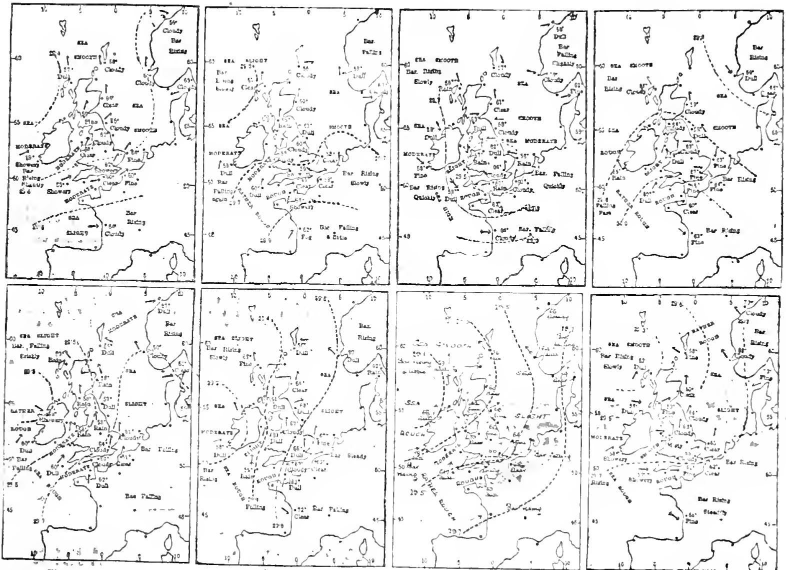
FRENCH EXCAVATIONS IN ASSYRIA.

Some most interesting particulars of the exploration of M. de Sarzec in Mesopotamia, which were recently mentioned in Knowledge, are to be found in a letter from the discoverer himself, read before the Paris Academy by M. Heuzy, and a commencement at deciphering the very ancient texts which are engraved on many of the antiquities has been made by Dr. Julius Oppert.

The site which has proved so exceptionally rich in archæological remains is situated on the left bank of the Shatt-el Hai, a large

WEATHER CHARTS FOR WEEK ENDING SUNDAY, JULY 16.

SUNDAY, 9TH. MONDAY, 10TH. TUESDAY, 11TH. WEDNESDAY, 12TH.



THURSDAY, 13TH. FRIDAY, 14TH. SATURDAY, 15TH. SUNDAY, 16TH.

In the above charts the dotted lines are "isobars," or lines of equal barometrical pressure, the values which they indicate being given in figures at the end, thus—30·4. The shade temperature is given in figures for several places on the coast, and the weather is recorded in words. The arrows fly with the wind, the force of which is shown by the number of barbs and feathers, thus ——, light; ——→, fresh or strong; ——→, a gale; ——→, a violent gale; ⊙ signifies calm. The state of the sea is noted in capital letters. The * denotes the various stations. The hour for which each chart is drawn is 6 p.m.

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canal excavated in pre-historic times to unite the two grand waterways—Euphrates and Tigris. The name Tello is given to the spot by the Arabs, because of the number of Tells, or artificial mounds, which cover the buried city of Sirtella (or Zirgulla). These Tells, which are very numerous, are scattered over a space of six or seven kilomètres, the principal one being at the north-east part of the group. The largest mound was occupied by the ruins of a large edifice in the form of an elongated parallelogram, called by M. de Sarzec a temple, but which may have been a palace, or both. The building was elevated on a massive substructure of crude bricks rising to a height of fifteen mètres above the uniform level of the desert, and having the angles directed to the cardinal points of the compass. During the last two years, M. de Sarzec's researches have been chiefly confined to disinterring the edifice concealed in this greater mound, and it was in it that were preserved the most valuable relics that have been recovered. Almost immediately after the workmen commenced cutting a gallery into the hill, they came upon the exterior walls, which were constructed of burnt bricks cemented with bitumen. All the bricks which have been examined bear the name of Gudea.* In order to more carefully preserve, and arrive at a true comprehension of the architecture of the building, the walls were first laid bare all round, and then an entrance effected by digging away the *débris* from some of the doors and windows. This naturally was a tedious and costly method, but both time and expense were amply repaid by the results.

In the largest hall or court, which proved to be the central one of the block, were found nine statues of diorite, also a sculptured head, nearly life-size. In one of the passages leading from this to another chamber they came upon portions of a statue with the bust covered with inscriptions, and a small statue of peculiarly short proportions, and carved out of a singularly green-coloured stone. Almost every part of the building produced something, but the great inner court proved most prolific, containing, besides the nine statues mentioned, many fragments of inscribed vases and statuettes, an exquisite small head of beautiful execution, and another nearly life-size, with curled beard. In this, as in many of the passages and rooms, numerous seals, cylinders, and other objects, were collected, and at the foot of the outer wall, on the north-east face, a mutilated statue. M. de Sarzec does not tell us whether he broke open the thick outer walls at the corners in search of record cylinders, a process which, however, after the discovery of the splendid perfect decagonal cylinder of Assurbanipal by Mr. Rassam, embodied in the very heart of a corner mass of masonry, seems to be necessary in Babylonian explorations.

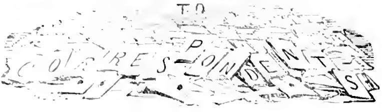
* M. de Sarzec says "bear the 'cartouche' of Gudea," but does not give any copy. It would be interesting to know if the royal name is enclosed in an oval, or cartouche, as in Egyptian hieroglyphs.

[illegible] M. de Sarzec excavated in all [illegible] in every case [illegible] time serving [illegible] back as four years [illegible] perfectly preserved terra- [illegible] two of the mounds [illegible] throughout with dried [illegible] cemented with bitumen; near [illegible] white marble, bearing a circular [illegible] was exposed two fragments of a bas- [illegible] very archaic cuneiform text, and carved with [illegible] warriors prostrate on the ground, and [illegible] with human remains in their talons. [illegible] discoveries, however, took place on the [illegible] mounds, where, about thirty centimètres beneath [illegible] four cubes of solid masonry built up of large [illegible] In the centre of each was a cavity filled with [illegible] and in each cavity was a bronze statuette, either [illegible] or a female standing. At the base of each [illegible] in the [illegible] of the recess, were two [illegible] white and one black, the latter nearly always [illegible] inscription [illegible] on the statuette itself. [illegible] every [illegible] a similar story, for all bore [illegible] of destruction [illegible] and many of the valuable [illegible] fragments of alabaster and [illegible] embedded in ashes. In one, [illegible] were found portions of a marble statuette, [illegible] and a life-size figure of a bull's [illegible] copper, moulded over a wooden model [illegible] by the heat. Here, also, lay the [illegible] which explains the form of head- [illegible] in such minute size on the oldest [illegible] structures, as described by M. de [illegible] architectural features, but it is [illegible] arrangement without plans; still, [illegible] together with an account of Dr. Oppert's translations of some of the inscriptions, a further paper which will prove of interest.

However [illegible] may be to elaborate a description of this [illegible] and correctly classify the antiquities now col- [illegible] M. de Sarzec's relics from Tello, at [illegible] their position in the history of the [illegible] it must be admitted that the time for doing [illegible] arrived. The difficulty of deciphering the texts [illegible] when they can be rendered into words, the mean- [illegible] For instance, it is not known [illegible] whose name is upon nearly every object dis- [illegible] independent prince or sort of viceroy over this part [illegible] The significance of the title Patesi which he gives [illegible] exactly known. Dr. Oppert points out that some [illegible] to be read vertically, and altogether much [illegible]

[illegible] to his own satisfac- [illegible] type of features indi- [illegible] whilst M. Heuzy tells us how sur- [illegible] Fortunately, this uncertainty will [illegible] when correctly understood, [illegible] information, and certainly their [illegible] wrested from them. To such veterans [illegible] Oppert, who, unaided by a single analogy, have con- [illegible] of the three languages of the Behistun and [illegible] though the very sounds of the signs were un- [illegible] prove but slight obstacles, and when [illegible] stepping-stone to approach the conquest of [illegible] yet lie [illegible] from the teeming [illegible]

[illegible] The solicitors of the Edison [illegible] That the Board of that [illegible] known as the Swan incandescent [illegible] patents." The solicitors of [illegible] they are advised that the [illegible] of the Edison or [illegible] before the public un- [illegible] of the lamps having been [illegible] Savoy Theatre alone." [illegible] the beginning of a sham [illegible] the two companies." It is [illegible] We believe the [illegible] of the process for ex- [illegible] but it is our impression [illegible]



Letters to the Editor.

The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.

All Editorial communications should be addressed to the Editor of KNOWLEDGE; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

THOUGHT READING AND THOUGHT RULING.

[475]—In the "Answers to Correspondents," you state, and rightly, that the truth of the facts asserted in my account of Caseneuve's feats depends solely on my veracity and the trustworthiness of my friend. With regard to the trustworthiness of my friend, let me say that we were travelling together, and that it was the day after our arrival at Athens that we attended Caseneuve's entertainment. I am not at liberty to publish my friend's name, but I enclose it for the Editor's information.

With regard to the question of my veracity, I will content myself with signing my name in full. HENRY MILTON.

[I am much obliged to our correspondent for thus adding weight to his evidence, though for my own part I had accepted his account with full confidence. Like Dickens's, it tends to prove more than thought reading—it proves thought ruling. There are few more interesting subjects of scientific inquiry than this influence of mind over mind. R. A. PROCTOR.]

RATIONAL DRESS.

[476]—The kind and encouraging notice you gave of the Rational Dress Society and of my pamphlet, leads me to hope that you would allow me to place before your readers a sketch of the plan of the "Anti-Fashionable Magazine" I am anxious to start. In the first place, a periodical is wanted to act as a corrective against those pernicious fashion papers which, month by month, incite our women to self-torture and slow suicide. Secondly, I wish to show that fashion in dress is but part of a larger question, and that is, the sinister influence which fashion exercises over the whole of our home and social life.

We women have been so preached to about the "woman's sphere," that verily we have become sick of the subject; but now I am beginning to see what the sphere really is, and that it is a beautiful one and a worthy one. It means the world of rest and of pleasure, the blossoming of life, the outward expression of the highest cultivation of the age. Now, this sphere, not having true principles from within to guide it, is ruled by arbitrary dictates from without, called Fashion. To discover these principles, and further to apply them practically to daily life, is a task of the very greatest difficulty. As the difficulties of sociology are to those of the other sciences, so would the difficulties of this science of domestic life be to sociology. If we try to reform this small portion of it—dress—we have to consult the laws of health and the laws of art—or, as I prefer to say, the laws of beauty—and at the same time the comfort, convenience, and several wants of the various wearers.

I have been accused of being apparently totally wanting in artistic feeling, "a person singularly devoid of art sense," says the *Queen.* On the contrary, I worship beauty; it is a perpetual grief to me that all beauty of form is being lost to us. But Art has hitherto been antagonistic to Nature in dress. It has not considered the needs of the body to be dressed, that it is a moving, working animal to be clothed, not a gracefully posed lay figure to be "draped" for exhibition in a picture or a statue. And, as I have before said, the taste of the day is too vicious and degraded for any true ideas of beauty or grace to be evolved from it. We must be content to wait. This is our punishment for our sins against nature and true art. But it surely is with this as with everything else in life. "Seek ye *first* the kingdom of God (or the good) and His Righteousness (or the right), and all these things (the outward beauty) shall be added unto you." It *must* be so, for beauty is inherent in the good and the true. This is but an imperfect sketch of what is but an imperfect idea in my own mind. My ability to work it out is but small, but I wish to make it the work of my life, and if I succeed even in the smallest degree, I shall think it no unworthy work.

I shall be only too glad of any advice as to the best means of practically carrying out my plan.

34, Cornwall-road, Bayswater. E. M. King.

METEOR, &c.

[477]—Many thanks to you for inserting my letter on "Meteor" in Knowledge. I am pleased that you considered it sufficiently interesting.

I saw in *Nature*, of June 8, page 124, a letter on the same object from the Stoneyhurst Observatory, which is about twenty-two and a-half miles from here in a N.N.E. direction. The meteor was seen by several persons about there, but in a very different direction to where I saw it. It first appeared to them near Arcturus, and passed between δ and ϵ Ursa Majoris, bursting under α Ursæ. This path differs so greatly from mine that, taking into account the comparative nearness of the two places of observation, I think it indicates pretty clearly that the meteor must have been very near the earth. Indeed, it appeared very near to me; literally speaking, it did not seem to be many yards from me. Unfortunately, I cannot give a more exact description of its path than the one given in my previous letter, as it passed so quickly and was such a startling sight, that I had not time to note its exact position. Excelsior.

LAW OF PROBABILITIES.

[478]—Playing Loo with two friends many years ago, one card—the Nine of Diamonds—turned up trump such a vast number of times that we were quite excited about it, and subjected the card to a most searching examination, but could detect no difference between it and any of the others. We then resumed play, resolving to count, and after that the same card turned up trump thirty-nine times.* What does the law of probabilities say to that? Hallyards.

* In how many trials?—Ed.

BREAK FOR A TWO-WHEEL VEHICLE.

[479]—Hinge a bar at each side at any point under the trap, and *before* the wheel. Let these bars be two or three inches longer than the height of the trap, and kept *back* and off the ground by a spring, and let there be a foot or more of rod above the hinge that may be acted upon by the driver pulling it towards him by a cord, screw, or any other arrangement, and this will bring the lower end more or less firmly upon the ground, and check the vehicle, and lift the weight off the horse's back. This is the principle of the Carter break that is applied to bicycles, and I think is patented; but information on this point can be got from Singer & Co., "Challenge" Bicycle Works, Coventry. G. S.

A MODERN SURGEON'S TOOLS.

[480]—The astute, sympathetic, and skilful Mr. Smaller will, I hope, pardon Mr. Smallest relating as briefly as possible the method adopted in a modern shop when an operation similar to that so touchingly described by him is performed.

A trochar and canula of a new form, but possessing the same much-despised point, previously well sharpened and polished to perfection with Tripoli and wash-leather, is placed in a tepid solution of carbolic acid beside the patient's couch.

The place selected for puncture is painted with a strong solution of the same drug, which renders it completely insensitive. The instrument removed from the bath is coated with a small quantity of a beautiful antiseptic ointment called vaseline.

The operator with a rapid, skilful stroke, sends it through the insensitive tissues, and the pent-up fluid glides noiselessly from the part through an indiarubber tube to the vessel intended for its reception.

The form of the point as at present made is necessary, the bluntness Mr. Smaller desires removed, enabling it to push aside important vessels lying in its course, thus preventing their severance and injury. A. Cowley Malley, B.A., M.B., B.Ch.

THE HIGHLAND CELT.

[481]—It seems to me that the word "brown," as used by "Charles Stewart," really means dark, and does not necessarily imply "light, fair, or sandy," but the contrary; in the word *gaidhil-dhonnur*, for instance, is not the suffix a derivative of "dhu," meaning black? while the southern equivalent, called "dun," is certainly dark. Speaking ethnologically, I should call brown hair the result of a mixture between the aboriginal dark Britons and the fairer Teutons or Gauls; and the reference to Tacitus is unfortunate, because that author uses the word "rutilæ," meaning unmitigated "carrots" not brown.

Then, again, Breadalbane can hardly be called the true highlands of to-day; that district lies south of the Grampians, and the real Caledonians—the wild Highlanders are north of that range. Perthshire was overrun and partly civilised by the Romans long ago; since which, a variety of Teutonic tribes have poured in, and but little Gaelic is spoken in the country parishes; perhaps it would prove more germane to the matter to ask Mr. Stewart's friendly schoolmaster as to blue or grey eyes, and as to red hair; for that gentleman does not appear to see that, even in the days of Agricola, the Caledonii are described as a mixed race, which fact leaves us as far as ever from deciding what was the original complexion of the primitive Highland Celt. A. H.

FIFTEEN SCHOOL-GIRLS,

Viz., *A*Aa, *B*Bb, *C*Cc, *D*Dd, *E*Ee.

[482]—First day the A's, B's, &c., to walk together thus:—

1st.
*A*Aa
*B*Bb
*C*Cc
*D*Dd
*E*Ee

To make the problem more definite, add the following conditions, viz., that the A's on the other six days are to walk in the first three rows; *BCDE* in the first row, or first in the fourth and fifth rows; BCDE in the second row, or second in the fourth and fifth rows; bcde in the third row, or third in the fourth and fifth rows. The following is obtained:—

2nd.	3rd.	4th.	5th.	6th.	7th.
ABC	*ADE*	*ABD*	*AEC*	a*BE*	a*CD*
ABC	AED	aDB	aCE	*A*EB	*A*DC
ade	abc	*A*ce	*A*bd	*A*cd	*A*bc
*D*Eb	*B*Cd	*E*Cb	*B*De	*C*Db	*B*Ec
*E*Dc	*C*Be	*C*Ed	*D*Bc	*D*Ce	*E*Bd

It will also be observed that the girls in the last two rows on the second day walk with the A's on the third, and those with the A's on the second walk in the last two rows on the third day, and so on the fourth and fifth, also on sixth and seventh. C. E.

COLD SNAPS.

[483]—With reference to cold snaps, do you know what the weather has been during the spring and early summer at Madeira?

I spent a winter there a year or two ago, and found February decidedly the finest month. The beginning of May (I left about the 12th) was absolutely cool, and the hills round Funchal were covered with snow, which was represented to me as a most unusual, if not an unprecedented, occurrence for the time of year.

In Teneriffe also, about the middle of April, the north-east trade wind was blowing, and out of the sun the weather was cool, not to say cold, particularly in the morning and evening.

I attributed, in my own mind, the freshness of Madeira in May, and the character of the Teneriffe wind in April, to ice in the Atlantic. It would, therefore, be interesting to learn whether this year, when we know that there has been an unusual quantity of ice about, a similar retardation of warm weather has taken place in these two semi-tropical islands.—Yours truly, G. H. O.

HAIR TURNING WHITE.

[484]—Perhaps the following may interest some readers of Knowledge. Less than a year ago I had a sudden and very heavy disappointment. My mind was so disturbed that I could not sleep at all during the night. Towards morning it occurred to me that my hair had changed colour. But I felt too sick to care to examine it. Either that morning or the next, I noticed a small white patch of hair just over the centre of my forehead, and some days after the back of my head was noticed to be covered with little groups of white hairs. I tried by change of air and scenery to regain my spirits, thinking my hair would return to its ordinary colour, black; but since then it has become slightly whiter. W. E. F.

Answers to Correspondents.

**** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—*1. No questions asking for scientific information can be answered through the post. 2. Letters sent to the Editor for correspondents cannot be forwarded; nor can the names or addresses of correspondents be given in answer to private inquiries. 3. Correspondents should write on one side only of the paper, and put drawings on a separate leaf. 4. Each letter should have a title, and in replying to letters, reference should be made to its number, the page on which it appears, and its title.*

M. B. A. [illegible] (1) Ah! if surmise were but certainty. (2) In each of the 25,000 years the earth's axis has swayed through its precessional range with respect to the star-sphere; but its inclination to the plane of the ecliptic is not much altered, and such change as there is is periodic. (3) I do not know whether the gentleman whose letter to your father you forward me is now alive.—J. A. D. If there are there are as many alphabets as there are letters in the sentence "Up guards and at them" (i.e., 17 alphabets, or 442 letters), the chance that these words will be drawn in their exact order will obviously be

$$17\left(\frac{2\,.\,1\,.\,1\,.\,1\,.\,3\,.\,1\,.\,2\,.\,1\,.\,2\,.\,1\,.\,1\,.\,1\,.\,2\,.\,1\,.\,1\,.\,1\,.\,1}{442\,.\,441\,.\,440\,.\,.\,.\,.\,.\,.\,.\,.\,.\,.\,.\,.\,.\,427\,.\,426}\right)$$

I would not deprive you of the pleasure of working out this little sum for yourself.—QUICKSILVER. If the sides of a right-angled triangle are in geometrical progression, and the area 579, you get, if you put the sides equal to x, xy, and xy^2, the equations—

$$x^2 + x^2y^2 = x^2y^4 \text{ or } 1 + y^2 = y^4$$
$$\text{and } \tfrac{1}{2}x^2y = 579$$

whence x and y readily obtained. J. HAMILTON. That comet was seen in England. See subject Comets in my article on Astronomy in the "Encyclopædia Britannica." It is a very celebrated comet. W. COLLIS. The work, if sent to us, shall receive what you ask for—fullest consideration. JARDINE PERKINS. Saying the moon has an apparent diameter of about a foot would imply that the moon appeared to be about thirty-six yards away. If this, regarded as a scientific statement, is not nonsense, I do not know what is. Have you never seen the moon, as she rises above a distant hill, appear larger than a house on that hill, though you knew the house to be a good deal more than a foot both in height and breadth? Why, apparent diameters and distances between objects are not measurable in feet or yards, but by the angles they subtend. On the other point you are right. Yes, my reference to indicating distance in firkins and kilderkins was, as you presume, a joke; yet the absurdity is no greater than in indicating the apparent diameter of the sun in inches. C. E. MUNRO. Thanks for your interesting letter. W. B. May 12 is Old May-day in the sense in which I wrote; that is, May 12 corresponds to the day of year which before the style was altered was called May 1. But if the style had not been changed in the eighteenth century, the year 1800 would have been a leap-year, and May-day would have fallen on what is now called May 13. In this sense May 13 is Old May-day. After the year 1900 May 14 will be Old May-day. L. BROWN. No such sketch-maps are sold [illegible] Knowledge. In my "Half-Hours with the Telescope" data are given for their construction. E. R. COWLEY. Most of your questions will be treated of in the series of papers on "How to get Strong." Author cannot answer individual querists.—CYANIDUS. No medical man would give an opinion without seeing you. [illegible] medical men would, I dare say, tell you "all about it," [illegible] ever appeared. Seriously, you should not ask for opinions [illegible] but be utterly untrustworthy. W. P. wishes to [illegible] Turkish tobacco, mentioned by "Constant Reader," [illegible] can be obtained. He mentions also that [illegible] from Swindon Junction, in an extension line to [illegible] the ballast of the line is full of casts of fossil [illegible] for the geologist. J. H. T. wishes to [illegible] is used for logarithms with the aid of [illegible] De Morgan's edition of "Shron's Logarithms."—G. B. [illegible] the solution of the top problem is quite inadequate. How can it be said that gravity has not time to act? When a top is traversing at its swiftest, gravity finds time to act [illegible] effect. The difference between the pressure of the air on the lower and upper surface of the top, again, whether sufficient or not to produce any effect, acts upwards precisely as the top's weight acts downwards, though with much less energy. Therefore, if gravity has not time to cause the top to fall by acting on the top's weight, neither can it have time to cause the top to rise, by producing upward air-pressure. (2) With regard to the pyramid, [illegible] you could set up your perfectly vertical [illegible] 50 ft. high and [illegible] from your horizontal line 100 ft. south of [illegible] would bring this upright into line with Alpha Draconis, &c. What you say you would do, an astronomer or a practical surveyor would show you to be absolutely impossible, with anything like the necessary degree of accuracy. On the contrary, the orientation by slant subterranean passages could be made to all intents and purposes perfect. The passages would, at first, be bored with only rough approximation to the desired direction; but the deeper they were carried the more perfect would be their working and slant, because Alpha Draconis could be observed along them at every sub-polar passage. Whensoever they had been carried down deep enough, a vertical boring could be carried down to the subterranean chamber into which the slant passage opens, a plumb-line could be let fall down this vertical boring: it might be a yard, or a foot, or more or less (according to the success of this first rough attempt to get a vertical mid line due south of the entrance) from the observed direction of the visual line along the middle of the descending passage to Alpha Draconis. Whatever correction had thus to be made, would, of course, be made east or west from the top of the vertical boring, giving a point due south of the centre of the entrance-hole of descending passage. The orientation thus obtained—practically perfect before the first layer of stones was placed—would be checked and improved (to something like theoretical perfection) as layer after layer was added. Permit me to say that no astronomer would regard your plan as capable of any scientific accuracy, while every astronomer sees the plan of a long slant passage directed to the pole star to be the only perfect way, though involving much labour and expense. As a trifling detail, it may be added that the passage is *there* with the proper northing and slope. You may prefer to believe that though the passage is thus carefully directed due north, and with an inclination bringing it to bear on the pole star of the day, it was really only meant for the sliding down of great stones; so also if you were shown how perfectly the stand of an equatorial telescope is suited to keep the telescope directed upon a star, you might answer that, in your opinion, the instrument was intended for a pump: but you must not expect every one to agree with you.—LOREESMITH.—How do you make £6,960 in third year provide for fourteen allotments of £500 each, with £140 over?—G. E. A. I do not find anything in Mr. Clodd's account of deposit of stalagmite over inscription to show that the deposit only takes place round the letters and not over them as well. J. M. N. Gray's Anatomy, profusely illustrated.—J. EVANS. With thanks. E. CARUS WILSON. The subject has been fully discussed in early numbers of KNOWLEDGE. The ice yachts only travel faster than the wind when the wind is more or less abeam. It can be shown that when a yacht is running with a velocity equal to the wind's (abeam) there remains effective driving action. Do not know whether tigers purr like cats.—H. D. No, the forward motion does not in any affect the action of gravity. It is a law of motion that each force acting on a body produces its full effect.—TOM T. Thanks. Excuse delay; your letter arrived when I was far from well. There are delicate but characteristic distinctions between the business type of face and the literary or scientific type. They have not, so far as I know, been classified, as Le Brun classified the effects of different emotions on the features (to refer only to artistic classification). They are in no way connected with "the science of phrenology" (there is no such *science*).—W. B. WICKEN. Thanks for your very kind and encouraging communication.—W. H. G. I fear it would be difficult to obtain any remunerative situation of the kind described.—E. N. *Is* it easier to swim in deep than in shallow water? It would be well to be sure of the fact before seeking to explain it. I have swum for more than an hour at a time in deep water, and for long spells in shallow water, without noting any difference of the kind. ERIN-GO-BRAGH. There are several methods of vulcanising. One is to immerse thin sheets of rubber in melted sulphur, and then roll them together. This is the most crude and the earliest. Parkes's is better. The rubber is immersed in 40 parts of bisulphide of carbon and 1 part of chloride of sulphur, then heated gently and carefully till the bisulphide is volatilised. The rubber is next boiled in a weak solution of caustic potash (500 grammes to 10 litres), and then washed to remove the alkali. I might add many other recipes, by the aid of which, as with the above, ERIN-GO-BRAGH will equally fail to obtain a moderately good specimen until he has spoiled a hundred or less of trial samples, and thereby learned the business.

ELECTRICAL.

A. H. H. The Maynooth battery has about three-fourths the electro-motive force of a Bunsen, but it is very uncertain, irregular, expensive, and altogether an unpractical type. Your other query involves several nice points, but if Mr. Editor can find room, I will deal with it next week. S. E. KILP. Your castings, I am informed, were duly despatched on the 28th ult. If not yet to hand, write again to the founders. STEADY SUBSCRIBER. See answer to "CONSTANT READER" a fortnight since.

Science and Art Gossip.

WE regret to announce the premature death, at the age of 32, of the celebrated electrician, M. Antoine Breguet, of Paris.

MESSRS. FELTEN AND GUILLEAUME give the following figures as the relative resistances of equal lengths of various metals at the same temperature and of the same section :—Copper, 1·5; phosphor bronze, 6·5; Swedish iron, galvanised, 8·7; Bessemer Swedish steel, galvanised, 9; German charcoal iron, galvanised, 10·3; Siemens-Martin iron, galvanised, 10·8; coke-iron, galvanised, 12; patent cast steel, 13·7 to 15·2.

AN exhibition of life-saving apparatus of all kinds has been opened in the Alexandra Palace. The exhibition is divided into the following six classes or sections :—(1) Railway safety appliances, including continuous brakes, signalling, and point-locking apparatus, switches, &c., this being the leading feature; (2) means for extinguishing fires, and the rescue of people therefrom; (3) mining safety appliances; (4) apparatus for all marine and inland water emergencies; (5) surgical and sanitary; and (6) engineering and miscellaneous safety appliances.

INSULITE.—We have received a letter from Dr. Fleming, the inventor of this material, complaining of the criticism we made on it a fortnight since. He sent us fresh specimens, which are certainly an improvement on those we saw a few weeks since, but it is still very far from being, in our opinion, of any practical utility. Exception was taken to our assertion that the material would not hold small screws, an assertion which we cannot withdraw, inasmuch as, although the screw bites well at first, it can never be driven fairly home. We believe that, as Dr. Fleming says, a supply of insulators has been furnished to the Post-office, and they are now undergoing a trial. There are other points we should like to refer to, but we forbear, hoping that Dr. Fleming will be able to overcome such practical difficulties.

INVESTIGATIONS made in Germany concerning the comparative vitality of children under various methods of feeding exhibit some peculiar results. Thus, of 100 children nursed by their mothers, only 18·2 died during the first year; of those nursed by wet nurses, 29·33 died; of those artificially fed, 60 died; and of those brought up in institutions, 80 died to the 100. Again, taking 1,000 well-to-do persons and 1,000 poor persons, there remained of the prosperous, after five years, 943, while of the poor only 655 remained alive; after fifty years, there remained of the prosperous 557, and only 283 of the poor; at seventy years of age there remained of the prosperous 235, and but 65 of the poor. The total average length of life among the well-off class was found to be fifty years, as against thirty-two among the poor.

MESSRS. HEROLD & GAWALOWSKI, of Brunn, make as follows a strong, artificial parchment, impermeable by water, and capable of serving for the diaphragm in osmotic operations on solutions of impure sugar, &c. :—The woollen or cotton tissues are freed, by washing, from the foreign substances, such as gum, starch, &c., which may cover them. They are then placed in a bath slightly charged with paper pulp; and to make this pulp penetrate more deeply, they are passed between two rollers, which slightly compress them. The principal operation consists in steeping the product for a few seconds in a bath of concentrated sulphuric acid, after which it undergoes a series of washings in water and ammoniacal liquor, until it has lost all trace of acid or base. It is then compressed between two steel rollers, dried between two others, covered with felt, and finally calendered, when the sheets are fit for use.

OBSERVATIONS made by M. Rafford, a member of the Société d'Horticulture at Limoges, show that a castor-oil plant having been placed in a room infested with flies, they disappeared as by enchantment. Wishing to find the cause, he soon found under the castor oil plant a number of dead flies, and a large number of bodies had remained clinging to the under surface of the leaves. It would, therefore, appear that the leaves of the castor-oil plant give out an essential oil or some toxic principle which possesses very strong insecticide qualities. Castor oil plants are in France very much used as ornamental plants in rooms, and they resist very well variations of atmosphere and temperature. As the castor-oil plant is much grown and cultivated in all gardens, the *Journal d'Agriculture* points out that it would be worth while to try decoctions of the leaves to destroy the green flies and other insects which in summer are so destructive to plants and fruit-trees.

THE AMEYA IN JAPAN.—This clever stroller's stock-in-trade consists of a little bench, furnished with a lamp, some plastic sugar, red and blue pigments, a few twigs of split bamboo, and a pair of scissors. Taking a lump of the sugar in his hands, he makes a funny speech to the parti-coloured little crowd, and ends by asking what it is their pleasure he shall produce. "A dragon," shouts some bold little beauty, while a murmur of approbation arises, and every eye is fixed on the artist. Little by little, the terrible creature grows out of the paste, a collection of unrelated details at first, which a few sudden touches complete as if by magic. Now some one calls for a gourd, another for a tortoise, a third for a man on horseback, and a fourth for a monkey swinging by its tail. It is a contest between the children and the old man, but they cannot nonplus him, try how they will. No matter what they call for, the ameya is equal to the occasion, and within three minutes his dexterous fingers conquer every difficulty which his audience may propound.—Mr. Pidgeon, in "An Engineer's Holiday."

ON the 11th inst., Lieut.-Col. Webber, R.E., the President of the Society of Telegraph Engineers, held a reception at Chatham. About 500 of the members attended, and were conducted in parties of about twenty-five over the various schools, &c., a short lecture on submarine mines having been previously delivered by Major Armstrong, R.E. The closing episodes in a very pleasant day's excursion were the blowing down of a stockade by 25 lb. of gun-cotton, the explosion of a submarine mine containing 100 lb. of gun-cotton in the Medway, and a subterranean mine of 1,000 lb. of gunpowder. As this was the first day of hostilities at Alexandria, especial interest was attached to these experiments, and everyone present left with a very marked impression of the powers of these materials, and of the vast superiority of gun-cotton over powder. The sight of enormous columns of water in the one case, and of earth and rocks in the other may, indeed, be called magnificent. Altogether it was an exceedingly enjoyable day, and the members felt universally grateful to their guests.

NOTORIETY.—The Guiteau case has brought out very strikingly the passion for notoriety, which seems to be fast becoming the disease of the modern world, and seems likely to become one of its great social forces, much as religious fanaticism was in the Middle Ages. It is not until such an event as President Garfield's assassination occurs that we get a realising sense of the burning desire to escape from the ordinary obscurity of their lives by which tens of thousands of persons are consumed, and the lengths they are prepared to go, if need be, in absurdity, to become known or talked about. If they cannot accomplish this by any act of their own, they are only too glad to accomplish it by connecting themselves in some manner, however queer or grotesque, with some notorious person. If they cannot be as much talked about as Guiteau, they are made happy by being able to retail Guiteau's talk. If they cannot have, like him, the fame of being hanged, without the suffering and the shame, they are content to furnish a patent gallows, or make the rope, or suggest a new device in knots, or in any manner whatever be publicly mixed up with an affair about which everybody is talking, and to have the air of knowing something more about it, be it ever so little, than other people. Of course this passion is fostered by the publicity afforded by the newspapers, which, indeed, are to love of notoriety what the sun is to plants. That it will increase is very certain, and that its power as a cause of crime as well as of folly will be recognised more fully as the years go on is, we think, equally certain.—*The Nation.*

IN the July number of the *American Naturalist*, Mr. Ivan Petroff, in a valuable paper on the "Limit of the Innuit Tribes on the Alaska Coast," makes some important observations on the rate at which shell-heaps accumulate. He says:—"The time required for the formation of a so-called layer of 'kitchen refuse' found under the sites of Aleutian or Innuit dwellings I am inclined to think less than indicated by Mr. Dall's calculations. Anybody who has watched a healthy Innuit family in the process of making a meal on the luscious echinus or sea urchin would naturally imagine that in the course of a month they might pile up a great quantity of spinous *débris*. Both hands are kept busy conveying the sea fruit to the capacious mouth; with a skilful combined action of teeth and tongue the shell is cracked, the rich contents extracted, and the former falls rattling to the ground in a continuous shower of fragments until the meal is concluded. A family of three or four adults, and perhaps an equal number of children, will leave behind them a shell monument of their voracity a foot or eighteen inches in height after a single meal. In localities in Prince William Sound I had an opportunity to examine the camp-sites of sea-otter hunters on the coast contiguous to their hunting-grounds. Here they live almost exclusively upon echinus, clams, and mussels, which are consumed raw in order to avoid building fires and making smoke, and thereby driving the sensitive sea-otter from the vicinity. The heaps of refuse created under such circumstances during a single season were truly astonishing in size. They will surely mislead the ingenious calculator of the antiquities of shell heaps a thousand years hence."

Our Mathematical Column.

[illegible] LESSONS IN THE DIFFERENTIAL CALCULUS.

No. IV.

W[illegible] the differential coefficients of certain [illegible], and to lay down rules by which the [illegible] any expression can be readily determined.

[illegible] that, for convenience, the quantity [illegible] coefficient is to be determined is commonly [illegible] the quantity whose variation causes the [illegible] commonly expressed by [illegible]. I select [illegible] for the [illegible] latter purpose. Let it be remembered [illegible] necessary for any fixed practice in this matter. [illegible], for example, I used in one case s and [illegible] instead of [illegible] the other example I interchanged [illegible] and y.

[illegible] the differential coefficient of one quantity y [illegible] is an expression indicating the rate at [illegible] the former [illegible] as we increase the latter. I advisedly [illegible] as respects [illegible] even though increase of [illegible] may [illegible]. For in such a case the differential coefficient [illegible], and a negative increase is the true algebraical equivalent of decrease.

[illegible] differential coefficients of the simple function.

[illegible] differential coefficient with respect to [illegible].

[illegible] is a positive whole number. In this case we [illegible] process for finding the differential coefficient. [illegible] Δ [illegible] and assume that y is thus increased by Δy.*

[illegible]

$y + \Delta$ [illegible] $+ \Delta$ [illegible]

$=$ [illegible] $+ n$ [illegible] Δ [illegible]

$+$ {a finite number of terms involving $(\Delta$ [illegible]$)^2$, $(\Delta x)^3$, &c.

[illegible]

[illegible] subtracting

[illegible] Δ [illegible] + terms involving higher powers of Δ [illegible] than the first

[illegible]

Δ [illegible] + terms involving Δx and its powers.

[illegible] suppose Δ [illegible], and therefore Δy, to become indefinitely [illegible] them respectively dx and dy, and we have

[illegible] + {a finite number of indefinitely minute quantities.

[illegible]

T[illegible] of this proof to the cases where n is fractional or [illegible] would not suit these columns. [illegible] suffice that [illegible] value of [illegible]

[illegible]

[illegible] dx

B[illegible] remove this result from the region of algebraical [illegible] for a moment, in order that its significance, and the [illegible] of sequent results, may be fully recognised. Take [illegible] to [illegible] to be 1, then

$$y = 10^4 = 1000.$$

[illegible] effect of adding to y [illegible] small quantity, say [illegible] instead of 10^4, y becomes $(10{\cdot}01)^4$, and if [illegible] of this, we find it to be

$$10040060040001$$

Th[illegible] of the increment of x is the 40, and the [illegible] to the increment of [illegible] (or 1-100th) is 4000. This [illegible] 10, [illegible]. And so in any case the reader [illegible] whenever [illegible], a minute increase in the value of x gives [illegible] increment [illegible] times as great.

The general result enables us to at once express the differential coefficient of all such quantities as [illegible], and so on. It is only necessary to write these (or [illegible] them written), in the form [illegible] to see that the respective differential coefficients are $\frac{1}{2}x$ [illegible] and $-2x$ [illegible], which we may write respectively $\frac{1}{2\sqrt{x}}$, $\frac{1}{3\sqrt[3]{x^2}}$, and $-\frac{2}{x^3}$. Any one who has become at all practised in applying the differential calculus, would of course write down these results at once. It is plain, too, from the mode of proof that if $y = ax^n$, where a is constant, $\frac{dy}{dx} = anx^{n-1}$.

The next simple function I shall take is the sine of an angle. And having in view the importance of the reader's obtaining clear views of the nature of a differential coefficient, I shall in this case employ a geometrical way of finding such a coefficient.

Let the angle x be represented by AOB, Fig. 1; then using the arc measure and making the radius unity, we have

x = arc AB,

and sin. x = BF, where BF is perpendicular to OA,

$= y$ suppose.

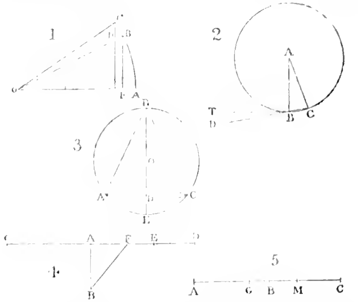
Now let angle AOB receive the small increment BOC, and call the arc BC, Δx: then, completing the figure, the corresponding increment of the sine is CD. Hence

$$\frac{\Delta y}{\Delta x} = \frac{\text{CD}}{\text{CB}}$$

Now it is clear that as C is brought nearer and nearer to B, the figure BCD approaches more and more nearly to the figure of a triangle similar to BOF; and therefore, the ratio $\frac{\text{CD}}{\text{CB}}$ approaches more and more nearly to the ratio $\frac{\text{OF}}{\text{OB}}$. Hence when C so moving is *just coming upon* B (in which state of things call BC dx, and CD dy) we have

$$\frac{dy}{dx} = \frac{\text{OF}}{\text{OB}} = \cos x.*$$

The reader should very carefully note that this is not an approximate result, but exact. In all these cases, where limits are dealt with, we are compelled to consider approximate *cases* in order to learn the nature of the final state of things; but our *result* refers to *that* state of things, and not to any intermediate state, *however near*. The reader has missed the essential point of the method of limits if he fails to see this. We have not to deal with approximate *results* at all in thus applying the method of limits. Perhaps the beginner may recognise this truth more clearly if I apply the method to solve a well-known problem. Let it be required to determine the angle ABT, included between a radius AB of the circle BCF (Fig. 2), and the tangent BT at B. Take C a point near B, and draw the secant CBD. Then conceive that C approaches B, carrying the secant along with it. Obviously when C has thus moved up to B, the secant will occupy the position of the tangent BT. Now in any antecedent position, as C in the figure, we have the triangle ABC isosceles; and the equal angles ABC, ACB together, differ from two right angles by the angle A. Hence ABC falls short of a right angle by half the angle A, so that ABD (which together with ABC makes up two right angles) exceeds a right angle by half the angle A. Now when C moves up to B, the angle A diminishes, and ultimately vanishes. Hence the difference between ABD and a right angle ultimately vanishes; so that when the secant CBD has become the



* [illegible] important to remember that Δx is a single quantity, [illegible] the increment of [illegible]. In the old notation [illegible] expression was used. But in advanced [illegible] differential calculus, the notation of fluxions [illegible] the mathematicians [illegible].

We have then, if

$$y = \sin. x,$$
$$\frac{dy}{dx} = \cos. x.$$

Let us study this result a little.

Remembering that the differential coefficient of a quantity expresses the rate at which the quantity is increasing, we see that the above result implies that as we increase the angle the sine increases, until x is a right angle or $\frac{\pi}{2}$. But after x has passed this value, cos. x is negative. This implies that the sine thenceforth diminishes; and we know as a matter of fact that the sine does diminish as the angle passes the right angle.

Again; notice how the differential coefficient implies the rate of change. We know that cos. x is unity, or has its greatest value, when $x=0$. As x changes from 0 then the sine changes fastest. Again; cos. x is nought when x is a right angle, and very small when x is nearly a right angle. Hence the sine changes very slowly as the angle is passing the right angle. All this, of course, is very obvious without any reference to the differential calculus. But it serves well to illustrate the application of the calculus to more difficult inquiries.

I leave the reader to prove by a similar construction that,

If $$y = \cos. x,$$
$$\frac{dy}{dx} = -\sin. x.$$

Obviously also, if $$y = a \sin. x,$$
$$\frac{dy}{dx} = a \cos. x.$$

and if $$y = a \cos. x,$$
$$\frac{dy}{dx} = -a \sin x.$$

Our Whist Column.

SIR,—I send you a game from actual play, which I hope will be both interesting and instructive to your readers. I have annotated the play for the benefit of the less experienced players.—Yours, &c., FREDERIC H. LEWIS.
Temple.

We commend the following game to the careful study of our numerous Whist students. The play is good throughout, except the mistake on Y's part, to which Mr. Lewis calls attention in his remarks; but Y's intention was excellent, and it was only A's deeper play which foiled it. Y had to take several things into account, and he took all points carefully into account except one: viz., that the lead could be thrown into Z's hand. The abundant signalling in the game is worth noticing, as also the way in which B omits the usual signal for length in suit headed by Ace, Queen, Knave.

THE HANDS.

A.
Diamonds—Q, 6, 5, 4, 3.
Spades—8, 6.
Hearts—K.
Clubs—Kn, 10, 5, 3, 2.

B.
Diamonds—8.
Spades—10, 5, 4, 2.
Hearts—A, Q, Kn, 9, 6, 2.
Clubs—A, 6.

B
Y Z (Dealer)
Trump Card, Diamond Ace
A

Y.
Diamonds—K, 7.
Spades—Kn, 7.
Hearts—10, 7, 5, 4, 3.
Clubs—K, Q, 8, 4.

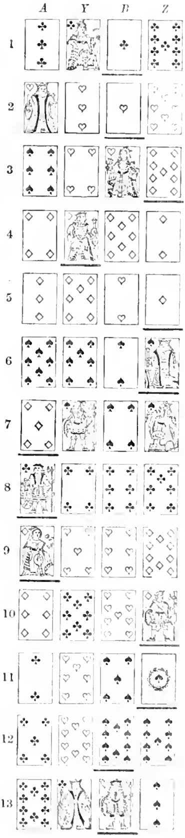
Z.
Diamonds—A, Kn, 10, 9, 2.
Spades—A, K, Q, 9, 3.
Hearts—8.
Clubs—9, 7.

Score:— { *A*, *B*, = 4 / *Y*, *Z*, = 4

tangent BT, the angle ABT is a right angle. We know this to be not approximately, but exactly true; but the reader must not be satisfied until he sees that the line of reasoning given here *proves* it to be so.

THE PLAY.

NOTE.—The card underlined wins the trick, and card below leads next round.



REMARKS, INFERENCES, &c.*

1. With five trumps, and five comparatively small cards, *A* properly leads from his plain suit [playing the penultimate, though if the score were different, a trump lead would be permissible, and, according to Pole, advisable, but the rule "always lead a trump from five," is open to question]. The fall of the nine from *Z* shows *A* that *Z* either has no more Clubs or is signalling [unless, which is less likely, *Y* held Queen only; in which case *Z* may have the King, and *B* have four Clubs left.]

2. *B* opens his strong suit.

3. *B*, although he has six Hearts, continues with the Queen, rather than with the Knave [see Leads, &c.] in order that *A*, having dropped the King, may not be in doubt. *A* refuses to overtrump *Z*, because it is clear to him that *Z*'s hand consists of Spades and trumps: he therefore discards a Spade.

4. *Z* sees his Spades in danger, and apparently from the weak hand. He plays, therefore, to find the King in his partner's hand, or finesse on the return. [*A* plays the penultimate trump, showing his partner (next round) that he held five originally.]

5. *Z* is obliged to play the Ace, so as to get the first force on *A* before he establishes his Club suit. [The care with which *Z* attends to this little matter will seem strange to those who think it a Whist offence of the first magnitude to give the enemy a chance of ruffing—they never call it "forcing," by the way—or to fail to give one's partner such a chance. It may be worth their while, if such there be among our readers, for these unwise players to try the effect of *Z*'s omitting to force.]

8. *Y* passes, in the expectation that *A* will continue the Club, in which he maintains the tenace. He thinks if he takes it, he must force *Z* at the risk of his being overtrumped. But he did not take into account that *A*'s trumps must be Knave, Ten, for if *A* had had the two best, he would probably have drawn the trumps. *Y*'s play was to win the Club, force *Z* with the Heart, thus keeping the second best Club when *A* was forced in return with the Club, so winning the game. *Z* completes his signal.

9 and 10. Well played, *A*! The play of *Y* in the last trick lets *A* into the whole of his hand. It is clear to him that *Y* is keeping up the tenace, and that he has not the best Heart. *A*'s play is then very pretty. By playing the Queen of trumps he throws, in the next trick, the lead into *Z*'s hand, taking the chance of finding *B* with a winning spade. The rest of the hand plays itself.

CHANCES OF HOLDING CERTAIN HANDS AT WHIST. The following calculation will show what is the chance of holding a hand at Whist

* The notes within brackets are by "Five of Clubs."

in which the cards are distributed among different suits in any possible way.

1 card or 12 cards may be taken from any suit in 13 ways.

2 or 11 cards may be taken from any suit in $\frac{13\times12}{2}=78$ ways.

3 or 10 cards may be taken from any suit in $\frac{13\times12\times11}{2\times3}=286$ ways.

4 or 9 cards may be taken from any suit in $\frac{13\times12\times11\times10}{2\times3\times4}=715$ ways.

5 or 8 cards may be taken from any suit in $\frac{13\times12\times11\times10\times9}{2\times3\times4\times5}=1287$ ways.

6 or 7 cards may be chosen from any suit in $\frac{13\times12\times11\times10\times9\times8}{2\times3\times4\times5\times6}=1716$ ways.

The number of ways in which a complete hand of thirteen cards can be made, having the cards distributed among different suits in a certain way, is obtained by multiplying together the numbers of the ways in which the numbers of cards in the several suits may be taken, and multiplying that product by the number of ways in which the suits can be chosen. For instance, if the cards were divided among the suits thus—1, 3, 4, 5—the number of ways would be 13 × 286 × 715 × 1287 × 24, 24 being 4 × 3 × 2, the number of ways of choosing the suits. A hand divided thus—2, 2, 3, 6—might be made in 78 × 78 × 286 × 1716 × 12 ways, 12 or 4 × 3 being the number of ways in which the suits of 3 and 6 can be chosen, the other two suits having two cards each. A hand composed of three cards of each of three suits and four of the fourth, may be made in 286^3 × 715 × 4 ways, there being only four ways in which the four suit can be chosen.

The following table, made in the manner above indicated, will show the chances of holding any sort of hand, the number of chances in each case being one-fourth of the number of the ways in which the hand can be made. The hands are arranged in the order of their respective frequencies.

Hand.	Chances.	Hand.	Chances.	Hand.	Chances.
4, 4, 3, 2	34,213,221,900	5, 5, 3, 0	1,421,164,602	9, 2, 1, 1	28,275,390
5, 3, 3, 2	24,633,519,768	6, 5, 1, 1	1,119,705,444	9, 3, 1, 0	15,950,220
5, 4, 3, 1	20,527,933,140	6, 5, 2, 0	1,033,574,256	9, 2, 2, 0	13,050,180
5, 4, 2, 2	16,795,581,660	7, 2, 2, 2	814,331,232	7, 6, 0, 0	8,833,968
4, 3, 3, 3	16,726,464,040	7, 4, 1, 1	622,058,580	8, 5, 0, 0	4,969,107
6, 3, 2, 2	8,957,643,552	7, 4, 2, 0	574,207,920	10, 2, 1, 0	1,740,024
6, 4, 2, 1	7,464,702,960	7, 3, 3, 0	421,085,808	9, 4, 0, 0	1,533,675
6, 3, 3, 1	5,474,115,504	8, 2, 2, 1	305,374,212	10, 1, 1, 1	628,342
5, 5, 2, 1	5,038,674,498	8, 3, 1, 1	186,617,574	10, 3, 0, 0	245,388
4, 4, 4, 1	4,751,836,375	8, 3, 2, 0	172,262,376	11, 1, 1, 0	39,546
7, 3, 2, 1	2,985,881,184	7, 5, 1, 0	172,262,376	11, 2, 0, 0	18,252
6, 4, 3, 0	2,105,429,040	6, 6, 1, 0	114,841,584	12, 1, 0, 0	507
5, 4, 4, 0	1,973,839,725	8, 4, 1, 0	71,775,990	13, 0, 0, 0	1

The total number of chances is 158,753,389,900, which is one-fourth of the whole number of ways in which a hand can be made. The [illegible] expressed in much simpler terms [illegible] will divide the whole number of [illegible] particular hand being 100, and the [illegible]. There are, however, only three hands of which the [illegible] simply by dividing by 2, 4, 10, 20, 25, or 100.

If [illegible] to know the chance of having any sort of hand [illegible] shall contain, or not contain, a trump, [illegible] as follow. If the hand comprises [illegible] the whole number of chances of having [illegible] chances of having such a hand, one [illegible] and two-thirds of the whole number [illegible] of having such a hand without [illegible] or portions are reversed, two-[illegible] having a trump and one-third not [illegible] a two-suit hand, 26 of the 39 [illegible] may be the trump card, [illegible] case of a three-suit hand [illegible] other suit. It is equally [illegible] having a certain hand of [illegible] trumps, for instance, in a [illegible] number of chances of having such [illegible] of chances of having such a hand [illegible] trumps [illegible] number of chances of the hand con-[illegible] trumps, and [illegible] is the number of chances of the [illegible] trumps. Of course, this applies only to a [illegible] being sure to have a trump, the [illegible] hand with 10 or 2 trumps, or only [illegible] of the whole number.

ALGERNON BRAY.

Our Chess Column.

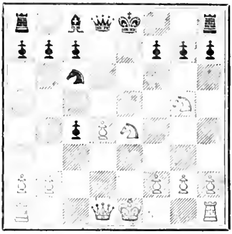
By MEPHISTO.

GAMES BY CORRESPONDENCE.

(Continued from p. 122)

Position after Black 10th move, P takes B :

BLACK (Chief Editor).



WHITE (Chess Editor).

There can be no doubt about it that Black is now subjected to a strong attack, and we think that the move recommended in our note (c) to a game, p. 597 (vol. i.)—viz., B to B4—is much stronger, and ought to yield Black the advantage. In order to test this, a subsidiary game was played between the Editors with the following continuation. Instead of 10. P takes B, 10. B to B4. 11. B to Kt3.

Instead of this move, our correspondent, Leonard P. Rees, thinks that in reply to B to B4, 11. Kt takes BP might be played. This, however, would result in the loss of a piece, *i.e.*:—

11. Kt takes BP	11. K takes Kt
12. Q to KB3 (best)	

(If 12. Q to KR5(ch), then 12. P to KKt3, and White has three pieces attacked.)

	12. Kt takes QP
13. B takes P(ch)	13. K to Ksq

and White must lose a piece.

We resume the subsidiary game, which continued—

	11. B takes Kt
12. Kt takes B	12. P takes Kt
13. B to R4	13. Q to Q4

A good move; it prevents White from taking the Knight and doubling the Pawns, it also prevents P to Q5, and, finally, it may also serve for the purpose of attacking White's Queen's Pawn by R to Qsq.

14. Castles	14. Castles KR
15. B takes Kt	15. Q takes B
16. R to Bsq	16. Q to QKt3

Our Chief Editor says in his note: "The rest of the game requires no comment. Only careful play is needed to ensure Black's winning." The game was continued up to the 32nd move, when White resigned, thereby clearly proving that 10. B to B4 is the proper reply to White's 10th move, KKt to Kt5 (for from the above position, Black (Chief Editor) played, as will be seen, a losing game).

(*To be continued.*)

SOLUTION OF PROBLEM No. 45,

By B. G. LAWS, p. 63.

1. B takes P	1. K to Q5
2. R to Q2(ch)	2. K moves
3. B takes P, mate	

(*a*).

	1. K to Q6
2. B takes P	2. K to Q5
3. R to Q2, mate	

(*b*).

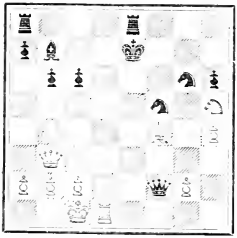
	1. K to B6
2. B takes P(ch)	2. K takes P
3. Kt to K3, mate	

PROBLEM No. 46.

End Position occurring in the Thorold Allgaier attack.

BY LEONARD P. REES.

BLACK.



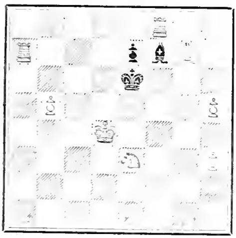
WHITE.

White to play and mate in five moves.

PROBLEM No. 47.

BY "MUZIO."

BLACK.



WHITE.

White to play and mate in three moves.

ANSWERS TO CORRESPONDENTS.

*** Please address Chess-Editor.*

G. W.—Received with thanks. We note the difference in the score.

Leonard P. Rees.—You will find all information you require. We do not forget anything, but we say, Better late than never.

A. Freeman.—1. Drawn game. 2. The same.

Correct solutions of Problem 45 received from G. W., Brenton, Bruin, J. B. B.

Alfred B. Palmer.—Received with thanks. Will be examined.

THE DIET OF THE JAPANESE.

FEW natives, except officers in the capital, sailors, and soldiers, eat beef. Mutton and pork beyond the treaty ports are scarcely yet known. About two hundred varieties of fish are eaten, one half of the people eating fish every day. The food of the masses is "ninety per cent. vegetable." A list of food-plants in use, not including sea-plants, has been prepared, with their analyses, by Professor Edward Kinch, of the Tokio University. A large number of these substances are unknown, or at least unused, in the United States. Of rice, which occupies in its culture one half of the cultivated land, there are two hundred and fifty varieties of seed in the country. Millet is extensively used, but bread raised from a "sponge" of yeast is scarcely yet known in the popular diet, the old Latin-Portuguese word *pan* being, however, in use.

The soy-bean, which in chemical composition closely approaches animal fibre, is extensively cultivated. Probably no country excels Japan in the variety of leguminous plants raised for food. Of tubers and roots, the sweet potato is the most popular, though, strange to say, as much tabooed by the aristocratic classes as onions are supposed to be among us. Sixteen million bushels of these "Satsuma potatoes" were produced last year, while the "Java," or "Dutch"—our common white potato—is left to foreigners, the native palate not liking it. Lily bulbs—sixteen varieties—serve as food, boiled and served with "drawn butter." The lotus root is eagerly eaten, without oblivion of country or decay of patriotism. Poppy seeds powdered as condiment, infusions of salted cherry blossoms for drink, horse-chestnuts and acorns, are among the articles of diet.

WOMEN'S DRESS.—The amount of air which any one can take into the body at one inspiration is called lung capacity, or vital capacity. The latter term is very significant, implying, as it does, that the working of the whole machinery of life depends upon the air which can be drawn into the lungs. The greater the amount, the better the health, the greater the strength and activity both of mind and body; while, the smaller the amount of air, the less the strength, the poorer the health, the lower the vitality, and the less altogether of bodily power and brain power. Now, I venture to say that not one woman in a thousand has ever attained to, or at present possesses, her full amount of lung or vital capacity. While men, from their youth upwards, have encouraged the development of lung capacity by vigorous exercise, by wearing garments which compress no vital organ, and offer the least possible impediment to muscular activity, women, on the contrary, have taken no vigorous exercise, and worn garments compressing all the vital organs while offering, at the same time, the greatest amount of impediment and hindrance to muscular activity.—*Mrs. King on "Rational Dress."*

Contents of KNOWLEDGE *No.* 37.

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CONTENTS OF No. 39.

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

By AMELIA B. EDWARDS.

V.—THE HYKSHOS KALENDAR AND THE EXODUS, ACCORDING TO THE SYNCHRONOUS THEORY.

IT has been suggested that Sut-aa-peh-peh Nubti instituted his Kalendar when he ascended the throne. This is pure assumption. We know nothing of Nubti but his name; and we know nothing of his Kalendar* beyond the fact that it had been founded 400 years before the tablet of Sān was erected by command of Rameses II.

But what we are fairly at liberty to conjecture is that Nubti, at some undetermined point in the course of his reign, sought to correct the fluctuations of the vague year by the substitution of a fixed year,† and that his improved Kalendar, though apparently set aside by the Pharaohs of the Restoration (*i.e.*, XVIIIth and XIXth dynasties), was still in vulgar use 400 years later among the semi-Semitic populations of the Delta. Let us say, then, that Nubti instituted his Kalendar in the year B.C. 1800, just 338 years before the commencement of the XIXth dynasty, and 97 years before the restoration of the native monarchy in the person of Ahmes, first Pharaoh of the XVIIIth Dynasty, B.C. 1703. At this time (B.C. 1800) the Hykshos dominion was about midway of its third dynastic line, and at the height of its prosperity and splendour. The tributary princes of Thebes had as yet shown no disposition to revolt; and the war of liberation—which did not break out till the reign of Apapi, and which, as I have already observed, cannot have been an enormously protracted war—was still far distant. It was therefore about this time, when there was peace throughout the land and peace along the frontiers, that Joseph must have appeared upon the scene. We may assume that he was born B.C. 1836, and that, having been sold as a slave to one Potiphar (Egypⁿ. *Peti-pa-Ra*: *i.e.*, Devoted-to-Ra), a native Egyptian officer in the service of the Hykshos sovereign, he was cast into prison upon an unjust charge B.C. 1808, being then twenty-eight years of age. Two years later (B.C. 1806) he would have been brought forth to interpret the king's dream; being, as it is expressly stated, "thirty years old when he stood before Pharaoh King of Egypt" (Genesis, Chap. xli., v. 46). This would be just six years before the institution of the Hykshos Kalendar, in B.C. 1800; and as the Bible narrative, which is here unusually precise, shows all this chain of important events to have happened under a single Pharaoh, we must conclude that the king who dreamed of the seven high Niles and the seven low Niles, and who raised Joseph to power because of the interpretation of his dream, could have been none other than Sut-aa-peh-peh Nubti.

From this point (B.C. 1806) we have now to reckon the seven years of plenty, in the sixth of which the King founded his Kalendar. The year B.C. 1800 marks, therefore, the new era of Nubti; and the year B.C. 1799 marks the last year of the good Niles. Next begin the seven years of low Nile* and scant harvest, after two of which, Joseph's brethren come from Canaan to buy corn. This brings us to B.C. 1797. Allowing a year for their double journey, and for the journey of Isaac and his household, we may next assign B.C. 1796 for the entry of the Hebrews into Egypt. From this time to the death of Joseph (if we credit him with the full traditional 110 years of life) we have to count seventy years, so bringing us to B.C. 1726: that is to say, to twenty-three years before the accession of Ahmes, B.C. 1703. During these seventy years, Nubti will have died and been succeeded by Apapi, who erects a magnificent temple to Set,† and adorns it with an avenue of human-headed sphinxes, carved in the likeness of his own features. By this act, and by the despotic fanaticism with which he sought, apparently, to promulgate the cult of Set among the tributary rulers of Middle Egypt, Apapi roused the slumbering hatred of the conquered race. A revolt broke out, headed by Sekenen-Ra Ta-aa, prince of Thebes. The revolt speedily became a national war, which, as recorded in the before-mentioned tomb at El Kab,‡ ended only with the final expulsion of the Hykshos. If, therefore (accepting Mariette's dates for the commencement of the XVIIIth Dynasty, B.C. 1703, and for the expulsion of the Hykshos in the sixth year of Ahmes, B.C. 1697), we allow thirty years for the duration of the struggle, we must take B.C. 1727 for the date at which it began. This would be one year before the death of Joseph.

* If the mounds of Sān were thoroughly excavated, nothing is more likely than that a tablet, or many tablets, might be found, engraved with this kalendar in full, like the sculptured kalendars of the temples of Denderah, Edfoo, and Medinet Haboo.

† The Egyptian year consisted of twelve months of thirty days each, to which were added five extra days (*epact*) to bring up the number to 365. Even so, the year fell short of the right time by a quarter of a day, which caused a loss of one whole day in every four years, and thus, in course of time, changed the relative positions of the seasons. Many attempts were made at various periods to substitute a fixed year; but none were successful until the Alexandrian year (which began on August 20) was established during the Roman period.

* The dreams of Pharaoh are essentially local. The seven fat kine, signifying prosperity, may be interpreted to mean the seven mystic cows, companions of Osiris-Apis, which we see represented in the vignettes to various copies of the *Ritual*; and the seven lean kine, omens of famine, may well be the seven cow-headed goddesses known as "the Seven Hathors"—minor divinities resembling capricious fairies, whose function it was to distribute good and ill luck. They "came up out of the river," which distinctly points to the annual inundation of the Nile; while the seven ears of good corn followed by the seven ears of blasted corn, as distinctly refer to the good and bad crops consequent on seven good Niles followed by seven bad Niles.

† Set, or Sutekh, the national God of the Hykshos and the Hittites. Three of these sphinxes were found *in situ* by Mariette.

‡ See KNOWLEDGE, No. 35, p. 65.

The rest of our calculation is soon made. The XVIIIth Dynasty, beginning with Ahmes, B.C. 1703, and ending with Horemheb, B.C. 1462, lasted exactly 241 years. The XIXth Dynasty began with Rameses I., and Rameses I. (who reigned from B.C. 1462 to B.C. 1456), was succeeded by Seti I. Seti I. reigned for fifty-one years—*i.e.*, from B.C. 1456 to 1405. He, however, took his son, Rameses II., into partnership; and this partnership, in the opinion of Brugsch, extended over the last thirty years of his reign. It would, therefore, have begun in B.C. 1435. And now, (observe that here is the turning-point of Brugsch's synchronous theory), *Rameses II. begins to date his reign from this period of partnership.* From B.C. 1435 we must accordingly count the sixty-seven years of his reign, which would close with his death in the year B.C. 1368. In the meanwhile Seti I. has died B.C. 1405, five years after which event, in the year B.C. 1400, Rameses II. celebrates the fourth centenary of Set-aa-peh-peh Nubti, by erecting the famous "Tablet of 100 years" at Zoan (Tanis). Finally, Rameses II. is succeeded by his thirteenth son, Menephthah, B.C. 1368. Moses, who had fled to Midian forty years before, now returns to Egypt for the purpose of delivering his people. The story of his contention with Pharaoh, as told in the Book of Exodus, covers apparently but a short time. The plagues of Egypt follow swiftly one upon another, and we shall probably not be far wrong if we place the flight of the Hebrews in the second year of Menephthah's sole reign—that is, in B.C. [illegible]. It now only remains to be seen how this date would correspond with the term of the Hebrew sojourn, as recorded in the Mosaic narrative. Turning to the Book of Exodus, we find that "the sojourning of the children of Israel who dwelt in Egypt was four hundred and thirty years. And it came to pass at the end of the four hundred and thirty years, even the selfsame day it came to pass, that all the hosts of the Lord went out from the land of Egypt." (Exodus, chap. xii., v. 40-41.) No historical statement could possibly be more precise than this. Not only is the number of years twice recorded, but a singular coincidence is noted by way of corroboration. Although the same fact is elsewhere roughly stated in round numbers at 400 years, there cannot, I think, be any doubt that the careful and precise computation of the twelfth chapter of Exodus is that upon which we are bound to rely. All that we have therefore to do is to count back 430 years from the second year of the reign of Menephthah; and 430 years of retrograde calculation, beginning with the year B.C. 1366, will take us to B.C. 1796, which is the exact year already assigned to the arrival of Isaac and his household, in the third year of the famine.

STIMULANTS AND STUDY.

BY THE EDITOR.

THE Abbé Moigno gives the following interesting account of his experience, not only as to the effects of tobacco, whereof he had first only spoken, but of the effects of stimulants—or, rather, of the absence of stimulants generally.

"I have learned," he says, "twelve foreign languages, by the method which I have published in my 'Latin [illegible]'—that is to say, I draw up the catalogue of the [illegible] or 1,800 root words, or simple primitive words, and fix their meaning in my memory by mnemotechnic formulas. I had thus taken into my mind nearly 41,500 foreign words, whose connection generally, or oftenest, has no connection with the word itself, and from ten to twelve thousand facts, with their precise date.

"All this existed simultaneously in my memory, always at my disposal when I wanted the meaning of a word or the date of an event. If anyone asked me, for example, who was the twenty-fifth king of England, I perceived in my mind that it was Edward, called Plantagenet, who ascended the throne in 1154. I was, as respects philology and chronology, one of the most extraordinary characters of my time, and François Arago used laughingly to threaten to have me burnt as a wizard.

"But I had lately fallen into the practice of snuff-taking, and an abode of several weeks in Munich, where I passed my evenings in a smoking-room with the learned Bavarese, who would each smoke four or five cigars, and drink two or three cans of beer (the most illustrious of these *savants*, Steinheil, used to boast that he smoked six thousand cigars a year—*six tausend cigarren im yahr*), I attained to smoking three or four cigars a day. When I edited my treatise on the Calculus of Variations—the most difficult of my mathematical treatises—I would at times, without thought of mischief, use up in a day the whole contents of my snuff-box, which contains 25 grammes (nearly an ounce) of snuff. Now, I was painfully surprised one day to have to recognise that I was constantly obliged to turn to my dictionaries for the meaning of foreign words, which before happened to me seldom, or never, and that the dates of numerous facts which I had made my own had fled from my memory.

"In despair at this melancholy failure of my memory, I took forthwith an heroic resolution, which nothing since has been able to shake. On Aug. 31, 1863, I had smoked three cigars and used 25 centimes (about 2½d.) worth of snuff; the day following, Sept. 1, 1863 [usually, ED.], and to the day of writing this, June 25, 1882, I have not taken a single pinch of snuff or smoked a single cigarette.

"It was for me a complete resurrection, not only of the memory, but of the general health and well-being. It was only necessary for me to do what I did eighteen years later, to diminish nearly one half the quantity of food which I took each day, to eat less meat and more vegetable food, to obtain such incomparable health as one can scarcely imagine—indefinite capacity for work, unconscious digestion, perfect assimilation of food, no hæmorrhoids, no constipation, no wrinkles, pimples, &c., &c., and I may be permitted to affirm it with perfect confidence—those who follow in my footsteps will be rewarded as I have been.

"Add to this the habitude, irrevocably established, of never saying *I will do*, or *I am doing*, but *I have done*, and you have the secret of the enormous quantity of work I have been able to achieve, and which I achieve each day, despite my eighty years. No one will deny me, hereafter, the honour of having been one of the greatest workers of my age.

"I ought, finally, to add that I find it well for me to take at breakfast a small half-cup of coffee without milk, to which, when only two or three teaspoonsful remain at the bottom of the cup, I add a small spoonful of brandy, or other alcoholic liquor. That is my whole allowance of stimulants. How happy would those be who should adopt my *régime*. They would be able, without harm, to sit at their desk immediately after breakfast, and to stay there till dinner time. No sooner would they be in bed, at about nine o'clock, but they would be softly asleep a few minutes later, and could rise at five in the morning, full of strength, after a nourishing sleep of eight hours.

"F. MOIGNO."

I would venture to add an expression of my own firm conviction that a life of study is aided by the almost entire avoidance of stimulants, alcoholic as well as nicotian.

I do not say that the moderate use of such stimulants does harm, only that so far as I can judge from my own experience it affords no help. I recognise a slight risk in what Abbé Moigno correctly states — the apparent power of indefinite work which comes with the almost entire avoidance of stimulants; but the risk is very slight, for the man must have very little sense who abuses that power to a dangerous degree. Certainly, if the loss of the power be evidence of mischief, I would say (still speaking of my own experience, which may be peculiar to my own temperament) that the use of stimulants, even in a very moderate degree, is mischievous. For instance I repeatedly have put this point to the test:—I work say from breakfast till one o'clock, when, if I feel at all hungry, I join my family at lunch; if now at lunch I eat very lightly and take a glass of ale or whisky-and-water I feel disposed, about a quarter of an hour later, to leave my work, which has, for the time, become irksome to me; and perhaps a couple of hours will pass before I care for steady work again: on the other hand, if I eat as lightly, or perhaps take a heartier lunch, but drink water only, I sit down as disposed for work after as before the meal. In point of fact, a very weak glass of whisky-and-water has as bad an influence on the disposition for work as a meal unwisely heavy would have. It is the same in the evening. If I take a light supper, with water only, I can work (and this, perhaps, is bad) comfortably till twelve or one; but a glass of weak whisky-and-water disposes me to rest or sleep, or to no heavier mental effort than is involved in reading a book of fiction or travel.

These remarks apply only to quiet home life, with my relatives or intimate friends at the table. At larger gatherings it seems (as Herbert Spencer has noted) that not only a heartier meal, but stimulants in a larger quantity, can be taken without impairment of mental vivacity, and even with advantage, up to a point falling far short, however, of what in former times would have been regarded as the safe limit of moderation. Under those circumstances, "wine maketh glad the heart of man," and many find the stimulus it gives pleasant,—perhaps dangerously so, unless the lesson is soon learned that the point is very soon reached beyond which mental vivacity is not increased but impaired.

I must confess it seems to me that if we are to admit the necessity or prudence of adopting total abstinence principles, because of the miseries which have been caused by undue indulgence—if A, B, and C, who have no desire to make beasts of themselves, are to refrain from the social glass because X, Y, and Z cannot content themselves till they have taken half a-dozen social glasses too many—society has an additional reason to be angry with the drunkards, and with those scarcely less pernicious members of the social body who either cannot keep sober without blue ribbons or pledges, or, having no wish to drink, want everyone to know it. I admit, of course, if it really is the case that the healthy-minded must refrain from the innocent use of such stimulants as suit them, in the interests of the diseased, it may be very proper and desirable to do so: but only in the same way that it might be very desirable to avoid in a lunatic asylum the rational discussion of subjects about which the lunatics were astray. For steady literary or scientific work, however, and throughout the hours of work (or near them) it is certain that for most men something very close to total abstinence from stimulants is the best policy.

FUTURE SOURCES OF OUR FOOD SUPPLY.

By PERCY RUSSELL.

II.—AUSTRALASIA.

VICTORIA—the island of Tasmania alone excepted—is the most contracted in area of all the principal members of the Australasian group, yet, as I shall presently show, it can of itself furnish a very important quota to our national food supply. The estimated area—something less than that of Great Britain—is 56,446,720 acres, and of these there were available for selection on January 1, 1881, nearly 10,000,000 of acres, while other lands were constantly becoming available as settlement developed *pari passu* with the advance of the railway system of the colony. The area under wheat was computed at 707,188 acres, and the average yield was 13·29 bushels to the acre. Maize, oats, and barley were, and are, successfully grown, while all the ordinary English farm produce was raised in great quantity and perfection, together with vines, which are capable of almost indefinite expansion, assuming that Australian wines should once become fairly popularised in these realms of ours at home. The live stock return comprised 216,710 horses, 278,360 milch cows, horned cattle generally 850,998, and 8,651,775 sheep, to say nothing of pigs and poultry. Although the population was in 1881 no less than 845,997, it is clear that the agricultural wealth of the community was rich indeed beyond all normal old world standards, and then it must be remembered that Victoria is the most thickly populated member of the whole group, consequent on the large extent of Melbourne, which contained in 1881 no fewer than 280,836 souls—being, curiously enough, considerably in excess of the total population of South Australia, and more than half the entire population of New Zealand.

The agricultural and stock-raising capabilities of Victoria are very great. Indeed, almost all fruits and vegetables grown in the British isles, are produced with facility, while such is the marvellous fertility of some of the rich lands, that as many as 60 bushels of wheat have been obtained from the acre! The vineyards are advancing apace, in spite of the prejudice wherewith the Victorian vintages are still regarded in this country. The average yield is some 250 gallons per acre, and if fiscal matters could be only equitably adjusted, and these wines properly introduced amongst us, we might have a practically inexhaustible supply of sound, wholesome, genuine wine, giving us as a nation something infinitely better than the *vin ordinaire* of the continent at an approximately nominal price. This, indeed, is a matter which merits much more careful consideration than our government has get given to the subject, and the friends of Temperance know well that intoxication results chiefly, if not wholly, from beer and spirits. To make a nation generally a wine-drinking community is to take a long stride towards virtual national temperance.

Passing now to South Australia, we have to consider a region which in extent and productive potentiality, altogether transcends our insular ideas of what constitutes a considerable cereal producing region, Norfolk and Suffolk, for example, being big factors in the domestic calculations of our English farmers. The total area of the colony is estimated at about 903,690 square miles, or 578,361,000 acres. Of this vast area there had been alienated up to 1880 some 8,940,327 acres, while some 29,000,000 acres remained ready for settlement. There were in 1881, about 1,730,000 acres under wheat, yielding 8,600,000 bushels, while 4,337 acres of vines produced half a-million gallons of wine. The live stock included 148,219 horses, 283,315 horned cattle, and 6,500,000 of sheep, but the population at the period in question was only 279,865 all told, whence it will be at once seen that the surplus in the way of productions was very great indeed. Many well organised railways are rapidly opening up the interior to the cultivator, and let it be borne in mind that the interior of South Australia is not the desert waste some have imagined. On the contrary, we have here splendid plains, including good soil, and while there are mountainous lands stretching off for hundreds of miles, thickly wooded with the famous eucalyptus, and often enclosing valleys which compare even with those of our own land in its most picturesque recesses. Very much of the scenery is, indeed, of a park-like character, and although intervals of stern sterile tracts intervene, these are seldom the rule, and many of these might yield to artificial irrigation, which, by-the-way, is now being extensively developed in Australia, to neutralise the serious effects of that principal enemy of the Austral husbandman—drought. During the year 1881 the colony exported flour to the value of £837,580, while the breadstuffs sent out were estimated at £2,469,720. When we reflect that the number of male inhabitants of this magnificent region was only 149,530, including those under age, it will be readily admitted that here again production has altogether outstripped population in a marvellous manner, and that in settling these grateful soils we have a very real and practical supplementary addition to our now comparatively insignificant wheat-fields at home.

But we have not yet by any means exhausted the potential food-raising capacity of the continent. Western Australia is a colony but little known or regarded in England, and as at present its very small population is less than 30,000 all told, it does not immediately enter into the calculations of our food importers. Yet it is a region well worth considering, since it includes some truly magnificent expanses—country especially adapted for cereal culture, while settlers only are needed to develope its flocks and herds into proportions that would even exceed the vast pastoral riches of South Australia, Victoria, and New South Wales. The total area is truly enormous, being 1,057,250 square miles, or eight times the size of the United Kingdom, to which, by the way, it lies nearest of all the members of the great Austral group. In 1880 there were nearly 64,000 acres under tillage, and about a third was under wheat, the average yield being 15 bushels to the acre. The live stock included 34,568 horses, 63,719 horned cattle, and 1,231,717 sheep. All the principal flowers and fruits of the world grow, or may be grown, in these fertile lands. The whole range of fruits peculiar to Europe can be reared in full perfection, while the olive and vine flourish exceedingly. The abundance of flowers has resulted in a vast increase of bees; and honey is produced in such quantities as to be locally of little or no value. Very much of the soil is naturally well adapted for farming purposes, and in some quarters there are downs of an extent equal to some European kingdoms, capable of supporting almost countless flocks and herds. The fertility of much of the soil in the vicinity of the watersheds is astounding. Thus, on the Greenhough River, there is a single flat containing some 10,000 acres, which raises 30 bushels of wheat to the acre, and that with culture of a superficial character. In other quarters there are vast forests of the famous jarrah wood. Until of comparatively late years, an idea prevailed that the interior was one awful, absolutely sterile desert, destitute alike of water and of land marks. Happily, Colonel Warburton, and subsequently, Mr. John Forrest, have, by their careful explorations, dispelled to a great extent the fallacy. There are certainly extensive deserts, but these are more like the rind ordinarily is to the pulp of the fruit, than the reverse, as once popularly imagined, and hundreds of miles in the far interior, beautifully undulating grass-grown plains have been discovered analogous to the well-known prairie soil of the far west of North America, where great harvests will some day be reaped by the aid of machinery, when once the civilizing railway has penetrated into these uncropped virgin soils. In effect, the rapid development of the great trans-continental railway is bringing us approximately near to the beginning of what must prove the true golden age of the antipodean agriculturist.

(To be continued.)

NIGHTS WITH A THREE-INCH TELESCOPE.

By "A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY."

AND now we come to the lovely object, of which Fig. 39 is nothing but a diagram, α Herculis; the contrast between the pronounced orange hue of the large star and the emerald green of the smaller one being perfectly charming. δ Herculis is a somewhat wide and very unequal pair. We insert it here on account of the extraordinary discrepancies which appear in the descriptions of the colour of the companion by various observers at different dates. This is a star which the observer will do well to watch.

Fig. 39. Fig. 40. Fig. 41.

α Herculis. ρ Herculis. 95. Herculis.

ρ Herculis is a close and beautiful double, the colour of the companion being very fine. It is shown in fig. 40. λ Herculis (between δ and μ, map, p. 626, Vol. I.) is only a single star, with nothing but its deep yellow colour to render it at all remarkable. It is inserted here, though, since it may interest the student to look at, or very near, the point in the heavens towards which our entire solar system is moving at the rate of some 422,000 miles per diem. One-third of the way from α Herculis towards Vega (the brilliant star α in Lyra) will be found a widish pair, 200 of Piazzi's XVIIth hour of R. A. It is noticeable for the beautifully-contrasted colours of its unequal components. If we draw an imaginary line in the sky from α Ophiuchi to β Lyræ, and travel 10° along it, we shall arrive at 95 Herculis, a tolerably close star, whose components differ but little in magnitude, though they have been alleged to do so notably in colour. Smyth called them "apple green" and "cherry red." Another observer described them as both golden yellow. At present they appear to us as of a palish yellow, both nearly of the same hue. 95 is represented in fig. 41. μ Herculis, a wide and very unequal pair, presents, as do so many other stars in this constellation, very finely-contrasted colours. 11° from β Lyræ, on line joining this star with α Herculis, lies 100 Herculis, a pretty and easy little pair of equal magnitude. It is shown in fig. 42. Such are a few typical objects among those with which this fine constellation abounds. Purely telescopic pairs fairly swarm in it, and may be picked up everywhere by simply sweeping the sky. At least seven well-determined variable stars, too, are numbered among its constituents; and in addition to the two clusters of stars of which we have given a short description above, it contains two planetary nebulæ and many interesting fields of stars. It will prove a very treasure-house to the incipient observer.

Libra, situated beneath a part of Serpens (*vide* p. 21), need not detain us long. Its two principal stars, α^2 and β, have very distant comites; but can scarcely be legitimately called "double." About $5\frac{1}{2}°$ to the south by east of α the observer will find 212 of Piazzi's hour XIV. It is just visible to the naked eye. It forms a pretty but very easy pair with a moderate power. This is really a triple star, but the third component is hopelessly beyond our aperture. μ Libræ is an extremely close pair, but is said to have been seen by Burnham with a $2\frac{1}{2}$-inch achromatic. Its appearance, as exhibited in an English 3-inch telescope, is shown in fig. 43. It is not marked in the map on p. 626, but is a little more than 2° to the north and west of α. About 6° west-south-west of μ Serpentis will be found Struve 1962 Libræ, a pretty and delicate, but not difficult, object. The remaining double stars (of which there are a good many) in this constellation are all invisible to the naked eye. Before quitting it we must look at that beautiful object, 5 of Messier's catalogue—a fine cluster of stars crowded into a nebulous-looking object. This lies nearly 9° to the south-west of α Serpentis, and forms a rudely-equilateral triangle with that star and μ in the same constellation.

Fig. 42.

100 Herculis.

Fig. 43.

μ Libræ.

Fig. 44.

λ Ophiuchi.

Below Hercules, and straggling in and out of Serpens, Libra, Scorpio, and Sagittarius, we find **Ophiuchus**, or the Serpent-bearer. The Serpent borne by this gentleman we have already described on p. 21. We now turn to its carrier himself. Unlike Hercules, the major part of Ophiuchus appears meagre and barren to the naked eye. It, however, resembles that constellation in being replete with objects of telescopic interest. Beginning with ρ^1, which is, by the way, terribly low down, we find a beautiful close pair of stars, with a pretty contrast between the pale yellow of the larger one and the blue of its companion; the pair forming the apex of a triangle with two other conspicuous stars. λ will tax the observer's powers and those of his instrument to the utmost. This is a binary star, with a period of 234 years; its components are very slightly opening just now. Fig. 44 gives some idea of it as seen as a merely oval object, with a high power under the finest definition. Some 3° north-west of η a new star blazed out in 1848, subsequently fading to practical invisibility in small instruments. This neighbourhood should be watched. 10° due east of Antares will be found 36 Ophiuchi, a pretty and fairly easy pair. It is too close to the horizon, though, for fine definition in these latitudes. 39 will be found 1° north-west of θ in Ophiuchus. It is very nearly as badly situated as the last star. The components are not very close; but their colours are fine. Another star, much better placed, which may be looked at for the colours of its components, is 67, $4\frac{1}{2}°$ east-south-east of β Ophiuchi. It is very wide, though. τ, a most interesting binary object, will, like λ, prove a crucial test for the observer. It will need an instrument of the highest class, a high power, a very sharp eye, and an excellent night to do anything with it; and even with these advantages it will only appear, like λ, as a misshapen star. 70 Ophiuchi,

Fig. 45.—70 Ophiuchi.

6° to the east-south-east of β, is an interesting pair, shown in fig. 45. The colour of the smaller star is believed, with some reason, to be variable. It used to be violet or purple, and is now yellowish. Ophiuchus is remarkably rich in nebulous-looking star clusters. As they are not marked in the map on p. 626, our directions for finding them will, we fear, appear somewhat vague. Beginning with 12 Messier, we shall find this about 8° 15′ north-west by west of ϵ. 10 Messier is nearly half-way between β Libræ and α Aquilæ. Messier 19 lies $7\frac{1}{2}°$ due east from Antares; 9 Messier will be found 3° south east of η Ophiuchi. About $6\frac{1}{2}°$ to the south-by-west of γ lies 14 Messier; while, finally, 23 Messier Ophiuchi, a fine cluster, will be found about 5° north-west of μ Sagittarii.

A GHOST STORY.

PREMISING that my personal belief in Ghosts is of the same kind and amount as that which I profess in the existence of the Phœnix or the Hippogriff, I should like to relate an absolutely true story of a circumstance or adventure which occurred to an old friend of my own, for the purpose of eliciting, if possible, some consistent explanation of it from some of your readers who are interested in psychology. I shall disguise the names of the actor (or actors) in the strange history I am about to relate (I have forwarded the real ones to the Editor) but nothing else.

During the first half of the present century, Francis and Horace Jones (two sons of Captain Jones, of the Royal Navy, who was drowned in the St. Lawrence River) emigrated to New Zealand. After undergoing various vicissitudes foreign to the purpose of this narrative, they settled down to farming, and built themselves a log-house at one extremity of a clearing in the bush. The only other occupants of this clearing (for, oddly, the natives never came near it) were, what they called, some Scotch "Shepherds," but who were in reality great sheep-farmers and stock-raisers. Between these Scotchmen and the Joneses an intimacy naturally sprang up. Now one night—and of all nights in the year it was Christmas eve—Horace Jones went over to spend a few hours with these Scotchmen. I need not say that whisky toddy formed a prominent feature in the celebration, and they toasted all those dear to them, who were removed by the semi circumference of the globe, sang "Auld Lang Syne," and, in fact, had a good deal more than "a wee drap" in their "Ee," when

Horace Jones left to go home. On getting clear of the stockade and out into the bush, his walk was perhaps a thought tortuous, but he kept on as straight as he could go (which was not, perhaps, saying much) in the direction of his own home. He had not, however, proceeded very far, before he became aware that some *thing* was progressing close by his side, going on when he went on, stopping when he stopped. The effect of the whisky toddy began rapidly to evaporate, and pulling himself together he nervously eyed his mysterious companion. He was walking at this time among trees, and the moon was hidden by clouds, so that all he could see with certainty was that whatever, or whoever, it was that was accompanying him, was very tall and of undefined figure. Well, he proceeded in this way, getting every instant more collected, until he came to a clear and open space, the moon at that instant breaking out from behind a cloud. To his dying day, he has often said, he shall never forget the sight which almost made his heart stop, and which rendered him as sober as a judge in an instant. Close beside and almost touching him stood a native, a superb figure of a man, quite six feet high, naked to the waist, but with his head cut off, and the blood shimmering in the moonlight as it trickled down from the stump of his neck which remained! With a shout or shriek Horace Jones turned and ran with all his might towards the Scotchmen's, as being the nearest point of refuge, never daring to turn round and see if his ghastly companion were following him; he battered with his hands at the door on reaching it, and as soon as it was opened fell forward into the house in a fit. When with some difficulty he was resuscitated, he told his entertainers what he had seen, they in their turn remarking as an odd coincidence that, at the same time something appeared to have got among the stock, which became as it were frantic. When, however, Jones calmed down a little, I rather fancy that they had some more whisky toddy. He of course spent the night there. On returning the next morning to his own home, and telling his brother Francis what had happened, he was so unmercifully chaffed, and his supernatural experience was so definitely predicated to be the result of an earthly spirit, that he held his tongue, and began to question whether there really might not be something in that hypothesis. Months passed, everything went on as usual, and he forgot all about it.

About a year afterwards the Joneses wanted a chimney built in their log house, and they called in the aid of some natives to do the work. While paying the chief man, Francis, who spoke Maori like one of themselves, asked him how it was that the natives, while squatting all about the neighbourhood, never came and encamped upon that clearing, which, with a beautiful river running through it, seemed to present a singularly eligible spot for such a purpose. "Well," was the reply, "I will tell you why we never come here. We have a tradition that in ages gone by our tribe was at war with another tribe, and that they used to fight hereabouts" (this Frank Jones has since often told me was probably true, as you could not put a spade into the ground without turning up human bones) "and" went on this naked savage "they say that our chief was treacherously sold to the enemy, who cut off his head, and *that he walks here of a night without his head*, and that is why we never camp upon this clearing."

And then Horace Jones remembered what he had seen on the previous Christmas Eve. F. R. M. S.

[It seems to us the only admissible interpretation of the story is that the native tradition *had* been mentioned, but forgotten till the stimulus of the whisky brought it to the surface, so to speak. Possibly it had been mentioned during the excitement of some former "bout." Of course, it would be interesting to know by what process of mental trickery the corresponding image was "made up"—possibly from some animal which had run beside Mr. Horace Jones. But the capacity of the excited and whisky-disturbed mind to form such images is amazing.—Ed.]

A THEORY OF FORESIGHTS.

Our esteemed correspondent, "F. T. P." writes to point out that the second of the larger drawings on p. 114, No. 37, is incorrect; instead of the disc representing the bull's-eye being round, it should be distorted by the encroachment of the diffraction fringe upon it, on the right side. This, of course, is the vital point of the whole thing. Unfortunately, our engraver, seeing in the rather rough picture sent him what looked like an ill-drawn disc, corrected the drawing, and made the disc circular, whereas it should have been shaped like the moon when some nine or ten days old, the defect from complete circularity being on the right-hand side. The pictures, unfortunately, did not accompany the proof, or the error would have been detected, "F. T. P.'s" description being very clear. Also on line 6, col. 114, for "fitting" read "being," and in last line but one of the letter, for "image" read "mirage." These corrections should be made, the right side of the lowermost black disc being reduced by a crescent of white (paint or the like) till the breadth of the white fringe on that side is equal to the breadth at top and bottom. "F. T. P.'s" communication is so valuable, and his method so well worth knowing, that we cannot but regret the inaccuracy of the most important diagram, obviously though the text suggests the necessary correction. It is important that all diagrams not drawn precisely as they are meant to be engraved, should have explanatory notes. For instance, we have shown an engraver "F. T. P.'s" later drawings, sent to show how the discs should be, and he tells us that he could certainly represent both the black spots by circular discs.

HOME CURES FOR POISONS.

VEGETABLE POISONS.

Our purpose in describing the chief vegetable poisons in our last was to indicate rather the effects of specific poisons, and the best method of home cure, than the botanical distinctions of the several poisonous plants. Several correspondents write to point out methods for distinguishing poisonous from non-poisonous varieties; but the subject is too wide to be dealt with in a few scattered notes. Hereafter a paper may be written on that subject specially. It will have to be illustrated, as the technical terms necessarily involved in written descriptions would only be intelligible to botanists.

Two correspondents write to say that Deadly Nightshade is *not* common in our hedges, though Woody Nightshade is; and one "presumes" that Bitter-sweet, or Woody Nightshade (*Solanum Dulcamara*), was mistakenly intended. The description should have shown that Deadly Nightshade (*Atropa Belladonna*) was referred to throughout, and not Woody Nightshade. The word "common" was ill-chosen, however; for though Deadly Nightshade is not unfrequently met with in hedges and thickets in various parts of England, it can hardly be described as commonly found there. *Woody* Nightshade, on the contrary, is often seen. It should have been added to our list of poisonous plants. It may be known by its zigzag stem, with alternate leaves, the lower lanceolate or cordate, the upper hastate or jagged. The flowers resemble those of the potato, but they are smaller. The berries are red or crimson, and are not unfrequently mistaken by children for red-currants. The taste is bitter at first, then sweetish, whence the names Bitter-sweet and *Dulcamara* (*Dulcis et amara*). The poisonous effects are similar to those produced by *Belladonna Atropa*, and though not so active for equal quantities, whether of berry, root, or leaves, are sufficiently dangerous, resulting even, in some cases, in fatal consequences.

LOWER LIFE FORMS.*

THIS book will be welcomed heartily by students of zoology, because it shows them just the sort of work which is most instructive. The author has not here given a text-book of zoology, but a hand-book for the thorough study of certain typical forms. Most teachers of natural science find so much time and space required for the presentation of the facts on which philosophical discussion is to be based, that little room is left for the investigation of scientific relations resulting from the study of facts. Dr. Brooks shows the student how to acquire a knowledge of the facts for himself. He takes a few types for description; calls the attention of the student to those structural features which he can readily observe for himself: points out by admirably-drawn pictures the methods and results of dissection and microscopical study: and indicates the significance of the observed facts. The complicated figures which accompany most monographs are not given, but the drawings of the author, or made under his direction from nature, have been reproduced by photographic processes. "It is hoped," says the author, "that the practicability and significance of the cuts, as guides to dissection and study, will more than compensate for the artistic finish and technical skill which has been lost by the employment of this method of reproduction." But the apology is not needed; we have seldom seen more effective illustrations. The following are among the subjects dealt with in this excellent hand-book :—The structure of Amoba, Paramœcium, and Vorticella : the Multiplication of Vorticella; Calcareous Sponge; the Starfish : the Sea-Urchin; Earthworms; Leeches; Crabs, Crayfish, and Lobsters; the Anatomy of Cyclops; the Grasshopper: Lamellibranchs; and the Squid (Loligo).

PROFESSOR OWEN ON VIVISECTION.†

ON March 28 last a meeting was held at the Royal College of Physicians, in London, attended by many of the most distinguished medical men of the day, the object being to "bring the legitimate influence of the medical profession more effectually to bear on the promotion of those exact researches in physiology, pathology, and therapeutics, which are essential to sound progress in the healing art." The Master of the Rolls remarked on that occasion, that "it would be most desirable that the public should be informed upon tho matters contemplated by the Association." The book before us has been written in response to this wish.

It will probably be useless to commend the careful study of this little book (full of most interesting matter outside its special purpose) to the more sentimental of the anti-vivisectionists, for whom, by-the-way, Professor Owen adopts the title of Bestiarians. But for those anti-vivisectionists who are not prepared to allow a regard (very just in itself) for inferior animals to overrule all other feelings, the study of this treatise will be useful and instructive. They will see how much of the humanity of modern medical and surgical practice is due to the practice which the Bestiarians describe as inhuman. Professor Owen shows that even inquiries not necessarily directed at their outset to pain-preventing discoveries, have led to the relief of an enormous amount of human suffering and untimely death. As a striking example, consider the case of John Hunter's researches into the annual growth and shedding of the antlers of deer. A buck having been put at his disposal, Hunter placed a ligature around the carotid artery supplying the growing antler, on which the pulsations of the formative "velvet" ceased, and the antler began to cool. The buck was released, and examined a week later. To Hunter's surprise the velvet had recovered its warmth, and the growth was proceeding as usual. The buck was thereupon killed (a "fearful piece of cruelty," though the annual hunting and killing of scores for venison is a "noble sport"). He found the canal of the carotid had been obliterated; but sundry ordinarily minute branches sent off below (*i.e.*, between the heart and the ligature) had enlarged, had carried the blood to other capillaries communicating with the carotid above the ligature, and the enlargement of these previously inconspicuous vessels had restored the supply to the cold antler, and with it the power of growth. Take now the other side of the picture. Not long after, a coachman, suffering from popliteal aneurism (caused by the pressure of the hard margin of the box-seat on the vessels of the ham), lies at Hunter's (now St. George's) Hospital awaiting amputation of the leg, to which operation he has given his consent. Hunter says to him, "If you will let me make a small cut in your thigh, I may save your life and limb both." "God bless you, sir," says the sufferer: "do what you think best, so you put me soon out of this torment." A ligature is thereupon put on the femoral artery, and immediately the tumour ceases to beat and begins to diminish. The patient exclaims that his agony is over. True, the leg begins to chill. Hunter will have no artificial heat applied, only flannels swathed round the foot and leg. In a day the natural warmth begins to return, but not the pulsations in the tumour. The morbid mass grows smaller and smaller, and in six weeks the coachman walked out of the hospital on both legs, cured of his aneurism. This was in 17[illegible]. In the years which have elapsed since, how many hundreds have been saved from torture and the risk of death by the application of this method, which substituted a comparatively trifling operation for rarely successful amputation. Even the operation is now usually avoided, pressure being substituted for ligature. And this is but one instance among many. Every one who wishes to gain a just and honest opinion on the vivisection question, should read this interesting work by our veteran naturalist. But those who wish to gain a cheap reputation for tender heartedness should avoid it, lest it convince them, against their will, that their tender mercies are very cruel.

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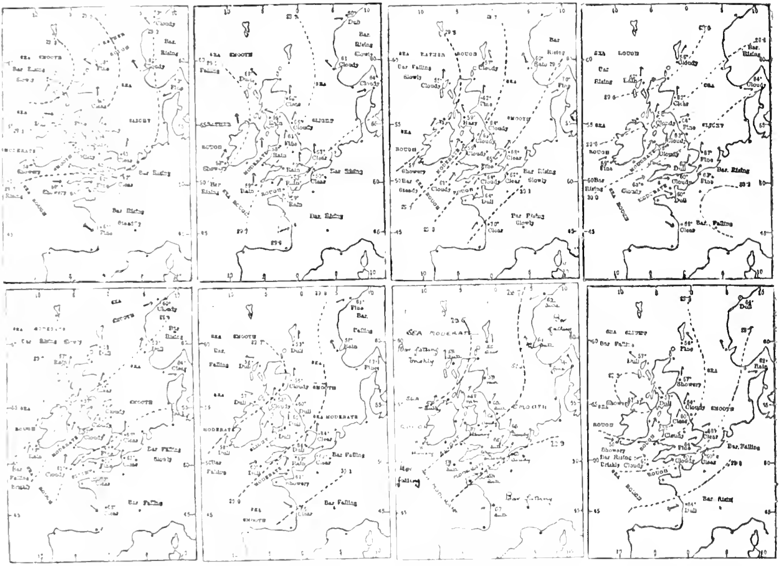
* "Handbook of Invertebrate Zoology, for Laboratories and Sea-side Work." By W. K. Brooks, Ph D., Director of the Chesapeake Zoological Laboratory of the John Hopkin's University.

† "Experimental Physiology, its benefits to Mankind; With an Address on Unveiling the Statue of William Harvey at Folkestone." By Richard Owen, F.R.S., &c. (Longmans & Co., London.)

WEATHER CHARTS FOR WEEK ENDING SUNDAY, JULY 23.

SUNDAY, 16TH. MONDAY, 17TH. TUESDAY, 18TH. WEDNESDAY, 19TH.



THURSDAY, 20TH. FRIDAY, 21ST. SATURDAY, 22ND. SUNDAY, 23RD.

In the above charts the dotted lines are "isobars," or lines of equal barometrical pressure, the values which they indicate being given in figures at the end, thus 30·4. The shade temperature is given in figures for several places on the coast, and the weather is recorded in words. The arrows fly with the wind, the force of which is shown by the number of barbs and feathers, thus:— ⟶ light; ⟶, fresh or strong; ⟶, a gale; ⟶, a violent gale; ⊙ signifies calm. The state of the sea is noted in capital letters. The • denotes the various stations. The hour for which each chart is drawn is 6 p.m.

Science and Art Gossip.

[illegible] that transitory colour blindness is pro[illegible] among snow fields illuminated by [illegible] green for a short time. The [illegible] perception of red is more prolonged [illegible].

[illegible] not by drowning them in a cage, but [illegible] into an apartment which, after [illegible] is made air-tight. One hundred [illegible], and their death is quick and [illegible].

[illegible] a water supply from a remarkable [illegible] penetrated 560 feet, salt water [illegible] further down a gravelly stratum was [illegible] water. After boring down 601 feet fresh [illegible]. Now from a depth of 675 [illegible] pure potable water of steadily increasing [illegible].

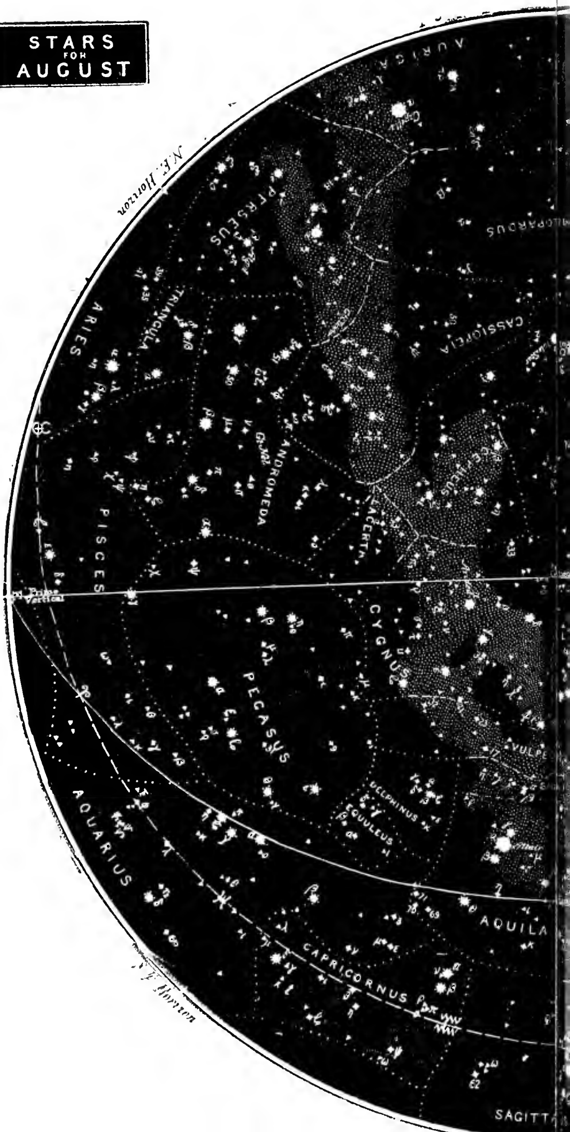
[illegible] The latest census gives the population of [illegible] males, 18,123,274; females, 17,935,720 an [illegible] increase over the last previous census in 1873. This increase, however, is in part attributed to the growing accuracy in collecting returns, the earlier estimates having been too low. The population of the three principal cities is thus distributed: Tokio, 979,081; Kioto, 830,829; Osaka, 587,998.

THE University at Toronto, Ont., admits women, and in his commencement address Chancellor Blake spoke very favourably of the experiment. In the class of three years' standing there are three women, and in the next younger five, while of the freshmen no less than forty-four are females. Moreover, the girls hold their own against the boys in scholarship, and get plenty of honours. The Chancellor thinks that in a little time female teachers will be introduced.

TWO NEW OCEAN CABLES. Under the Bill which has passed Congress incorporating the Baltimore and Ohio Cable Company, the railroad company contemplates immediate preparations for laying two ocean cables. It is probable that one point of landing on the American side will be near Boston, or between that city and New York, and the other near Norfolk, Va. The latter cable is likely to be laid *viâ* Bermuda and the Azores to the coast of Portugal, and the northern line will probably be laid to England. Preliminary examinations and preparations are in active progress.

INSECT pests, like men, make their way chiefly from east to west. With the exception of the grape phylloxera and the Colorado potato-beetle, Europe has not received from America any con

STARS FOR AUGUST



Our Star Map.—The circular boundary of the map represents the horizon. The map shows also the position of the equator and of that portion of the Zodiac now most favourably situated for observation. The names of ninety-nine stars of the first three magnitudes are given below.

On July 30, at 10·30 p.m.
On Aug. 3, at 10·15 p.m.
On Aug. 7, at 10· 0 p.m.
On Aug. 10, at 9·45 p.m.
On Aug. 14, at 9·30 p.m.
On Aug. 18, at 9·15 p.m.
On Aug. 22, at 9· 0 p.m.
On Aug. 25, at 8·45 p.m.

ARABIC NAMES OF STARS.

The following table exhibits the names of all the stars of the first three magnitudes whose names are in common use:—

α Andromedæ	*Alpheratz*
β ———	*Mirach, Mizar*
γ ———	*Almach*
α Aquarii	*Sadalmelik*
β ———	*Sadalsuud*
δ ———	*Skat*
α Aquilæ	*Altair*
[illegible]	*Alshain*
	Tarazed
α Arietis	*Hamal*
β ———	*Sheratan*
	Mesartim
α Aurigæ	*Capella*
β	*Menkalinan*
α Boötis	*Arcturus*
	Nekkar
ε ———	*Izar, Mezar, Mirach*
η	*Muphrid*
α Canum Venat.	*Cor Caroli*
α Canis Majoris	*Sirius*
β ———	*Mirzam*
ε	*Adara*
α Canis Minoris	*Procyon*
β ———	*Gomeisa*
α Capricorni	*Secunda Giedi*
δ ———	*Deneb Algedi*
α Cassiopeiæ	*Schedar*
β ———	*Caph*

α	Cephei	Alderamin
β	———	Alphirk
γ	———	Errai
α	Ceti	Menkar
β	———	Dipoda
ζ	———	Baten Kaitos
ο	———	Mira
α	Columbæ	Phact
α	Coronæ Borealis	Alphecca
α	Corvi	Alchiba
δ	———	Algores
α	Crateris	Alkes
α	Cygni	Arided, Deneb Adige
β	———	Albireo
α	Draconis	Thuban
β	———	Alwaid
γ	———	Etanin
β	Eridani	Cursa
γ	———	Zaurac
α	Geminorum	Castor
β	———	Pollux
γ	———	Alhena
δ	———	Wasat
ε	———	Mebsuta
α	Herculis	Ras Algethi
β	———	Kornephoros
α	Hydræ	Alphard, Cor Hydræ
α	Leonis	Regulus, Cor Leonis
β	———	Deneb Aleet, Deneb-'a Deneb
γ	———	Algeiba
δ	———	Zosma
α	Leporis	Arneb
α	Libræ	Zuben el Genubi
β	———	Zuben el Chamali
γ	———	Zuben Hakrabi
α	Lyræ	Vega
β	———	Sheliak
γ	———	Sulaphat
α	Ophiuchi	Ras Alhague
β	———	Cebalrai
α	Orionis	Betelgeux
β	———	Rigel
γ	———	Bellatrix
δ	———	Mintaka
ε	———	Alnilam
α	Pegasi	Markab
β	———	Scheat
γ	———	Algenib
ε	———	Enif
ζ	———	Homan
α	Persei	Mirfak
β	———	Algol
α	Piscis Australis	Fomalhaut
ε	Sagittarii	Kaus Australis
α	Scorpionis	Antares, Cor Scorpionis
α	Serpentis	Unukalhai
α	Tauri	Aldebaran
β	———	Nath
η	———	Alcyone (Pleiades)
α	Ursæ Majoris	Dubhe
β	———	Merak
γ	———	Phecda
ε	———	Alioth
ζ	———	Mizar
η	———	Alkaid, Benetnasch
ι	———	Talitha
α	Ursæ Minoris	Polaris
β	———	Kochab
α	Virginis	Spica Azimech, Spica
β	———	Zavijava
ε	———	Vindemiatrix

siderable pest, while innumerable noxious species have crossed the Atlantic from Europe. There is a comparative scarcity, too, of Asiatic insect species on the western seaboard of America, notwithstanding frequent ocean traffic. Spite of great arid plains and lofty mountains, nearly all the insects of Eastern American States, including those from Europe, have found their way across the continent to the fields, orchards, and vineyards of the Pacific States.

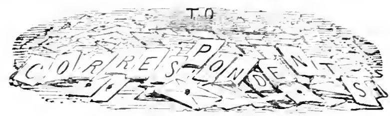
A FREE POSTAL PHOTOGRAPHICAL SOCIETY has been founded as a postal society for the convenience of amateurs in different parts of the country for (1) the circulation of prints, negatives, &c., (2) the exchange of photographs and of information on photographic matters, and for the general advancement of the science and art of photography. This society will in no way interfere with any society now in existence, but will rather tend to the advancement of existing societies by bringing their members more into communication with each other. Entrance fee, 2s. 6d. annual subscription, 5s. Further information and a copy of the rules may be had on application to H. H. Cunningham, Hon. Sec., 7, Fig-tree Court, Temple.

THERE is a weed in the South known as the wild coffee plant, which has caused the planters a good deal of trouble and annoyance, and has consequently been greatly despised. It has recently been discovered that the plant has its use, as rope can be made from it equal to the best hemp, and stronger and finer than jute. The discovery was made by a negro who needed a piece of rope, but could find none. On looking around, his attention was attracted to this plant, and he cut the stalks and treated them in the same manner he had been accustomed to see hemp treated in Kentucky, and the result was a fibre of good length and of surprising strength, which the old man soon converted into rope.

THOUGHT READING.—A Plymouth correspondent (notes the *Echo*) says a strange incident is reported in that town. On Tuesday evening a young man, residing at Devonport, called upon the Editor of a local paper and begged to be informed if any telegrams had been received giving the names of Englishmen killed during the day in Alexandria. He was informed that no such message had been received. He thereupon mentioned that during the afternoon the mother and wife of a petty officer named Revington, serving in Alexandria, had what they regarded as a token of his death. They were sitting together in their house, talking and working, when they heard, or thought they heard, the voice of the absent son and husband say, "Mother!" three times. With forebodings upon them, the brother was at once despatched to the nearest newspaper office, with the result indicated. On Wednesday, however, the relatives of Mr. Revington received a telegram from the Admiralty to the effect that he was shot in the streets of Alexandria on Tuesday, whilst serving on police duty.

THE Salt Lake (Utah) *Herald* says that sea gulls have been uncommonly numerous and active there this spring. Wherever there was a newly-ploughed field, there you could see the gull, and as fast as a furrow was turned up the birds would fly behind the ploughman and commence devouring the insects which were thus exposed to sight. They seemed perfectly fearless. And they have good reason to be fearless here, for the farmer looks upon them as his friend, and they seem to understand fully that he holds them in that light. They fly all about him, within three or four feet, and while perhaps unwilling to submit to being caught, they will allow any other familiarity that can be practised, for they themselves take a great many good-natured liberties. They will not touch grain, or anything that the farmer desires should remain untouched; they only eat the worms and insects which are injurious to the soil and to crops. Only once before have the gulls been so numerous, and that was in 1848, when they saved the settlers from an invasion of mountain crickets.

AMERICAN WATCHES IN NEW ZEALAND.—In a report on the watch and clock trade of New Zealand, Consul Griffin (American) says that, though the introduction of American clocks and watches into New Zealand is comparatively of recent date, they have become so very popular and so general in use that the trade in them bids fair to swell to large proportions. Most of these goods reach New Zealand by way of London. Mr. Bartlett, a leading jeweller of Queen-street, Auckland, said to Mr. Griffin: "It is difficult to sell an English watch, and as far as the Geneva watches are concerned, they are being fast driven from the market. Everybody seems to want an American watch. I am not prepared to say that American watches are any better than other watches, but it is the fashion to have them. There is not a boy or a servant girl in the country who can raise five pounds, who does not want to invest it in an American watch." Mr. Bartlett, while acknowledging the popularity of American watches, expresses a decided preference for the old-fashioned hand-made watch, but frankly admits that his customers do not agree with him.



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.

All Editorial communications should be addressed to the Editor of KNOWLEDGE; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

AN EFFECTIVE ACCUMULATOR.

[485]—Some time since you published in KNOWLEDGE a description of Sutton's accumulator. A scientific friend, Mr. J. Williams Gifford, of Chard, informs me that he has obtained much better results with an accumulator of which I append a description.

The accumulator consists of a lead trough, coated on the inside with finely divided lead. This is formed from red lead laid on and retained in its place by a lining of canvas, kept close to the sides of the box by wooden stays. In the middle of the lead box is suspended a plate of zinc well amalgamated. It is well thoroughly to amalgamate the lead before laying on the minium, so as to form a thoroughly good connection between the lead and the finely divided lead formed from the minium.

To form the cells, they are filled with sulphuric acid and water, one of acid to nine of water, and are connected in series; the zinc is thus dissolved by the acid, which changes to a zinc sulphate solution, while the lead oxide becomes the before-mentioned finely divided lead. The cells are now ready for use. It is to be distinctly understood that no external battery is to be used to form the cells; their own current is quite sufficient. When formed, they may be charged by a dynamo or battery, but require a motive force of from 5 to 6 volts for each accumulator.

It is well to keep the zinc thoroughly amalgamated; this will ensure the maximum of current given out after a given charge. If the accumulator is only required to last from half to one hour, the minium may be omitted with advantage, and the lead only amalgamated, but if for several hours it must be used, but will slightly increase the internal resistance. The sulphate of zinc solution made in forming the cell gives up its zinc, which is electroplated on the large suspended zinc; the finely divided lead is changed into lead peroxide by the atoms of O from the H_2O split up during action, while the H escapes as bubbles; (hence it is necessary to add a little water from time to time) the solution left when fully charged being $H_2SO_4 + H_2O$. JOHN BROWNING.

PROGENITOR OF VERTEBRATA.

[486]—"W. R." puts a highly interesting question to me, requesting information regarding a statement made by me in an article in *Good Words* for 1875, wherein I say that from personal observation I believed the notochord of the Ascidian larva to be "ventral" in position. I need not say to those readers of KNOWLEDGE who have perused my papers on "Found Links," that if I still maintained this view, the homology or relationship (maintained by evolutionists) of the sea-squirt larva's "notochord" with that of the lancelet could no longer be urged by me. The correspondence of the two structures in sea-squirt and lancelet respectively depends on the recognition of the fact that they are exactly and hereditarily related. The notochord is the same in both; it is dorsal (or lies in the back) in both sea-squirt and vertebrate: such is the evolutionist's stronghold. Now, since 1875, every naturalist has learnt a vast deal respecting "sea-squirt" development and vertebrate homologies. I have great pleasure in fully and freely acknowledging that, although, whilst fairly stating the two views held on the subject in 1875, and whilst leaning to the side of Von Baer, Metschnikow, and others, I have since found reason to change my opinions, and

[illegible] the views of Kowalewsky. Indeed, in 1875, [illegible] of the probabilities of evolution, I could not [illegible] the As[illegible] relationship of vertebrata. Now, however, [illegible] for any candid naturalist (despite some [illegible]) to do otherwise than to fully accept K[illegible]. Farther acquaintance with recent work [illegible], as it made me, an ardent evolutionist; [illegible] nature, and the teachings of these facts, as the [illegible] nature's meanings. As a matter of science, I [illegible] between the sea-squirts larva's structure [illegible], to have been so fully made out, that no [illegible] of the relationship I described in my [illegible]."

ANDREW WILSON.

A[PP]ARENT PARADOX IN PROBABILITIES.

[487]—[illegible] your correspondents stated, referring to some [illegible] (not having the No. of KNOWLEDGE by me I [illegible] reference), that if, out of a bag containing an [illegible] tickets, 100 were drawn, and it was found [illegible] marked A, 30 B, and 20 C, the chance that [illegible] drawn would be marked with some letter of the [illegible] $\frac{101}{102}$ (I think), and that the sum of the chances [illegible] marked A, B, and C, respectively, would be [illegible] state the fractions exactly right, but, at [illegible] fraction was greater than the first. Now, on [illegible] the fraction expresses the exact chance, not [illegible] both the fractions do in fact express the [illegible] as your correspondent pointed out, would [illegible] paradox in a case of this kind is an im[illegible] the chances were exactly calculated [illegible] assumed as the basis of the calculation. [illegible] of such an event can be exactly [illegible] form seems to me to be a very curious [illegible] with two other undoubted facts which have [illegible], namely, that the contents of a [illegible] $\frac{2}{3}$ of those of the containing cylinder, and that [illegible] is $\frac{2}{3}$ of that of the containing rectangle. [illegible] probabilities may one day get out of [illegible] and the multiplication table, and [illegible] region to which this question belongs.

ALGERNON BRAY.

[illegible] our papers on probabilities beyond [illegible]; but our correspondent can, we [illegible] for himself the following demonstration of [illegible] above, and afterwards extend the [illegible] complex case. Let him then first show that [illegible], the sum $1^p + 2^p + 3^p + \ldots$ to n terms, [illegible] have been drawn in succession out of a bag of [illegible] or black, but in unknown proportion, the [illegible] each time the chance that the next q [illegible] an exact proposition. Next let [illegible] $\frac{1^p + 2^p + 3^p + \ldots + n^p}{(p+1)\,n^{p+1}}$ is very [illegible] proposition, only exact when [illegible] difficulty in showing that if in p [illegible] possible cases, the same event [illegible] the next q cases is $\frac{p+1}{p+q+1}$

AN [illegible]

[488]—[illegible] interesting article on [illegible] the following anecdote [illegible] may be interesting to [illegible] by the observer [illegible] of ants on [illegible] path. The ant [illegible] content, and [illegible] with twenty or more [illegible] purposely re[illegible] to the astonishment and discomfiture of the ant who had enjoyed the feast, and decidedly to the chagrin and rage of his companions, who, after apparently listening with disdain to the arguments of their comrade (as shown by the action of his antennæ and the strong "ant language" used on the occasion), suddenly set upon, killed, and devoured their unfortunate and vainly protesting brother.

It certainly would be an effectual method of getting rid of proved human swindlers, but I should be doubly sorry in that case to be one of the "swindled."

HENRY J. BUCK.

THE DOUBLE STAR CASTOR.

[489]—As Mr. Herbert Sadler (letter 470, p. 118) appears to be severely exercised in his own mind with reference to my reply concerning Castor, on p. 83, I may perhaps ask for half-a-dozen lines to explain exactly in what sense I gave it. I said, and I repeat, that Castor is *not* regarded by astronomers as a triple star; although in speaking of the 11th mag. Star having "no physical connection with the well-known pair," I certainly expressed myself too strongly. If, however, Mr. Sadler is going to insist that all stars possessing a common proper motion, are double, triple, and so on, then must he, to be consistent, call β, γ, δ, ϵ and ζ Ursæ Majoris a quintuple star! inasmuch as your own admirable researches, Sir, have shown that these stars are all moving together through space, a result subsequently placed beyond cavil by the independent testimony afforded by the Spectroscope.* The fact is that "double star," "triple star," &c., are forms of expression conveying a perfectly definite meaning to the telescopist, and to include stars more than 60″ apart in either of these categories is to open the door to very ridiculous misdescription. One has only to note how the late Admiral Smyth padded his "Bedford Catalogue" with such objects, to see where we should be landed if we followed out Mr. Sadler's system to its logical conclusion.

A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

[I may note here a rather amusing misprint in Answers to Correspondents, somewhat reminding one of the familiar "Mary Stet" story. In correcting the proof, I substituted, for what had before been the description of the 11th mag. star, the words "small star." This was taken very literally by the compositor—see p. 100, 1st. col., line 7.—R. A. P.]

A VITREOUS GLAZE FOR STONE.

[490]—The following account of Gatakre Hall has been supplied me by Mr. Hubert Smith, of Bridgenorth, and is an extract from a note in his work, published some years ago: "Tent Life with English Gipsies in Norway".—

"Thomas Gatakre was born 1571, of a very old and ancient family, still retaining their ancestral heritage of Gatakre in Shropshire. The former Hall of Gatakre was built of stone, three sides of the exterior of the mansion being entirely covered with a glaze of greenish glass. It has puzzled many to account for the method by which the walls received their vitreous coating, effectually preserving the stone from the action of the weather. The foundation of a building on the estate where the glass is supposed to have been made still retains the name of the "Glass House." We have in our possession some of the stone with its covering of glass, given to us by one of the family. The roof of the mansion is said to have been supported by an enormous oak-tree turned upside down. This interesting relic of former ages was pulled down during the last century, and replaced by the present large and spacious brick-built Hall of the Gat-acres of Gat-acre.

Mr. Hubert Smith has kindly procured me two little samples of the above-mentioned vitreous coated stone, and I find that the glaze is somewhat unevenly laid on the surface, varying in thickness from a thin film to about one-eighth of an inch in thickness.

The stone used was a greyish sandstone, and may have been quarried in the neighbourhood, and was evidently well adapted to withstand almost any amount of heat; and, judging from the small specimens before me, a considerable degree of fire must have been applied to the surface, as that part nearest the glaze is much harder than at a depth of an inch. Mr. Hubert Smith further tells me that all the joints were also covered with the glaze.

I trust that among your numerous scientific readers, some one may be able to suggest a solution of the above puzzle, which is evidently a lost art, and may, if discovered, be of some use in preserving some of our public and private buildings from farther decay.

J. MILO-GRIFFITH.

* "The Universe and Coming Transits," p. 141. "Pleasant Ways in Science," p. 143, &c.

GOLD IN INDIA.

[491]—"J. S." will, I trust, excuse my answering his question from second-hand information, desirous as he is particularly to obtain the opinion of some one who has been out in India. At present, I am afraid, he will have difficulty in obtaining reliable information on the subject, for Professor Ball is himself rather puzzled owing to the conflicting nature of the evidence as to the extent of the auriferous character of the quartz reefs of India. The opinion, however, of a gentleman who—to use his own words—has done more work (mining) in India than anyone else, besides having had over twenty-five years' experience in Australia and New Zealand as a gold-mining engineer, and of whom Professor Ball has said, before a meeting of the Society of Arts, "As far as we know of him (Mr. H. A. Severn) by reputation, he was a gentleman distinguished from others, who must have reported (*i.e.*, prospects of gold mining) absolutely against their consciences," may be valuable to "J. S."

For fear of taking up too much of the Editor's space, I leave out Mr. Severn's account of the great difficulties encountered by him in transporting mills, capable of crushing 500 tons of quartz per week, through the Wynaad district, which, he says, might not unfairly, be compared to the rough work of New Zealand; but I give nearly verbatim his account of the Indian quartz. Arriving out there he says, "I was much struck with the great similarity between the auriferous quartz of India and that which I have seen both in Australia and New Zealand; in fact, so far as I could see, the quartz we were to treat was, as nearly as possible, similar in every chemical respect to the best quartz in those countries. I have seen some very fine samples indeed in various parts of the Wynaad district, and several of the lodes were from 6ft. to 14ft. in thickness, with a heavy strike extending over several miles of country." He then proceeds to show the folly of those gentlemen "styling themselves mining engineers," who, seeing a speck of "surface gold in quartz," pound it up, &c., and base all their calculations from that speck; and he then says truly, that "what we want, which will take, I believe, another eighteen months, is to get 500 ft. below the mean level of the country, and there pick up the quartz lodes. I am as certain of getting payable gold in India as I was in working some of the mines in New Zealand. . . . . As a practical man, I can hold out great hopes; but we must get to a greater depth than we are at present working." "J. S." will see from the above, that to really obtain a satisfactory answer to his question, it will be necessary to wait for another year, until the depth of 500 ft. has been reached by the miners. Knowing Mr. Severn personally, I am able to fully bear out Professor Ball's high opinion of him.

F.C.S.

LOCAL WEATHER LORE.

[492]—From time to time I see letters in KNOWLEDGE which indicate that considerable general interest is taken in the subject of weather forecasting. You will therefore, perhaps, be able to find room for a word about a matter intimately connected with that subject.

In a letter printed in the *Times*, and which, I think, was quoted in KNOWLEDGE, I attempted to show where our present system of weather forecasting is defective. The method pursued is wrong in principle, and accordingly it yields unsatisfactory results. If practical proof of what is theoretically evident be wanted, it is only necessary to point to the fact that of the forecasts issued from the Meteorological Office, those for London and neighbourhood are the most accurate, those for the rest of England much less so; while those for Scotland are too often but bad guesses. This does not argue any want of skill on the part of the great Victoria-street functionaries. It only shows that their system is faulty; and it further indicates where the imperfection lies. Weather forecasts, to be as accurate as possible, must be framed by *local* observers.

Let me, very briefly, explain how the daily forecasts are made. At certain hours, at certain stations throughout the British Isles and north of France, certain observations are made. The results are telegraphed to the office in London. By charting the particulars thus obtained, the official in London has a bird's-eye view, so to speak, of the state of the barometer, the temperature, the wind, and the weather prevailing over the British Isles at that particular time. From the chart he infers the presence or approach of a cyclone, or the existence of an "area of high pressure," called an anticyclone. He has then all the available data upon which to base his forecasts. Let us look at one or two of the chances of error. Suppose there are indications of an approaching disturbance to the west of Ireland. The barometer there is falling, the wind is S. and rapidly increasing in force, dense masses of cloud are coming up before the wind. Now, we know what kind of weather characterises, as a general rule, each part of the cyclone, and it would not be a very difficult matter to predict what weather would prevail at the places which are about to be encountered by those different parts; but in order to do so, it is essential for us to know the *size* of the disturbance, the *direction* of its motion, and the *rate* of its progression, and those are precisely the particulars which we can't get. The forecaster only knows that a disturbance is approaching, and he must guess all the rest. Then take the case of an anticyclone. If the forecaster has to trust in great part to luck in founding predictions on a cyclone, he has to trust altogether to it when an anticyclone lies over the country. Anything whatever in the shape of weather might very well happen within an area of high pressure, so long as this little disturbance is of local dimensions. Thus it might rain at one place, hail at another, blow at a third, thunder at a fourth, and so on, all without producing the least effect upon the "area of high pressure." It is seen, then, how largely guess-work enters into the calculations of our weather-prophets.

Situated as we are, with about 2,000 miles of ocean in the quarter from which nearly all our disturbances come, this can never well be otherwise. The particulars of extent, direction, and rate of progression, which are so necessary, we cannot hope to obtain with any degree of precision; and so long as they are wanting, forecasts can never be aught but unreliable.

I come now to the other class of weather-phenomena, with which it is the more immediate object of this letter to deal, namely, phenomena related in some way to the circumstance of *place*. And I may say, to begin with, that while, when an area of high pressure is over the country, the weather is *entirely* the result of local agencies, a cyclone may also be locally *modified* by the same factors: so that in reality local meteorology occupies a far more important place than has hitherto been assigned to it.

This letter is already so long that I must refrain from entering into the subject of local weather. What I wish more particularly to point out is, that local meteorology rising in the scale of importance, local weather-lore, which embodies the observations and experience of generations respecting the phenomena peculiar to localities, must rise with it, and that such folk-lore, if carefully collected, would form an invaluable adjunct to the weather chart in framing forecasts. Although I am no believer in the existing administration of the Meteorological Office, I can quite well see that great difficulties stand in the way of the adoption of what Mr. Scott himself holds to be the best system, *i.e.*, the supplementing of the London forecasts based upon general laws by the experience of local officials; but if that plan be impracticable in the meantime, is it not possible to have the weather at each observer's station described in sufficient detail to enable a meteorologist in London, with a topographically-arranged book of weather-wisdom before him, to make at least a better guess at the approaching atmospheric conditions than he otherwise could? Here, again, there is the difficulty presented by the very sparse distribution of observers, but notwithstanding that, I believe some such plan as I have suggested would materially improve the forecasts.

In conclusion, I may say that any of your readers who may come across weather-saws of purely local application, would oblige me by sending them to me (together with the name of the district to which they apply), as I purpose compiling a book of weather folk-lore, arranged according to localities, as soon as I can find time.

J. A. WESTWOOD OLIVER.

HAIR TURNING WHITE.

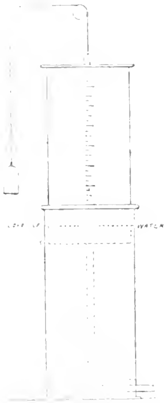
[493]—I can supplement the experience of "W. E. F." (letter 484, p. 133) by an [illegible] case of my own. Three years ago I lost an entire estate through a fraudulent agent. This involved a most serious reduction in my establishment; the discharge of servants, putting down carriages, &c., and caused me the most terrible anxiety. I could not sleep for many nights, and, as the result, my hair, which before my trouble was of a dark brown, turned in about ten days as grey as that of a badger. It has never regained its colour up to the instant at which I write. W. N.

TRICYCLING.

[494]—In a recent deliverance on the subject of Tricycling, Dr. B. W. Richardson, he emphatically condemned its practice by persons suffering from hernia. I believe that a tolerably reliable estimate places the proportion of ruptured subjects of [illegible] at one in five or one in six, and as the vast majority of these persons are not disqualified thereby from partaking in most kinds of field sports and exercise, it may be useful to enquire why tricycling in particular should be considered pernicious. Some evidence upon this point, based upon actual experience, would be more satisfactory than a mere medical dictum. E. A. H.

AN INSPIROMETER.

[illegible] of your papers on "How to get Strong," [illegible] the "Inspirometer" have been numerous. [illegible] a simple kind of "inspirometer" [illegible] the pleasure of reading the first paper [illegible] drawing shows its construction.



[illegible] the one—15 inches long—sliding [illegible] inches in length. Each of them has a [illegible] larger cylinder is soldered in about one [illegible], when placed "on end" on a table, the [illegible] from top to bottom *inside* is the same, viz., [illegible] leaving the end of the larger cylinder one [illegible] allow space for a ½-inch block-tin tube, [illegible] the cylinder, along under the bottom, [illegible] the centre of the bottom into the interior, [illegible], terminates about half-an-inch from [illegible]. The cylinder is filled with water up to [illegible] the table and the smaller cylinder is then put in [illegible] the larger one; it would, of course, sink [illegible] own weight, pressing out the air through the tube; [illegible] to the end of a cord, which, passing over a pulley, [illegible] other end which keeps it just balanced. I apply [illegible] other end of the tube and draw the air out of this [illegible] descends according to the quantity of air [illegible] into my lungs, and that quantity is shown by [illegible] of the moving cylinder, forming a register of [illegible] (the figures) descend.

[illegible] serves the purpose as well as any [illegible] elaborated machine.

[illegible] with the communication, but if I am [illegible] your attention, pray excuse me, as [illegible] familiar to you, called the "waste [illegible]." Yours very respectfully,

[illegible] 1882. AMICUS.

[illegible] CONSUMPTION.

[illegible] of phthisis in men or [illegible] tobacco-smoking. [illegible] they live, and to [illegible] the life of woman [illegible], whilst a smoker, I had [illegible] to breathing through [illegible] and always use my nose for [illegible] from colds. I will [illegible] smoke as it was [illegible]

JOHN ALL[illegible] OLLARD, F.R.M.S.

Answers to Correspondents.

**** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded, nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

FACIFIAT. Suggestions forwarded to author of those papers. Many thanks. Glad the look of Volume 1. pleases yon.—CUPIDUS COGNOSCERE. Thanks for extract from recent number of *Tit-Bits*: "Prof. Proctor says the sun never lacks a supply of fuel, and that it will retain its energy and perpetuate its beneficent work eternally. We breathe easier now. An impression has got abroad that the sun would burn out in 17,000,000,000,000 years." This joke promises to last about that time. The passage appeared first in an American paper, nearly ten years ago. (2.) You ask, Who is Prof. Proctor? In 1873, about Oct. 6 (having sailed from Liverpool on Oct. 4, and been sick and sorry in the interval) I was first addressed as Professor Proctor by American fellow passengers; and thenceforth, I have been usually so denominated in America and by Americans. They mean it pleasantly, and I like them too well to object,—though I have repeatedly explained to them that not only have I never been a professor, but I have never been a candidate for any professorship, and have on four distinct occasions declined professorships offered to me,—three, on very generous terms, in America (I have a presentiment I shall one of these days accept one of these tempting offers), and one in this country—the Professorship of Astronomy and Mathematics at the Catholic University, Kensington. Thus I am so emphatically non-professorial that I might almost be called anti-professorial. (3.) You ask, What is the meaning of the statement about the sun? There you are "too many for me." I have not the least idea. TRIA. I refer to periodic changes of the major axis in length, not to variation of the epoch, or to effects of ether. A. BRITLAND would like to know the date and place of the death of Edward Simpson, known as Flint Jack, the ingenious forger of fossils, flint implements, and Roman antiquities. Perhaps some reader can tell him? TARANAKI. Thanks. Correction forwarded to writer of those articles. J. F. SIMPSON. The trouble is as to space; the readings for one place only would be of little use, and not harmonise with the maps. On the other hand, to give two registers daily, fourteen weekly for each datum registered, for a score or so of places, would take much space. Will, however, think of the suggestion.

F. C. S. The subject of your plan is a little outside our purpose. GRADATIM. (1) You are right. Huxley's statement that the difference between the sidereal and mean solar day proves the earth's revolution is erroneous. It proves only the sun's westwardly motion (along the ecliptic); that this is not due to a real motion of the sun requires independent demonstration. (2) The other mistake about longer axis of ocean ellipsoid pointing moonwards has been repeated so often that one can hardly wonder at its not being corrected in the astronomical parts of a book by a non-mathematical writer. Airy's geometrical proof of the real nature of the tidal motion may hereafter find space here. (3) I do not remember such a passage in Newton's works. I suppose he noticed that as the surface of the water in a bucket at the pole would be paraboloidal, with a definite focus to which light rays would be reflected, there would not only (theoretically) be proof of the earth's rotation, but the means of measuring its rate. The idea is a pretty one. I would suggest substituting mercury, as water at the pole would probably freeze—so, indeed, would mercury, part of the time. TRIA. After getting $s = -\log(1-t)$, you proceed "if $t=1$, $s=-\infty$; ought it not to be $+\infty$?" Decidedly it ought; and it is. For since $\log.(1-t) = -s$, we have $(1-t) = e^{-s}$; whence when $t=1$, $e^{-s}=0$, $\therefore e^{s}=\infty$. Wherefore $s=\infty$. G. G. BRAZLEY. Many thanks; have forwarded your note to the publishers. SUNDEN. (1) You should have referred to number, page, and column. I certainly have not told you that the apparent size of a cloud can vary while its distance (from observer) remains the same. (Distance from earth, perhaps.) I do not remember answering about any such subject. (2) What *can* you mean by saying that I "seem to lose no opportunity of exhibiting," &c., &c.? Where has any such feeling been shown *once* even in these pages? If you choose to regard every scientific statement which you cannot reconcile with "&c.," as an exhibition of "&c., &c.," that is not my fault. But you should not misrepresent matters. For my own part, I find readers like yourself lose no opportunity of exhibiting *their* views about &c., &c. (3) The theory you refer to is preposterous; it is also an old one, long since disposed of. G. ST. CLAIR. How can I give any opinion about your theory till I know what it is? From your seeming to regard apparent proximity to the sun as evidence of real proximity, I feel doubtful as to your power to solve what astronomers have long regarded as one of the most perplexing problems presented to them. But all things are possible. Thanks for pamphlet.—J. A. OLLARD. It never occurred to me to add a likeness of "the editor" to Vol. I. Whenever I see my likeness (?) in magazines, &c., I find myself saying (with the little old woman of nursery fame) "Sure this isn't I?"—H. F. W. I know of no scientific men who believe in lunar influence on the weather. Many sailors and agriculturists do, just as many confirmed card-players believe in all sorts of absurdities about luck. Odd coincidences, not directed by systematic observation, suggest these false and fanciful notions. Not one of the regular moon rules has ever stood a year's steady testing. T. A. That water may be decomposed by electricity is well known; but that when large masses of cloud are charged with electricity the water in the cloud is so decomposed is not known, and that the atmosphere around such a cloud comes to contain hydrogen and oxygen in the right proportions for explosion is altogether impossible. Even as an acoustic phenomenon, it is only possible to explain thunder as produced by the electric discharge as—in less than the thousandth of a second—it traverses many miles of air. I share your admiration for a thunderstorm; and I doubt whether there is the slightest appreciable increase of danger when we enjoy the grandeur of the storm instead of shrinking into backrooms or cellars. In most cases, too, death by lightning is absolutely painless. The flash is not even seen; for the optic nerve takes hundreds of times longer to carry to the brain the news of the flash than the flash takes to destroy life throughout the whole body. AN EDINBURGH SUBSCRIBER. In this number appears an account, illustrated, of an inspirometer invented and described by a correspondent.—H. ASKEW. You are among those to whom an apology is due for long-delayed reply. M. Pasteur is unquestionably a believer in evolution, and recognises the truth of the Darwinian theory as to one of the chief factors in evolution. Probably whoever cited him as an opponent of Darwinism, supposed Darwinism and atheism to be synonymous terms, which, of course, is utterly absurd. There is nothing atheistic in the modern doctrines of evolution any more than there is in the older doctrines. The argument of the narrow-minded runs thus:—"*I* cannot believe in a Deity if I believe in evolution on the large scale, though my faith is not shocked by the growth of a plant or an animal; modern men of science *do* believe in evolution on the large scale, therefore modern men of science are atheists." From this bad logic may be obtained the following syllogism in relation to Pasteur:—

Believers in evolution are atheists.
Pasteur is not an atheist.
∴ Pasteur is not a believer in evolution.

But Pasteur is a believer in evolution, and Pasteur is not an atheist; nay, Pasteur finds himself led to reject atheism, chiefly because he recognises the infinity of the domain of evolution. The God of science, in fine, is Almighty and All-wise: shallow-brained, slope-browed men, of the street-preacher type, therefore denounce science as atheistical, and instead of saying, "I believe in God, Father Almighty, Maker of Heaven and Earth," they din into our ears their wearisome "Thou shalt believe in *my* God," that is, in a God fashioned after their own image. The less cannot contain the greater; no human brain can conceive what God is; science in considering even the least of His works has come upon the unfathomable; but those least of all can conceive of God aright, who praise as God the Idol they have fashioned from their inner selves. Their pretended zeal against science is, in reality, anger at the contempt which Science feels for the puny wooden idol they have made out of their feeble brains. Yet suppose they are honest enough, though blind—or, at the best, bat-eyed. G. A. STOREY. Later, lathe work may come in for treatment. Just now space forbids; but many thanks. NEMO wants to learn how looking-glasses are silvered.—JOHN GREENFIELD. Yes: Laplace and Lagrange proved that the planets, so far as gravitation is concerned, may continue moving round the sun for ever. That is very different from saying the universe can last for ever. Your own communication showed that you referred to heat and lighting as well as movement. I am conscious of no irresistible influence causing me to object to "solar rays moving in circles in space." I know only that, so far as telescopic vision has extended, rays of light and heat go straight. Surely it was not very severe to say of a speculation involving the working round of sun-rays in enormous circles that it is rather vague. How large are these circles? In what planes do they lie? Whereabouts are their centres? What turns the rays from their straight course? Why does it make them work in circles and not in some other curves? When they have worked back, why should we not catch them coming that way towards the sun instead of always seeming to come from the sun? Such are a few of the questions which occurred to me as I wrote the words, "rather vague."—W. B. WICKEN. Thanks; but luminous paint is not available for presswork at 74 & 75, Great Queen-street. Will insert your other letter on tobacco and consumption if can find room; but already, before the last fortnight's letters even touched, we had five or six pages of correspondence standing over. C. C., JUN. I do not know why gooseberry jelly changes colour during the second boiling. Some reader may be able to tell us. A. SMITH. Your remarks about Great Pyramid too vague for any use. I hear with interest that Prof. Piazza (usually called Piazzi-Smyth) has disproved the tomb theory for the Great Pyramids. That he had tried to, I knew; that he had done so is news indeed. For one who writes rather dogmatically (though you rather condemn the Pyramidalist's coincidences than any I have insisted upon), your other question is rather mild. Have you really been "bothered a great while" by the difficulty of finding the vertical angle of a cone formed from a sector of given angle? Let r be the radius (which will presently disappear), a the angle of the sector, which may be anything short of 2π, then the arc of the sector is ra, and as this forms the circumference of the base of cone, we have radius of base $= r\frac{a}{2\pi}$. Now the slant side is r. Hence the sine of half the vertical angle, which of course is (radius of base) ÷ (slant side) $= \frac{a}{2\pi}$; so that, knowing this ratio, and expressing it as a decimal fraction, you can at once obtain from a table of natural sines the semi-angle of the vertex.—W. W. The points of the compass marked in my monthly star-maps have relation to the earth only. The star-map shows what stars lie to the north, east, south, or west of a terrestrial observer; which stars high up, which low down, and so forth. The maps tell nothing of the position of the earth in space. Your "plane of the heavens" is fully as mysterious as your "celestial compass." If you ask towards what point on the star sphere the earth is moving at any time, I can answer. The earth is always moving towards that point on the ecliptic which lies 90 degrees (or one quadrant) behind the place of the sun at the moment. Thus on or about June 20 the sun is 90 degrees in longitude from the first point of Aries. At that moment, then, the earth is travelling towards the first point of Aries. "Whitaker's Almanac" (a most excellent work) and any star-maps showing the ecliptic and marking the longitude along it (as my "Library Star Atlas," for instance, or the smaller "Star Atlas") will serve to indicate the point towards which the earth is at the moment travelling. Thus at the hour of writing, July 22, at about noon, "Whitaker's Almanack" (p. 42) shows that the sun's right ascension is 8h. 6m. 43s. Turning to one of my atlases, I find this point to be very near the first point of Leo, marked in the map with a lion's tail and also with the number 120 degrees. (This is in Map VI.) Going back 90 degrees along the ecliptic, which, as the border numbers show, carries us to Map IV., and thence into Map II., I find that the earth is now travelling towards a point of the star-sphere near the first point of Taurus, lying near the place where the three constellations, Aries, Pisces, and Cetus, meet. W. WILSON, LL.D., &c. I cannot at the moment find a passage I noted in which Mitchel (not Mitchell?) confounds the parallelogram of velocities (a kinematical law) with the parallelogram of forces (a statical) law. But in looking for it, I came (at p. 135 of his "Orbs of Heaven") across a passage where he confounds the latter with the second law of motion (a dynamical law). His account of the so-called centrifugal force on p. 137 is as unsound as Joyce's. The supposition of two forces mutually destroying or counterbalancing each other, where in reality there is but one force causing the body to deviate from the straight line on which it is travelling and would otherwise continue to travel, is essentially unsound. The account of Newton's demonstration of the law of gravitation is full of mistakes. The account of pendulum experiments for showing that the force of gravity is exerted by all the particles of the earth's globe (pp. 148 and 149) is altogether misleading,—utterly valueless in fact; while processes of demonstration, the most effective proofs, are left entirely unnoticed.—W. M. I rather like the idea of a paradox column. The showing of paradoxers' absurdities serves some useful purposes. I have often noticed that the misapprehensions which cause a Newton Crosland, a Hampden, a Parallax, and such folks to rush forth into new and nonsensical theories, are not uncommon, though without leading to so preposterous a result, among many well-educated persons, who have studied scientific matters insufficiently.

W. G. We cannot well do sums, so many are sent us, and many times as many would be sent if we worked all. Then those you send are so elementary. With regard to the last, involving a difficulty, note that the equation $(1-x)^{-1} = 1 + x + x^2 + x^3$

[illegible] regard [illegible] series on the right is [illegible] It [illegible] greater than unity. The real [illegible]

$$\frac{1}{(1-x)} = 1 + x + x^2 + \ldots + x^n + \frac{x^{n+1}}{(1-x)}$$

[illegible] neglected when x is less than 1 and n [illegible] large, but can by no means be neglected when [illegible] 1. For instance, when $x=2$, this equation [illegible]

$$\frac{1}{1-2} = -1 = 1+2+4+\ldots\ldots+2^n-2^n$$

w[illegible] exceeds in absolute value by unity all the other t[illegible] JESSE BOYCE. Not the ellipticity alone, [illegible] of sun's path to ecliptic explain the [illegible] so-called equation of time. It is not [illegible] the [illegible] without diagrams. May one of [illegible] for an illustrated account in these columns. [illegible] G[illegible] explanation of the tides to which you refer, [illegible] given not only by Mr. Chambers and others n[illegible] by Mr. Christie, the Astronomer Royal, — is [illegible] compared with *this*, as an explana[illegible] inclined top. "Gravity acting on [illegible] to topple over," the thing to [illegible] top does *not* topple over. O[illegible] good subject for a future paper [illegible] K[illegible] Time and Tide wait for no [illegible] wait for time. Just now we are tied [illegible] W. C[illegible] T[illegible]. Thanks; will try to find r[illegible] S[illegible] of *that* sort has done more to f[illegible] credulity. Take mesmerism [illegible] nothing in the phenomena observed, [illegible] the credulous accept pretty [illegible] sceptic runs about proclaiming th[illegible] shown that unmistakably there is [illegible] for [illegible] runs about proclaiming, just as [illegible] the absurdities claimed by professional [illegible] If you w[illegible] to be led astray by the untruths [illegible] Thought Reading, do not mislead yourself by th[illegible] nothing to be explained. Men [illegible] who have done more than any [illegible] tricksters, in psychological and so[illegible] much more safely followed in what [illegible] quote in what (knowing nothing) [illegible] encouraged a spirit of *Incredulity*, [illegible] place among the virtues. Show [illegible] and I will show you (without [illegible] to be most thoroughly de[illegible]

Our Mathematical Column.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

No. V.

By RICHARD A. PROCTOR.

IT may be well to apply the method already used to determine the differential coefficient of $\sin x$ to the other simple trigonometrical functions; for not only does the method indicate well what [illegible] coefficient is, but as all these functions are dealt with [illegible] way, the memory is aided to retain all their differential c[illegible]

As [illegible], we use the circular measure for angles, and regard radius [illegible] unity. The construction of the figure is obvious.

Put arc A[illegible], Bb [illegible] Δ[illegible].

Then we have seen that [illegible]

[illegible]

[illegible] Δ [illegible] B[illegible] B[illegible] [illegible] Δ [illegible] Δ[illegible] are both indefinitely [illegible]

$$\frac{lB}{Bb} = \frac{[illegible]}{OB}$$

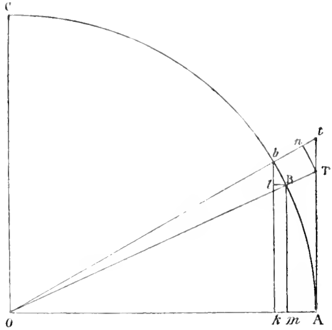
[illegible]

[illegible] AT [illegible] T [illegible] O [illegible] centre. [illegible] $(x+\Delta x)$ [illegible] A − TA [illegible]

$$\frac{\Delta y}{\Delta x} = \frac{[illegible]}{[illegible]} = \frac{T[illegible]}{T[illegible]} \cdot \frac{T[illegible]}{B[illegible]} \cdot \frac{TO}{BO}$$; and when Δx and Δy are both indefinitely small, we have $\frac{Tt}{Tn} = \frac{OB}{On} = \sec x$;

and $\frac{TO}{BO} = \frac{TO}{OA} = \sec x$. So that when

$$y = \tan x, \quad \frac{dy}{dx} = \sec^2 x = \frac{1}{\cos^2 x}.$$



When $y = \cot x$, we have a precisely similar construction, but we may here conveniently use the same construction which has given us $\tan x$ to give us $\cot x$. For this purpose we set OC at right angles to OA and call the arc Cb, x; and bB, Δx. Then we get At for $\tan x$ and AT for $\tan(x+\Delta x)$. So that we have the same difference Tt, only in this case it is a diminution instead of an increase. We have also, $\frac{TO}{BO} = \frac{TO}{OA} = \sec BA = \text{cosec}\, CB = \text{cosec}\, x$ (when Bb vanishes). Hence

when $y = \cot x$; $\frac{dy}{dx} = -\text{cosec}^2 x = -\frac{1}{\sin^2 x}$.

Next take $y = \sec x = OT$. Then

$\Delta y = \sec(x+\Delta x) - \sec x = Ot - OT = nt$

$\therefore \frac{\Delta y}{\Delta x} = \frac{nt}{Bb} = \frac{nt}{Tn} \cdot \frac{Tn}{Bb}$; and when Δx and Δy are both indefinitely small, we have $\frac{nT}{Tn} = \frac{AT}{OA} = \tan x$; while $\frac{nT}{Bb}$ as before $= \sec x$. So that, when

$$y = \sec x; \quad \frac{dy}{dx} = \tan x \,.\, \sec x = \frac{\sin x}{\cos^2 x}$$

And similarly, calling COb, x, as in dealing with cot., we find when

$$y = \text{cosec}\, x; \quad \frac{dy}{dx} = -\cot.x\ \text{cosec}\, x = -\frac{\cos x}{\sin^2 x}$$

The student should have the differential co-efficients of the six simple trigonometrical functions at his fingers' ends, as they are constantly wanted. The six functions are here collected into the three which have positive differential coefficients (for arcs less than a quadrant), the sine, tangent, and secant; and those which have negative differential co-efficients, the cosine, the cotangent, and cosecant.

If $y = \sin x$; $\frac{dy}{dx} = \cos x$	If $y = \cos x$; $\frac{dy}{dx} = -\sin x$
$y = \tan x$; $\frac{dy}{dx} = \frac{1}{\cos^2 x}$	$y = \cot x$; $\frac{dy}{dx} = -\frac{1}{\sin^2 x}$
$y = \sec x$; $\frac{dy}{dx} = \frac{\sin x}{\cos^2 x}$	$y = \text{cosec}\, x$; $\frac{dy}{dx} = -\frac{\cos x}{\sin^2 x}$

Let us next try the inverse trigonometrical functions, and see whether they admit of similar treatment.

Take $y = \sin^{-1} x$. Then in our figure we may represent y by arc BA, whose sin is Bm, so that Bm represents x.

Thus $y = BA$ $\quad x = Bm$

Put $bl = \Delta x$ so that $(x+\Delta x) = bk$

Then $\Delta y = \sin^{-1}(x+\Delta x) - \sin^{-1}\Delta x$

$= \text{arc}\ Ab - \text{arc}\ AB$

$= Bb$

$\therefore \quad \frac{\Delta y}{\Delta x} = \frac{Bb}{bl}$. Now when Δy and Δx are both indefinitely small $\frac{Bb}{bl} = \frac{BO}{Om} = \sec\ y$. Hence when $y = \sin^{-1} x$; $\frac{dy}{dy} = \sec y = \frac{1}{\sqrt{1-\sin^2 y}} = \frac{1}{\sqrt{1-x^2}}$.

Applying a similar method for the other simple inverse functions, we find—

$$\text{If } y = \cos^{-1}x \; ; \; \frac{dy}{dx} = -\operatorname{cosec} y = \frac{-1}{\sqrt{1-x^2}}$$

$$\text{If } y = \tan^{-1}x \; ; \; \frac{dy}{dx} = \cos^2 y \quad = \frac{1}{1+x^2}$$

$$\text{If } y = \cot^{-1}x \; ; \; \frac{dy}{dx} = -\sin^2 y = \frac{-1}{1+x^2}$$

$$\text{If } y = \sec^{-1}x \; ; \; \frac{dy}{dx} = \frac{\cos^2 y}{\sin y} \quad = \frac{1}{x\sqrt{x^2-1}}$$

$$\text{If } y = \operatorname{cosec}^{-1}x \; ; \; \frac{dy}{dx} = -\frac{\sin^2 y}{\cos y} = \frac{-1}{x\sqrt{x^2-1}}$$

The student will find no trouble whatever in obtaining any of these results. He will find in every case, on making the geometrical construction (or examining that already made, for the figure illustrates all the cases) that the value of $\frac{\Delta y}{\Delta x}$ in the case of an inverse function is the reciprocal of the value of $\frac{\Delta y}{\Delta x}$ in the case of the corresponding direct function. For instance, in dealing with $y = \sin^{-1}x$, we found $\frac{\Delta y}{\Delta x}$ to be $\frac{Bb}{bl}$, whereas in dealing with $y = \sin^{-1}x$, we found $\frac{\Delta y}{\Delta x} = \frac{bl}{Bb}$. This was to be expected, when we consider that to say $y = \sin^{-1}x$ is the same as to say $x = \sin y$, so that x and y are simply interchanged, in passing from the consideration of a direct function to the consideration of the corresponding inverse function. Nevertheless, it would not be sound at this stage of our inquiry to determine $\frac{dy}{dx}$ from this consideration only. We shall hereafter show under what limitations it may be assumed that $\frac{dy}{dx}$ is the reciprocal of $\frac{dx}{dy}$. At present we have to regard $\frac{dy}{dx}$ as a single expression. It is derived from $\frac{\Delta y}{\Delta x}$ by supposing Δy and Δx to diminish indefinitely. Now, when Δy has any definite value, and therefore Δx a definite value, it is of course true that $\frac{\Delta y}{\Delta x}$ is the reciprocal of $\frac{\Delta x}{\Delta y}$; but we must not assume that *of necessity* the value to which $\frac{\Delta y}{\Delta x}$ tends with the indefinite diminution of Δy and Δx is the reciprocal of the value to which $\frac{\Delta x}{\Delta y}$ tends under the same conditions. This would be assuming that we can treat dx and dy as themselves definite quantities, whereas they are in reality indefinite, though they bear to each other a definite relation. It would matter very little so far as the dx and dy of the simple $\frac{dy}{dx}$ are concerned, that we should treat these as separable quantities; but as we advance with the calculus we find occasion to differentiate differential coefficients, and we are led to the use of such forms as $\frac{d^2y}{dx^2}$, $\frac{d^3y}{dx^3}$, &c.; and it would be altogether inadmissible to regard dx^2 and dx^3 of these expressions as if they were the square and cube of the dx in the expression $\frac{dy}{dx}$.

Of course when, after starting from, say, the statement

$$y = \sec^{-1}x$$

we find $\frac{dy}{dx} = \frac{\cos^2 y}{\sin y}$, it is easy to express this result in terms of x: for we have $x = \sec y$. So that

$$\cos y = \frac{1}{x} \text{ and } \sin y = \sqrt{1-\frac{1}{x^2}}$$

I might here give some examples illustrating the application of the differential calculus—with the coefficients already determined—to various problems of interest. But it will be well first to get over so much elementary ground as is involved in the determination of rules for differentiating all expressions whatever. For then we can take a much more varied range of examples than we could by limiting ourselves to the application of what we have already learned. It is seldom in physical questions that we are limited to simple trignometrical functions, and we could scarcely advance half-a-dozen steps without feeling the necessity of rules for finding the differential coefficients of complex functions and functions of functions. Indeed we should have found the use of such rules in simplifying what we have already done, only that it seemed well to have a few examples of the process of obtaining a differential coefficient directly. Otherwise when we had to consider, say, $y = \sec x$; we might have regarded y as a function of $\cos x$, and proceeded from $y = \frac{1}{\cos x}$ to write down the differential coefficient. Again we might have written, for $y = \tan x$

$$y = \sin x \, . \sec x$$

and at once written down $\frac{dy}{dx}$, if we had the rules, which I shall proceed to examine and establish (as far as is necessary in such elementary papers as these) in my next. Then we can proceed to discuss a few problems which will not only show the great value of the calculus, but also illustrate the real meaning of what we have thus far done.

I may, however, here pause to note that the reader must not allow himself to be mystified by the use of such an expression as differential co-efficient, a term which might seem expressly devised to deter the young mathematician from the study of the calculus, as implying that it cannot possibly be of any practical use, at any rate, in simple problems. For what idea of utility does the expression "differential co-efficient" convey? and why should an expression be employed really belonging to a matter with which elementary applications of the calculus are in no way concerned?—the expansion of sundry functions in the form of series, of which what we are calling the differential co-efficient is one of the co-efficients. What the young student has to bear in mind is that what (to avoid the invention of new terms) we call the differential co-efficient is in reality a quantity indicating the rate at which whatever function—simple or complex—we want to deal with, changes with the change of the variable it involves. When we consider how many problems depend on such changes and cannot possibly be dealt with unless we can determine their effects and limits, the importance of a calculus devised for this purpose will be at once obvious. We shall very soon be able to show this, for we shall very soon have completed our inquiry into methods by which the rate of increase of any quantity whatever, as its variable increases, can be determined.

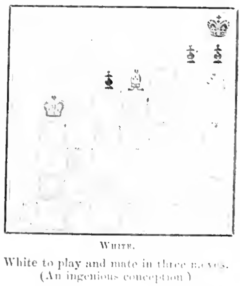
Our Chess Column.

BY MEPHISTO.

PROBLEM No. 48.

BY H. A. N.

BLACK.



WHITE.

White to play and mate in three moves.

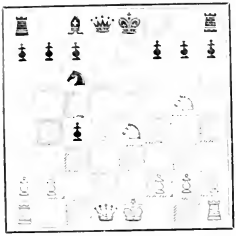
(An ingenious conception.)

GAMES BY CORRESPONDENCE.

([illegible] p. 138)

P[illegible] after Black 10th move, P takes B.—

BLACK (Chief Editor).



WHITE (Chess Editor).

W[illegible] pleased to find that our discursive games find favour w[illegible] readers. We have received several communications, [illegible] following letter, having reference to the line [illegible] our correspondent Leonard P. Rees:—

"R[illegible] Diagram, you suggest that 10. B to B4 is Black's [illegible] reply, and that if White ventures 11. Kt takes BP he w[illegible] followed by 12. Q to B3, likewise suggested by [illegible] E[illegible]. But suppose after

11. Kt takes KBP	11. K takes Kt
12. Kt to Kt3	

[illegible] see that White need lose a piece, although after

	12. P takes B
13. Kt takes B	13. KR to Ksq(ch)
14. Kt to K3	

Black can win a Pawn,

	14. Kt takes QP
15. Q to R5(ch)	15. K to Ktsq
16. Castles Q side	

W[illegible] still have a good game. "W. T. PIERCE."

T[illegible] is quite correct, and we are thankful to our corre[illegible] for [illegible] help in our researches. White will soon regain the [illegible] and Black will have great difficulty in getting rid of the [illegible] the pinning of his Knight by the White Rook.

W[illegible] the original game.

B[illegible] 11. Q to K2.

[illegible] accompanying this move, Chief Editor remarks: "An [illegible] defence with K's file free of Pawns, but P to KKt3, [illegible] would doubtless be Q to R6 would leave me the [illegible] of defending KB3 with Queen alone from the in[illegible] backed up by both Rooks presently. I could [illegible] Pawn, still defending the threatened square; but this [illegible] matters worse, bringing his Queen's Rook at once into [illegible] of Queen [illegible]." White replied with

12. C[illegible] QR.

[illegible] best, as it brings the QR on Q's file, while the [illegible] K[illegible]. The answer was

12. B. to B4.

[illegible] of move, as it might enable Black to Castle [illegible] B protects the KRP; but Black is rather [illegible] move is, "Where is safety to be [illegible] a little [illegible] might have saved me, but now [illegible]. Possibly at move 10, instead of P takes B, B[illegible] Black's game safe." It must be borne [illegible] White [illegible] P to Q5 and Q6, &c. For that reason [illegible] would be of no avail, as Queen would play to R6. [illegible] P to Q5, for which a good deal might be said, [illegible] attacking line open, which Chess Editor [illegible]

13. Kt to Q6(ch)

[illegible] to give White a superiority, for if [illegible] K[illegible] 14. Q takes BP(ch) 14. K to Qsq 15. Q takes [illegible] K[illegible] Black [illegible] the Bishop. [illegible] no other reply

13. P takes Kt

[illegible] This followed by Kt to K4, and B to Kt3, when for a moment a white Pawn occupies his King's file, seems the best course. But very bad is the best."

14. KR to Ksq	14. Kt to K4

with the following note by Chief Editor:—"Probably it would lead to a more prolonged defence to take the Rook, although the odds in force against Black would not be great, and his power of developing his game somewhat increased. Such a course against Mephisto would be equivalent to resigning at once." As after Q takes R White will retake with a check, that course would be very unsatisfactory, as this would be followed up by either Q takes BP or Kt takes BP in both cases White would win at least another piece.

15. P takes Kt	15. B to Kt3

We certainly think that Black could have minimised White's advantage by Castling KR; moreover, the black Pawn on B5 which might be supported by the QR, would have become troublesome. Black, however, did not avail himself of this opportunity for turning the tables on White, but played

15. B to Kt3

to which the reply was

16. P takes P	16. B takes Q
17. R takes Q(ch)	17. K to Bsq
18. P to KKt4.	

This move is more risky than QR to Ksq, which was, perhaps, White's simplest course.

18. B to Kt3.

B takes P would have been unsatisfactory on account of R takes BP (ch); but we think that 18. P to KR3 would have given Black a much better defence than the move in the text.

19. R to Q4.

With a covered design not, of course, to take the QP, but anticipating Black's next move

19. P to KR3.

20. Kt takes BP.

If now 20. B takes Kt then R to B4, with the prospect of getting both Rooks on the seventh file, which has rightly been called the "spot-stroke," and also the advanced QP. Chief Editor thereupon resigned.

ANSWERS TO CORRESPONDENTS.

, *Please address Chess-Editor.*

W. T. Pierce.—Thanks for communication. You had an obviously won game by Q takes BP, as you suggest in your letter.

Leonard P. Rees.—You are revenged by W. T. P.

J. P. Solution incorrect. If 1. B to K4. 1. B takes P. 2. Kt to Kt2. 2. B to B2. 3. Kt to B4(ch). 3. K to B4, and there is no mate.

Our Whist Column.

BY "FIVE OF CLUBS."

THE following game is so far artificial that only *B*'s hand was actually left on record, with the score, *A*'s first lead, and the result. At the score of "Three all" *B* must have felt absolutely sure of success; but why, being sure, did he not keep so, by playing the sure game? The case illustrates well the necessity of playing always to the score. The wild signalling of *B* after his mistake, his despairing appeals to his partner to do what *A* never has the chance of doing, are of course little touches thrown in to make the lesson more impressive.

THE HANDS.

A.

Spades—4.
Hearts—7, 5, 4, 2.
Clubs—10, 7, 5, 3, 2.
Diamonds—Kn, 7, 3.

B.

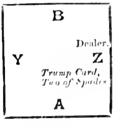
Spades—K, Q, Kn, 10, 9, 8.
Hearts—A, K.
Clubs—A, Q.
Diamonds—8, 5, 2.

Y.

Spades—7, 6, 5, 3.
Hearts—None.
Clubs—Kn, 9, 8, 6, 4.
Diamonds—K, Q, 10, 6.

Z.

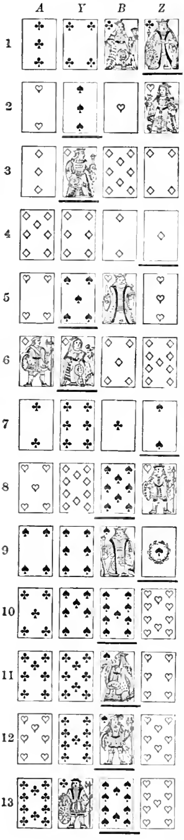
Spades—A, 2.
Hearts—Q, Kn, 10, 9, 8, 6, 3.
Clubs—King.
Diamonds—A, 9, 4.



Score:—{ *A*, *B*, = 3; *Y*, *Z*, = 3

THE PLAY.

NOTE.—The card underlined wins the trick, and card below leads next round.



REMARKS, INFERENCES, &c.

A properly leads the penultimate card of his long suit. *B*, finessing according to rule, and overlooking the fact that the case belongs to the exception, deliberately throws away the game.

2. *Z* leads Q, from Q, Kn, 10, &c. *Y* trumps, following Clay's rule not to pass a certain trick unless you see your way to making three by refraining. *B* begins to signal now that he has thrown away the game.

3 and 4. *Y* and *Z* begin to take their tricks in Diamonds, *B* signalling violently in a new suit.

5. *Z* properly forces his partner instead of leading a Diamond. *B* completes his signal in Hearts, naturally.

6 and 7. *Y* having made his Diamond Queen, leads a Club, as very likely to give *Z* a ruff. For *Y* had five Clubs originally, and *A* having led, has four at least. With trick 7 the game is won, whatever honours *B* may hold, for the Ace of trumps will make the necessary eighth trick. For the sake of symmetry we give the remaining rounds as they would probably have been played did the rules of Whist require that all thirteen rounds should be played.

This game illustrates forcibly the necessity of playing to the score. Had *B* played his Ace of Clubs first round, of course the game was won, as he held two by honours in his own hand, and five more tricks certain.

FORCING THE ADVERSARY.—The various ways men take to loose games are truly wonderful. We were looking on at Whist, a short time since, when we noted the following:—*A*, original leader, leads trumps (Clubs), *Z*, fourth player, wins the trick and leads Hearts. *A* has no Hearts, and discards a Spade. *X* wins the trick with the Heart King. He has now two trumps left, four good Diamonds with King, Knave; three Hearts with the Ace and two small Spades. He led a small Diamond. We do not care so much about the Diamond, although, to ordinary mortals it would appear that by leading the Diamond, *X* was leading up to *A*'s declared strength. A lesser light would have said to himself, "If, as I assume, *A*'s strength is in trumps and Diamonds, at any rate I can take care of the Diamonds." After the game was out, we mildly suggested that the Ace of Hearts would have been a strong card to lead, and we received the reply: "Yes, to have it trumped, I suppose, Mr. Clever." *X*, who in his own estimation is a very good player, thought the suggestion of leading the Ace to have it trumped a joke, or the wild invention of a lunatic. Yet we think that the Ace was a very good card to lead. Had *A* ever heard that a player is never too weak to force the strong hand? *X* lost the game by not forcing his adversary at the proper time, but *X* does not know that he lost the game, nor will he ever know it or believe it. The next hand *X* was punished, for he had one of the prettiest hands we ever saw. With Ace, King, Knave, and another trump, a hand full of court cards, but with two Hearts, the first force was got on *X*, and four long Hearts were got in against him. *X* certainly looked astonished, and we think he was, but whether he will ever believe that a force is of use or not we cannot tell. This we do know, he will never lead the Ace of Hearts to be trumped.—*Westminster Papers.*

ANNAMESE SUPERSTITIONS.—Consul Tremlett, in his trade report on Saigon and Cochin China for the past year, gives an interesting account of some of the superstitions which prevail in Annam. It is bad luck for a fish to leap on board a boat; the fish must be cut in two and thrown into the water again, half on either side. The capture of a porpoise is a very bad omen, for he is the messenger of infernal gods. The cries of a "Gecko," if odd, are lucky; if even, the reverse. A bird crying at night is always bad a presage of death, in fact. This, says Consul Tremlett, is infelicitous; for some birds of the country only cry at night and all night. The squeak of a musk rat announces visits. A cock crowing at noon foretells that the daughters of the house will not turn out well. The tiger is, of course, much dreaded, and the mention of him is interdicted in some districts. Sacrifices of pigs are made at least yearly, with a document attached, which is, or should be, exchanged by the beast for the one sent him the previous year; if the tiger omits this, it is a bad lookout for the village. However, it is all an affair of predestination, so it does not matter much. The water-buffalo is an imaginary animal living in rivers and only coming on shore at night; for all that, he is patent enough in the district, and uncomfortably curious towards Europeans. The Annamese have several kinds of talking-birds—commonly a starling or a raven, who looks after the property while the master is absent, and recounts what has passed when he returns. To meet a serpent in the road is a very bad omen, and whatever business is then in hand must be renounced. As for ghosts and spirits, they abound in Annam—always, everywhere, and of all descriptions.

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CONTENTS OF No. 40.

FOUND LINKS.

By Dr. Andrew Wilson, F.R.S.E., F.L.S.

(*Concluding Paper.*)

NOW, as regards the past history of the Mammalia, there exists abundance of evidence to show that many extinct quadrupeds stand in relation to these existing orders in the light of "intermediate forms" or "links." The recent researches of Professor Marsh amongst the American fossil mammals have been fraught with literally surprising results in this latter direction. Prior, however, to Marsh's discoveries, there were not wanting facts which pointed to the conclusion that the demands of evolution for links between the existing orders of quadrupeds would not be made in vain. Take for example the single order of the Whales. No more circumscribed and apparently distinct group of animals exists, yet their relationship to other orders of quadrupeds is no mere matter of conjecture, but one of proof. There is a fossil whale known as *Zenglodon*, found in Tertiary deposits, and so named from the peculiar double-nature of the molar teeth. Whales with such teeth are unknown to-day, and when the affinities of Zenglodon are examined, they are seen to point to a clear connection with the Seals and Walruses, belonging as we have seen to the *Carnivora.* It would thus seem as if the natural idea that the Seals and Whales were near relations was founded on fact; and fossil whales certainly tend to bridge over the gulf betwixt the two groups. But this case, powerfully as it argues in favour of the connected series of animals which evolution requires, is by no means solitary. We have long known, for example, of the *Anoplotherium*, an extinct quadruped, which presents in itself a curious mixture of the characters of Pigs and Ruminant animals, *i.e.*, those that "chew the cud," and comparative anatomists will tell us that the pigs and hippopotamus group themselves show, in many respects, an approximation to the Ruminants. Or to take yet another example from Cuvierian times, we find in the *Palæotherium* an animal which links the Tapirs to the Horses, and which shows a combination of characters that amply satisfies the evolutionist of its "intermediate" nature.

But the more recent discoveries of Marsh throw the foregoing cases into the shade in respect of the mass of material which that indefatigable palæontologist has accumulated. Thus we have been forced to constitute a whole series of new orders for the reception of the forms Professor Marsh has unearthed. What, for instance, shall we say of the extinct *Dinoceras* and its neighbours? These huge elephantine animals united in themselves the characters of Elephants, and of odd-toed "hoofed" quadrupeds. With limb-bones like those of Elephants, *Dinoceras* possessed teeth that exhibited a combination of the characters of carnivorous animals with those of "hoofed" forms. More extraordinary still were the *Tillodonts* from the Eocene rocks of the United States. Here are combined the features of hoofed quadrupeds (*ungulata*), *Carnivorous* animals, and *Rodents.* With a skull like that of a Bear, *Tillotherium* possessed front teeth exactly resembling those of the Rodents, or "Gnawers," and which appear to have combined to grow throughout the life of the animal, whilst the grinding-teeth were those of a hoofed animal. So, also, another group of extinct animals, of which *Toxodon* is the chief, presents us with a combination of characters mingling those of the "Hoofed" forms with those of Rodents and Edentates—such as the Sloths, Anteaters, &c.

As a final example of the curious "links" between existing forms, which may be found amongst the treasures disclosed by scientific inquiry, the curious "Flying Lemurs" (*Galeopithecus*) may be mentioned. These animals are found in the Eastern Archipelago, and resemble Squirrels in appearance. A curious fold of skin stretches from the sides of the neck to the fore limbs, and between hind-limbs and tail. The body is thus fringed, as it were, by a broad fold of skin, and although, unlike the bats, the flying lemurs do not possess true powers of flight, the skin-folds serve as a kind of parachute, supporting these animals in the air, as they take their flying leaps from tree to tree. In their internal anatomy these animals exhibit transitional features, and on the whole may be regarded as linking the Insectivora with the higher group of the Primates in which Man and Apes are included. Whilst it seems tolerably clear that the Bats themselves are merely Insectivorous animals which have undergone the modifications fitting them for true flight.

Such is a brief and meagre outline of the result of an incursion into the province of geology as that science relates itself to the past history of living forms. In concluding the series of papers on "Found Links," I may perhaps be permitted to add that the design of these articles will have been fully served, if they may in any way stimulate the personal inquiries of my readers into the great study of modern times, namely, that of ascertaining how the universe of life has been modified and evolved. Such a study is fraught with profit in more ways than one. The search after evidence in favour of or against Evolution necessitates an amount of inquiry which is certain to strew the observer's pathway with curious facts concerning every department of life science. Furthermore, the main question at issue is one which in reality underlies all our conceptions of life, and of the order of nature. It is the question which the best and wisest of mankind have ever asked and inquired of themselves—the How, Why, and Whence of this world and its belongings. Happy indeed are they who, in the spirit of earnest truth seekers, are permitted to engage in the work of discovering new facts and phases of the wondrous story of creation, which Nature is ever inviting us to peruse.

THE RELATION OF EXERCISE TO BRAIN-WORK.

RECENT numbers of the London *Spectator* have contained very interesting communications on this subject. Nothing like a general rule can be evolved from them, because individual temperament, employment, and circumstances create an endless variety of cases that no rule could cover. The more witnesses, however, the greater the chance that the inquirer will find a hint suitable to himself, and it is every one's experience that such hints often determine the happiness of a lifetime. The author of "The Duties of Women," a great believer in physical exercise, thinks that it "need not and cannot well be taken on the same days when the heavy mental work has to be done." Mind and body may best be strained alternately by days or by seasons. Especially does she hold that every woman should provide for some perspiring exercise—"a natural Turkish bath"—at short intervals. An Oxford man advocates pleasurable *change* as the chief element of recuperation, more important than the muscular exercise; for which reason he prefers horseback and bicycle riding to walking. His rule is—"One hour of some thoroughly good form of exercise every day, and every week several additional hours' 'change.'" Another contributor has "uniformly found that reducing the diet, and especially avoiding the too free use of heat-producing foods, if not an equivalent for the lack of exercise, at any rate enables one to pursue one's desk-work in comfort, with efficiency, and without harm accruing." No doubt there is sense in all these suggestions, and some are within the reach of everyone. We should ourselves lay stress on the advantage of a thorough gymnastic training as the basis of all subsequent modes of exercise. The muscular tone of the system, once established in this way, can be maintained with a minimum of effort and time by the chamber use of clubs, dumb-bells, or even simpler contrivances. The back, the chest, and the abdominal organs, which are the chief sufferers from sedentary pursuits, can thus be directly addressed in the countervailing exercise. If to this can be added a short half-mile run in the open air, the account will generally be found squared daily for any but exhausting mental exertion. The rule, *Impletus venter non vult studere libenter*, is, of course, as good for exercise as for brain work. Beyond this, it is hazardous to dogmatise. Some cannot safely take a long walk on an empty stomach, or before breakfast; to others, nothing is easier, more exhilarating, or apparently more harmless. Some walkers have only rambling thoughts while on the road; others do their best and closest thinking under such circumstances. Rousseau belonged to the latter class: his mind needed the motion of the body to stimulate it to its utmost. Yet he was not jaded by this two fold activity, and was, moreover, alive to the passing beauties of the scene: he did not overlook the wayside periwinkle. With some the morning and daylight hours are best for intellectual performance; others require the silence of the small hours of the night. Anyone who can order his habits to suit his idiosyncracies, physical and mental, has no excuse for running down from lack of proper exercise or from over-exercise. Among all the felicities of Darwin's life, this ability was certainly one of the most enviable and the most profitable for mankind. From the *Nation*.

Buoy for Electric Light.—A large iron buoy was recently towed from the Government works at Tompkinsville, Staten Island, to the Lower Bay where it is to be used to support an electric light.

THE AMATEUR ELECTRICIAN.

ELECTRICAL MEASUREMENT.—I.

IT is only natural that before we attempt to measure a substance, we should inquire what that substance is. Generally speaking, we can answer such a question. We can say that we have a pound of potatoes, that a potato is a vegetable product, and occupies space. We can see it, feel it, taste it. We can say that the potato is so many inches in circumference, or that it displaces a greater or less quantity of water. Not so with electricity. It requires no argument to demonstrate that we can get neither a pound, a pint, or an inch of it. All substances that can be so measured are ponderable, have a definite chemical constitution, and are in many cases visible. Electricity, on the other hand, is invisible, inodorous, tasteless, and imponderable. The weight of a mass of metal, &c., is not increased or decreased by charging it with electricity.

If, then, electricity has neither of the properties by which material substances are measured, we must ascertain what properties pertain to it which are available for rendering measurement possible. It is assumed that all are acquainted with the fundamental differences between force and matter; that whereas matter embraces everything which has weight, force may be said to be a condition of that matter, or that which will produce a change in matter. It follows that to measure a force, we can only do so by studying its effects on matter. Thus we speak of heat as being sufficient to convert ice into water, water into steam, &c. Similarly, we may measure electricity by its capacity for producing chemical changes, deflecting magnetic needles, generating other forces (light, heat, &c.), and so forth.

Electricity, then, possessing all the general attributes of those forms of force with the effects of which we are well acquainted, we may fairly maintain that it also is embraced in that classification. To measure this force it is necessary to say first a few words on its production. It is known to most people of general scientific intelligence, that if a piece of glass is rubbed with a piece of flannel, or if two pieces of metal are connected and immersed in acidulated water, an electric current is generated, or if the junction of two pieces of metal is heated, or if a magnet is moved in a coil of wire, we get electricity. But it would not be difficult to find that many other changes in the physical world are accompanied by a more or less active display of electricity. In fact, turn where we may, electricity shows itself, and recent discoveries seem to indicate in no very uncertain sounds that every movement, whether it be of the mass or the particle, whether it be chemical or physical, is accompanied by a greater or less development of electricity.

We shall use the ordinary galvanic battery as the method of producing the electricity which we are about to measure.

The strength of a current varies according to the circuit through which it passes, but the first feature necessary for us to understand is its *potential*. Potential is that property of electricity which determines its motion from one point to another. Thus the power it has to overcome resistance, to leap across air in the form of a spark, to burst through the gutta-percha covering of a wire—in fact the power it has to form a current, is its potential. We may compare it to force with which high-pressure steam in a closed vessel persistently endeavours to escape. If two bodies at the same potential be connected with each other by some conducting medium, such as a wire, nothing will occur, but if one be at a higher potential than the other, a current will pass through the conductor, and so equilibriate the two potentials. It is as impossible to say what this potential is due to, as it is to assign a cause for chemical affinity. All we can do is to say it exists, and that to a considerable extent it is governable.

It is commonly accepted that if we plunge a red-hot iron ball into water, both the water and the iron endeavour to impart heat one to the other in proportion to their respective temperatures, until ultimately equilibrium is attained, when no further transmission of heat takes place. Now we should be able to see that when the water and the iron have arrived at the same temperature, no further change will take place, or, in other words, equilibrium is established, which will endure until a third body at a different temperature is introduced, or until the temperature of one of them can be raised or lowered. There must, then, be a difference of temperature to produce what we may venture to call a "flow of heat." A close analogy may be observed in electricity. A conductor connecting two bodies at different potentials is traversed by a current the intensity of which is equal to the difference between the potentials, and this difference is called the *electro-motive force.*

HOME CURES FOR POISONS.

Mercury, in the metallic shape, often, perhaps generally, passes through the body without producing any harm, but it is not so safe to take it as many, judging from such cases of immunity, imagine, for it may become oxidised, and cause serious mischief in that form. However, the risk from mercury in this form, or applied as a metal to the skin, need not occupy much of our attention, since there are few persons so foolish as to try experiments from which no good can conceivably result, and serious harm may.

The chief forms in which mercury may be taken so as to produce poisonous effects are the two chlorides — corrosive sublimate (formerly known as the bichloride, per chloride, or oxymuriate of mercury), and calomel, the subchloride or dichloride of mercury. Cinnabar, or vermilion, the red sulphide of mercury, is also poisonous, but it is not likely to occasion any domestic anxieties.

When the use of mercury in any medicinal form, but especially the corrosive sublimate, has been continued too long, or in too large doses, the system suffers in several characteristic ways. The brain and spinal chord are in a special manner affected, and serious diseases of the brain have been known to follow. The limbs tremble and quiver, and the tissues show a morbid sensibility which is very readily recognised. The secretion from the skin is abundant, and the salivary glands, becoming irritated, pour out large quantities of saliva. When poisonous doses have been taken, the effects on the salivary glands are not so conspicuous, and indeed are often not noticed at all. In severe cases, the symptoms then resemble very closely those observed in cases of arsenical poisoning, only they come on more quickly. An intense constriction of the throat is a marked feature of severe cases; violent vomiting and pains in the pit of the stomach are nearly always noticed.

Antidotes for mercury are selected with the object of preventing or limiting, as far as possible, its local action. Corrosive sublimate has the power of combining with albuminous substances, and therefore, when swallowed, abstracts albumen from the coats of the stomach. In the process calomel is formed. The poisonous action results from this combination with the albumen of the stomach. Therefore, to prevent or limit the poisonous action, albumen must be supplied from without. If white of egg, which is pure albumen, be taken into the stomach in good time, the coats of the stomach will be preserved from injury. According to Orfila, the proper proportion is the white of six eggs to half a-pint of water. Decoction of bark or gall-nuts may also be used with advantage. If the pains have become intense before such remedies have been tried, we must assume that the poison has already acted injuriously upon the coats of the stomach. In this case, only a medical man can be trusted to suggest suitable remedial measures, the action of which will usually be more or less tedious. Warm baths, diluent drinks, and a diet of milk and farinaceous food, are suitable when the stomach has been thus injured. But usually medical advice can be readily obtained in time for the initiation of remedial measures of this kind.

THOUGHT-READING.

By the Editor.

In endeavouring to explain those phenomena which come out, after careful elimination of doubtful cases, we must be careful to avoid equally undue confidence and scepticism. For my own part, I am disposed to agree with Professor Barrett in considering that the assumption of *à priori* impossibility is more to be deprecated in the present state of our knowledge of Nature. There is very little fear that science will accept any wild hypothesis in explanation even of phenomena most unlike those which have hitherto been brought within its sphere; for the corrective capacity of science, already strongly developed, increases daily. On the other hand, there is always some degree of danger that questions of interest may unwisely be put on one side as not worth inquiring into, *because* they do not at first seem explicable by known physical laws. The two dangers are, however, closely related together. It is noteworthy that the mind which most recklessly rejects evidence which seems new or strange, is the readiest eventually to accept the most wildly impossible theories. It appears to me that Professor Barrett and his colleagues very fairly present the *à priori* difficulties in this case. Apart from the legitimate grounds of suspicion, open—as they say—to all who have chanced to encounter the alleged phenomena in their vulgarest or most dubious aspects, "it is inevitable that, as the area of the known increases by perpetual additions to its recognised departments, and by perpetual multiplication of their connections, a disinclination should arise to break loose from association, and to admit a quite new department on its own independent evidence. And it cannot be denied that the department of research towards which the foregoing experiments form a slight contribution, presents as little apparent connection with any ascertained facts of mental and of material science. Psychological treatises may be searched in vain for any amount of transmission of mental images otherwise than by purely sensory channels."

Yet the only explanation science can seek is a physical one. It is open, Prof Barrett considers, to surmise that there is some sort of analogy to the familiar phenomenon of the transmission and reception of vibratory energy.

We are led along this line to conceive that some association may exist between the phenomena of so-called thought reading, and those strange stories of apparitions at the time of death or of intense suffering, which have been narrated by so many persons of good repute (by so many, ended, well known to fancy, as to make the simple rejection of such accounts a very unsatisfactory way of dealing with the evidence.

Respecting these experiences, the editor of the *Nineteenth Century* formulated thirteen years ago in the *Spectator* the following attempt at an explanation:—

"Let it be granted that whensoever any action takes place in the brain, a chemical change of its substance takes place also; or, in other words, an atomic movement occurs. . . .

"Let it be also granted that there is, diffused through all known space, and permeating the interspaces of all bodies solid, fluid, or gaseous, a universal, impalpable, elastic 'ether,' or material medium of surpassing and inconceivable tenuity. . . .

"But if these two assumptions be granted, and the present condition of discovery seems to warrant them, should it not follow that no brain action can take place without creating a wave or undulation in the ether? for the movement of any solid particle submerged in any such medium must create a wave.

If so, we should have as one result of brain action an undulation or wave in the circumambient, all-embracing ether—we should have what I will call Brain-Waves proceeding from every brain when in action.

Each acting, thinking brain, then, would become a centre of undulations transmitted from it in all directions through space. . . . Why do not such undulations, when meeting with and falling upon duly sensitive substances, as if upon the sensitised paper of the photographer, produce impressions, dim portraits of thoughts, as undulations of light produce portraits of objects?

"The sound-wave passes on through myriads of bodies, and among a million makes but one thing sound or shake to it; a sympathy of structure makes it sensitive, and it alone. A voice or tone may pass unnoticed by ten thousand ears, but strike and vibrate one into a madness of recollection. In the same way the brain-wave of Damon, passing through space, producing no perceptible effect, meets somewhere with the sensitised and sympathetic brain of Pythias, falls upon it, and fills it with a familiar movement. The brain of Pythias is affected as by a tone, a perfume, a colour with which he has been used to associate his friend; he knows not how or why, but Damon comes into his thoughts, and the things concerning him by association live again. If the last brain waves of life be frequently intensest—convulsive in their energy, as the firefly's dying flash is its brightest, and as oftentimes the "lightening before death" would seem to show—we may, perhaps, seem to see how it is that apparitions at the hour of death are far more numerous and clear than any other ghost stories.

"Such oblique methods of communicating between brain and brain (if such there be) would probably but rarely take effect. The influences would be too minute and subtle to tell upon any brain already preoccupied by action of its own, or on any but brains of extreme, perhaps morbid susceptibility. But if, indeed, there be radiating from living brains any such streams of vibratory movements (as, surely, there must be), these may well have an effect even without speech, and be, perhaps, the *modus operandi* of "the little flash, the mystic hint" of the poet—of that dark and strange sphere of half experiences which the world has never been without. . . .

"No doubt atomic movements, causing waves in space, must start from other parts of the body as well as from the brain. . . . But the question here is simply limited to *how brains* are affected by the movements of other brains; just as the question of how one pendulum will make other pendulums swing with it is a fair mechanical inquiry by itself, though doubtless other questions would remain as to how the movement of the pendulum would affect all other material bodies, as well as pendulums, in the same room with it."

Of course, the difficulty in this, as in all other attempts at explaining these occasional and extraordinary experiences, is, that there are no known physical laws which would account for the supposed physical action, and that as yet there seems no possibility of any experimental researches on either of the brain powers supposed to be involved—the power of originating the suggested brain-waves, or the power of receiving them. Then, again, it is difficult to understand why, if the theory be true, the observed instances are so few, compared with the number of occasions on which (considering the 1,500,000,000 persons existing on the globe) we might suppose the suggested powers would be exerted.

If we follow Dr. Muirhead in likening the action of the brain in such cases as these to its action when the organs of sight, hearing, feeling, &c., communicate to it impressions from without, the questions (which Dr. Muirhead reminds me that I asked of him four or five years since) come before us, "What is the organ by which ethereal waves affect the brain? and how are they conceived to act?" This, he says, is asking too much, at least in the present state of psychological physiology. Yet, until these questions are answered, it cannot be said that there is any sound scientific basis for the brain-wave theory.

ENGLISH SEASIDE HEALTH-RESORTS.

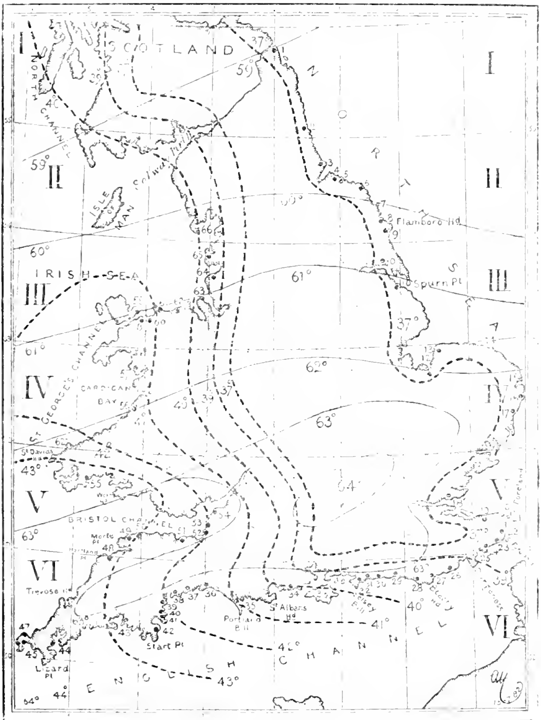
By Alfred Haviland, M.R.C.S., F.R.M.C.S. Lond.

CLASSIFICATION (*Continued from page 110*).

THE accompanying climate chart of England and Wales will, so far as temperature is concerned, enable us to understand the effects of the gulf-stream in winter and the sun-heat in summer, on the climate of our sea-coasts. The mean air temperatures of January and July are given, simply because they are the months in which the extremes of cold and heat are observed.

The *dotted* winter or Gulf stream *isotherms* (heat-contours) must be studied so as to leave a distinct idea on the mind of the mode of their arrangement *around* our coasts. In the first place, it will be seen that they more or less follow the lines of longitude, and therefore cross the parallels of latitude at different angles. Secondly, that they have two sets of curves; *one* having their long axes in the direction of the tidal wave on both sides of England, whilst the others take an opposite direction.

The first set are seen to be deflected from their general north-easterly direction on the west coast, first, by the English Channel, when the degrees 43°, 42°, 41°, 40°, and 39° have their long axes in mid-channel, from off Plymouth to the Straits of Dover, in an E.N.E. direction. Next come the Bristol Channel curves, which give evidence of the important part this broad inlet of the sea plays in tempering the winters of those charming health resorts with which the north coast of Devon and the coasts of Somerset and South Wales are studded. These curves belong to the same isotherms as those in the English Channel, but owing to the axis of the Bristol Channel, their direction is as nearly east as possible. The curve in the 37° isotherm shows that the influence of the Bristol Channel extends even as far as the north east of Gloucestershire. In St. George's Channel the curves deviate less from their normal direction, the



ENGLISH SEASIDE TOWNS AND HEALTH-RESORTS.

1. Berwick-on-Tweed.	34. Bournemouth.
2. Tynemouth.	35. Weymouth.
3. Hartlepool.	36. Lyme Regis.
4. Redcar.	37. Sidmouth.
5. Saltburn.	38. Exmouth.
6. Whitby.	39. Dawlish.
7. Scarborough.	40. Teignmouth.
8. Filey.	41. Torquay.
9. Bridlington.	42. Dartmouth.
10. Hull.	43. Plymouth.
11. Gt. Grimsby.	44. Falmouth.
12. King's Lynn.	45. Penzance.
13. Hunstanton.	46. Sennen.
14. Cromer.	47. St. Ives.
15. Gt. Yarmouth.	48. Clovelly.
16. Lowestoft.	49. Ilfracombe.
17. Aldborough.	50. Lynton.
18. Southend.	51. The Anchor.
19. Herne Bay.	52. Burnham.
20. Margate.	53. Weston-super-Mare.
21. Ramsgate.	54. Clevedon.
22. Deal.	55. Tenby.
23. Dover.	56. Aberystwith.
24. Folkestone.	57. Barmouth.
25. Hythe.	58. Bangor.
26. Hastings.	59. Beaumaris.
27. Eastbourne.	60. Penmaenmawr.
28. Seaford.	61. Llandudno.
29. Brighton.	62. Rhyl.
30. Worthing.	63. New Brighton.
31. Littlehampton.	64. Southport.
32. Bognor.	65. Blackpool.
33. Isle of Wight.	66. Morecambe.

EXPLANATION.

.... Dotted lines show the winter temperature as influenced by the Gulf Stream.

(Isotherms for January 37°, 39°, 40°, 41°, 42°, 43°, 44° Fahr.)

——— Fine continuous lines show the *summer* temperature, as influenced by the sun-heat.

(Isotherms for July: 59°, 60°, 61°, 62°, 63°, 64°.) The 44° and 64° Isotherms have been accidently omitted. A line drawn through the Lizard and St Ives Bay would represent the former, and a curve from 64° to the Land's End would show the place of the latter.

Interlatitudinal Zones I., II., III., IV., V., VI.

north-east, and, favoured by the Solway Firth, are seen to cover a large portion of Cumberland.

On the eastern coast 37° isotherm hugs the coastline very closely; still it is seen to be deflected to south-west at the broad mouths of the Tees and the Humber, and to a still greater extent around the Wash and the mouth of the Thames. We need not here repeat the names of the health-resorts which lie between or on these isotherms; they are sufficiently indicated on the map by figures which correspond with the names in the list of seaside towns and health-resorts in England and Wales given above.

Having seen how the Gulf Stream heat tempers the winters of our coasts, we will now proceed to examine the July isotherms, represented by *fine continuous lines*. These lines may be said to cross the January isotherms almost at right angles, and to follow roughly the parallels of latitude. They also are characterised by curves which have a northerly direction as regards their axes. Whilst, however, the winter curves showed that the axis of greatest heat is carried in a North-Easterly direction over the *sea* during January, the summer curves equally well show that the axis of greatest heat extends from South to North over *land*, and that the isothermal curves reach the highest points towards the North along the central axis of the country, whilst on each side of the coast the isotherms are depressed, indicating the cooling effect of the sea on the sun heat of July.

Again, we may contrast the effects of the sea on the air temperature during winter and summer. We have just seen that the Bristol Channel and the Thames *embouchure* allowed the sea warmth to penetrate the surrounding country in the winter; if we now look at the curves in 63° July isotherm around these two sea inlets, we shall at once observe how remarkably the winter heating and summer cooling depends upon the sea.

In our next, we shall group the health-resorts in accordance with the heading at the beginning of our last paper.

Fire Insurance and the Electric Light.—The fire insurance companies of Philadelphia will hereafter, says *Engineering*, cancel policies wherever they find electric illuminating wires attached to the roofs of buildings on which they have outstanding risks.

OUR NATIONAL GAME.

CRICKET has such a charm for all Englishmen, and such special fascinations for experts, that even its faults are loved—in this sense, at least, that few ardent cricketers can bear to hear of any suggestions of change, even though it be manifest that (on the whole) change would introduce marked improvement. There are also certain points in the game, as at present played, which are deservedly in favour, that would be, to some extent, affected were the changes I am about to suggest introduced. We shall see presently what these are. But be it noticed that the defects to be corrected are not trifling. They affect very seriously the value of the game. It is practically a gross absurdity, for instance, that the finest game we possess should, in quite a large number of cases, result in drawn battles, when yet the progress of the play has decidedly shown the superiority of one side or the other. It is absurd that to the large element of chance already existing in the game itself there should be added *this* further element as affecting the season's fortunes of various clubs, that the games in which they have been inferior may all, or nearly all, be played out, while those in which they would probably have won may all, or nearly all, be drawn: or *vice versâ*. Take, for instance, the Australian eleven—doubtless superior to any county eleven we can just now put into the field, and capable of coping with fair prospect of success, with elevens representing All England. It cannot be denied that to the really glorious success they have achieved on their merits (a success, however, not surpassing that which has in past years attended the season's work of various counties, as Kent and Sussex in times now regarded as remote, Surrey later, and more recently Gloucestershire) has been added a very conspicuous share due to chance. At the time of writing, the Australians have won fifteen games and only lost one (the game with Cambridge),* while five games have been drawn—but most of the drawn games have been drawn very much in favour of their opponents. Supposing only three out of the five to have been lost by them, it makes a very different record to say that only four games have been lost to seventeen won, than to say that out of sixteen games played out they have lost only one.

We have already touched on the very serious defect in cricket as now played, that a match may not occupy the full time assigned to it. It is very disappointing to all interested in a contest, and should be so to the players themselves, when a three days' match ends in two days; and it is still more annoying when, after two days of play, only three or four (or perhaps only two or three) wickets remain to be taken on the third day.

The element of chance arising from changes in the state of the ground as the game proceeds, or as the weather changes, and again, that arising from the time of day when an eleven goes in, must be regarded as most injuriously affecting the quality of the game, these do not belong to the "glorious," but to the ignoble "uncertainty of cricket"; and no honest cricketer should have any feeling but disgust when his side wins, because "We went in, Sir, with the ground like a billiard-table; but when we sent them in, about an hour before the end of play for the day, the ground was a good deal cut up and the light bad, so that we got their six best wickets for less than ten runs apiece." Then heavy rains may come after the first day's play, and those who have gone in under unfortunate conditions may have to resume on wickets all in favour of the ball, and, having to follow on, be all disposed of to the tune of a one-innings defeat. Yet they may be as good as their opponents, or even better.

Cricket is such a fine, manly sport in itself, while the element of chance inseparable from it is already so large, that it should be the interest of all who really love the game *to make encounters as fair as possible, and to eliminate every element of chance which can really be removed without touching the essential character of the game*, while *every game would occupy the full time allotted to the match*, and no *game ever end in a draw*. This could readily be effected by letting the wickets fall alternately on the opposing sides, instead of letting all ten wickets on one side fall before the other side goes in: to which would accrue this additional advantage, that neither eleven would be kept idle long, unless when a wicket gave a good deal of trouble: but an eleven which could not patiently allow nine of its number to look on while the other two made a good stand, perhaps saving what had looked like a lost game, would scarcely be an eleven of true cricketers.

To illustrate by an example, rather than by a lengthy general description, the nature of a game played on this plan, we may suppose the following to be the description of the cricket match between the Australian eleven and the Marylebone Club, as thus played:—

"What promises to be one of the most interesting matches of the season, and a contest tending (as far as can be judged from present appearances) to retrieve the fame of our English cricketers, was commenced Monday, July 10, at Lords. The representatives of Marylebone were Lord Harris, Dr. W. G. Grace, Messrs. Hornby, A. P. Lucas, C. T. and G. B. Studd, A. G. Steel, Tylecote, and Evans, with the professionals Barnes and Flowers. The club having won the toss, put in Dr. Grace and Mr. Hornby, to the bowling of Spofforth and Garrett. At 13 Mr. Hornby gave a chance to the wicket-keeper, which was not taken; but when the score was at 76 he was tempted off his ground by Garrett, and cleverly stumped by Blackham. His innings of 45 was made in his usual brilliant style. The Australians then sent in Massie and Bannerman to the bowling of Steel and Flowers, but when only 5 runs had been made, Massie was smartly taken at the wicket. The Club sent in Mr. Lucas, who played with his customary steadiness, several bump-balls misleading the inexperienced into the delusion that he had been caught out. With the score at 103, Dr. Grace was bowled for 46 by a magnificent ball of Spofforth's. He had played more nearly in his old style than he has yet done this season—in fact, his innings was faultless. The Australians were even more unfortunate with their second wicket than with their first. They sent Murdoch in, but before a run was added Bannerman was easily taken (at mid-off) by Hornby off Flowers. The Club now made a magnificent stand. C. T. Studd was sent in. The score rose steadily to 137, when Lucas let out at a no-ball of Spofforth's, and was caught by Giffen at mid-on, much to the disgust of the bowler. When 142 had been made, Studd was very nearly run out. . . . [Here is supposed to intervene a full and particular account of the play of Studd and Lucas, before the latter lost his wicket.] "When the total had reached 208, Lucas sent Garrett high through the slips, where the ball was held by Bonnor. Lucas had made 15 in his well known safe style. Studd not out 64. The Australians now sent in McDonnell, who began rather wildly. After a risky square hit (off Steel)

* Commenting on this game, the *Times* (in a leading article), after giving the correct score of the elder Lyttelton in the match with Cambridge, during the first visit of the Australians, said that Mr. Lucas played for Cambridge on that occasion. Our strong impression is that he did not play, being unwell. He was at that time regarded as the best Cambridge bat.

for 2, and a fine square hit (on to the awning of the Grand Stand) for four, the scoring was fairly brisk until McDonnell skied a ball of Steel's to mid-on, where Evans made a clever running catch. The Australians had now made 29, (McDonnell 16), Murdoch not out, 3. The Club, with 199 to the good, sent in Lord Harris; but when 16 had been added, Harris was caught at long-on by Palmer off Garrett. Total, 220; Harris, 4; Studd not out, 76. The Australians, who now sent in Horan, were again unfortunate; for only eleven runs had been added when they lost their captain (for 3 only), caught by C. T. Studd (a fine one-hand catch) off Flowers."

The description would go on, we may suppose, to describe how play was interrupted by rain on Tuesday, the fall of the remaining wickets, alternately, throughout Wednesday, and we can imagine it ending (in accordance with the actual play in the match) somewhat as follows:—

. . . . "The Club sent in Mr. Tylecote, and a few minutes later a single from him brought the 300 on the board, amidst a hearty outburst of applause. But almost immediately after, the Cantab, who had made so grand a stand, was clean bowled by Garrett, having made a faultless innings of 114; total, 300. The Australians sent in Palmer to the bowling of Studd and Barnes. Palmer made a single off Barnes, but was immediately after bowled by him; total, 95. Evans came in next on the Club side, and when, after two more had been made by Tylecote, Evans was easily caught by Palmer off Garrett, there seemed every prospect that the champion would have a part at least of a second innings, but the tenth wicket of the Australians was defended with unexpected obstinacy. Spofforth (the newcomer) and Giffen made runs with considerable freedom, and at ten minutes before 7 the board showed 120. At 122 Steel replaced Barnes, and Spofforth cut him for two. Flowers took the ball at the other end, but "the demon" drove him twice to the boundary in successive overs. Steel tried his hand at tho pavilion end at 137, but it was not until the final over before time was up, and with the last ball but one of that over, that Grace clean-bowled Spofforth. The match thus ended after the fall of ten wickets on each side, the Club winning by 164 runs."

It will be understood, of course, that a match would be completed with the fall of the last wicket taken before time was up, if that gave both sides an equal number of wickets —otherwise with the last but one, *unless* after the last but one had in this case been taken, the other side without losing a wicket carried their score beyond that made by their opponents, when of course they would be adjudged winners by so many runs and a wicket. Otherwise, every match would be won by so many runs, never by wickets. There would be no "following on" under any circumstances.

It seems not unlikely that if an arrangement such as this were adopted—by which every match would be decided, yet every match would occupy the full time allotted to it—three days' matches would, for the most part, be replaced by two days' matches, more games being arranged during each season.

We are quite aware that in the working out of this scheme several minor matters would arise to which exception would be taken; but they would not be comparable for a moment with the very serious defects which this system of the alternate fall of wickets would obviate. Let it suffice to note that, according to present arrangements, the odds are greatly against a match satisfactorily filling up the time allotted to it and yet being completed within that time, while in the great majority of games the toss, or weather chances independent of the toss, largely affect the result. With such defects it must be confessed that cricket as at present played has some most unsatisfactory features. As modified, it would deserve to be regarded as the finest outdoor game of combined skill and chance in existence.

A TERRIFIC COMBAT.

THE following account of a fight between a snake and a rat is extracted from a Californian paper, the *Stockton Mail*, near which city the encounter is said to have been witnessed; and has a rather less impossible air about it than most newspaper yarns in which the "Ophidia" play a part. I transcribe it *verbatim*, in the hope that it may prove of passing interest to your readers, not in illustration of any principle:—

"The snake was of unusual size, and of a different appearance from those commonly found in water. The rat was of the ordinary brown variety, and was running along the shore when the fight began. The snake was coiled upon a little point of mud just above the water, sunning itself, and probably asleep. The rat, apparently without noticing the snake, jumped directly upon the folds of the serpent's body.

"The snake struck instantly, fastening its fangs between the rat's shoulders. Then began a contest that, in its small way, was truly thrilling. The rat, struggling violently, endeavoured to shake itself free, while the snake as persistently endeavoured to drag the head of its victim into its own mouth.

"This feat it was at first unable to accomplish. The rat writhed in its convulsive efforts to escape, bit the big snake severely in the neck, just at the back of the head, until the blood flowed and mixed with its own.

"These counter-attacks became at last so savagely painful, that the snake loosened its grip, remaining, however, in half-coil. But the respite was too brief to afford the rat an opportunity to escape, for again the snake's fierce jaws descended and closed, this time around the rat's head.

"The heavy body of the rat swayed violently, but dragged with it the head of the snake, until the latter was completely out of coil. By this time, however, the rat's struggle had become comparatively faint, and the snake was apparently the victor.

"But the next moment the snake in its turn began to struggle violently, as if to release its adversary's head, but ineffectually, and the reason was soon apparent.

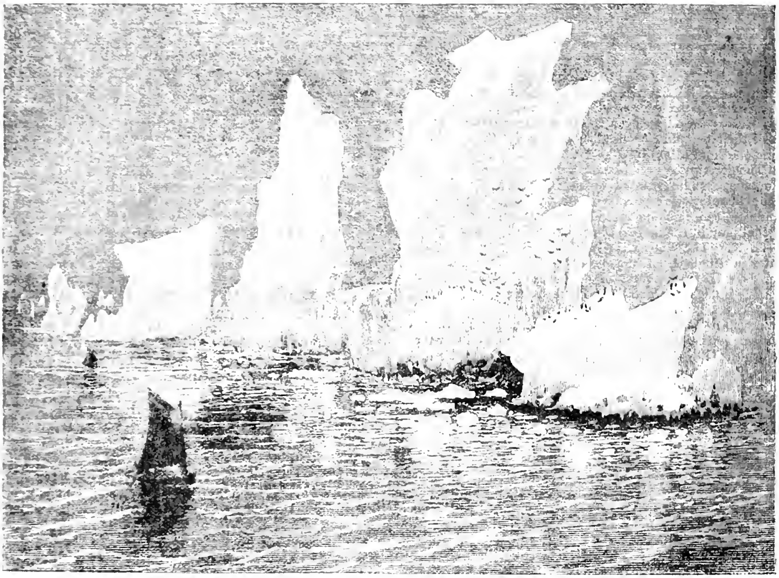
"The rat had bitten quite through the snake's throat, and its sharp teeth could be distinctly seen in the narrow slit they made.

"The writhings of the snake were now intense. It lashed the ground with its tail, and raised its thick folds to almost half its length from the ground.

"The spectator stood hesitating, scarcely knowing whether he ought or not to interfere. The next moment, the snake, with one last convulsive effort, threw half its length into the muddy water, and the doughty twain sank together to a common death."

This snake, if the narrative be really a true one, must have been some non-venomous colubrine—probably some species of genus Coluber, or possibly a large variety of Heterodon or Ablabes; a non-constrictor, too, otherwise it would have crushed the rat to death before attempting to commence the swallowing process (its "remaining in half-coil" is rather vague, and does not count for much in any case). Most likely it was naturally a frog and fish-eater, like most colubrine snakes, but was exceptionally ravenous after desquamation. "Fangs" is, of course, a figurative expression; clear enough in its import when applied to a wolf or dog, but rather apt to be misleading when used in respect of a serpent. Teeth are evidently meant, since it is obvious that the reptile could not have been a poisonous one. There are much fewer extravagancies and palpable inaccuracies in this anecdote than are commonly met with in such. The declaration that it only "raised almost half its length from the ground" commends itself to our admiration; most snakes in so strongly dramatic a situation would have been seen to leap bodily into the air. The brusque behaviour of the rat precludes any pretence of "fascination," also; while "probably asleep" is remarkably ingenious, and may be held up for the consideration of certain writers who assume a much greater familiarity with matters ophiological than the modest spectator of the above-quoted incident lays claim too, and who too often assert that such and such a snake "was asleep at the time," or something to that effect. How on earth can they say when a snake is asleep? It can't shut its eyes, and mere quiescence is most certainly not enough to indicate it, since the reptile will often spring upon its prey from a position of repose which it may have occupied for a long while previously, without any warning or indication by movement.

Snakes do occasionally catch a tartar. There is a preparation in the Museum of the College of Surgeons, showing the stomach of one, the coats of which have been ruptured and the superjacent



A PROCESSION OF ICEBERGS.

been perforated by the jaws of a little lizard, which had retained sufficient vitality to exercise them in that situation.—I am, Sir, your obedient servant, ARTHUR STRADLING, C.M.Z.S.
29, Woodford-road, Watford, Herts.

A PROCESSION OF ICEBERGS.

WHILE a procession of icebergs in New York Harbour would be a genuine novelty sure to attract general attention, the spectacle is so often witnessed in Placentia Bay, off the south coast of Newfoundland, as to possess little interest to spectators. This bay is a deep inlet, seventy-five miles in length, and nearly sixty miles wide at its entrance. The icy monsters from the North float in with the tide in spectral procession, and then drift out again in irregular groups, often colliding and going to pieces, and always a strikingly picturesque effect to the bay. The illustration faithfully shows the scene as it presented itself to the artist on a summer day.—*Frank Leslie's Illustrated.*

EXCAVATIONS AT EPHESUS.

AT a meeting recently held at the Mansion-house, to promote the resumption of the excavations at Ephesus, on the site of the Temple of Diana, the Lord Mayor, who presided, said the famous Temple of Diana, at Ephesus, one of the seven wonders of the ancient world, had been hidden from view for many centuries, and its exact site was unknown, when in 1869, Mr. J. T. Wood, after six years of search, found its remains more than 20 feet below the present level. The trustees of the British Museum, who had supplied the means to explore some of the public buildings at Ephesus, then authorised the exploration of the ruins of the temple, and five years were devoted to the work, with the aid of Government grants to the amount of £12,000. In 1874 very important excavations at Babylon and Nineveh were being carried on by the English Government, and the trustees resolved to suspend the work at Ephesus, as they thought it inexpedient at the time to apply to Government for fresh grants for the purpose. Mr. Wood had from year to year applied for a grant to continue and complete the explorations at the temple, but the times had been unfortunate for such enterprises, and there was little or no chance of further Government aid. An influential committee, under the patronage of the Duke of Albany and the presidency of Mr. Beresford Hope, M.P., had been formed to resume the explorations by the aid of a public subscription, and it was in support of that object that that meeting was convened. Professor Hayter-Lewis read letters expressing sympathy with the movement from the Prince of Wales, the Dukes of Connaught and Albany, the Primate, Cardinal Manning, Lord Shaftesbury, Canon Farrar, and others, including Sir F. Leighton, the President of the Royal Academy, who wrote that few discoveries had been of greater interest to the world of art and archæology than those at Ephesus, and it would be a grievous thing if this country, possessing, as it did, the site of the Temple of Diana, should not continue the excavations, which had already produced so valuable a harvest. Mr. Beresford-Hope, M.P., said Mr. Wood was only on the threshold of his discoveries, and the very idea of a further grant from Government to continue the excavations was beyond hope. Mr. Newton, C.B., moved that the complete excavation of the Temple of Diana at Ephesus was an object well worthy of support from the nation, which now possessed in the British Museum the only portions of the beautiful sculpture as yet discovered at the temple, and that a subscription list be at once opened for the purpose. Professor Donaldson seconded the resolution, which was adopted unanimously.

WEATHER CHARTS FOR WEEK ENDING SUNDAY, JULY 30.

Sunday, 23rd. Monday, 24th. Tuesday, 25th. Wednesday, 26th.

Thursday, 27th. Friday, 28th. Saturday, 29th. Sunday, 30th.

In the above charts the dotted lines are "isobars," or lines of equal barometrical pressure, the values which they indicate being given in figures at the end, thus—30·4. The shade temperature is given in figures for several places on the coast, and the weather is recorded in words. The arrows fly with the wind, the force of which is shown by the number of barbs and feathers, thus:— ⟶ , light; ⟶, fresh or strong; ⟶, a gale; ⟶, a violent gale; ⊙ signifies calm. The state of the sea is noted in capital letters. The * denotes the various stations. The hour for which each chart is drawn is 6 p.m.

CHALDEAN ANTIQUITIES AT THE LOUVRE.

Although it will be necessary to await the publication of M. de Sarzec's promised work on his explorations, before it is possible to finally assign to his Chaldean relics their true position in the history of culture, yet there are a few considerations regarding this primitive civilisation, concerning more particularly the peculiar style pourtrayed in the objects themselves, which will be of interest. This is especially the case because of the recent acquisition by the British Museum of a fine collection of antiquities from the same site.

Before proceeding to discuss these, it is worthy of notice that we can glean enough from M. de Sarzec's letter to the French Academy to make it certain that the architectural arrangement of the edifices were direct precursors of those already made known by Layard, Botta, and Rassam, as essential features of the temples and palaces of Assyria. For, like these, the buildings lately unearthed have the angles carefully oriented to the cardinal points of the compass, and are constructed of dried bricks, erected upon a massive foundation courses made of crude bricks cemented with bitumen. In at least one case, also, a Ziggurat, or building with retreating stages, has been found.

The most striking objects of the collection are the numerous statues, especially a group of them found crowded together beneath the soil in the large edifice occupying the principal mound at Tello. Besides being connected by this strange proximity of position, they are united by the fact that they one and all bear the name and titles of Gudea "patesi" of Zirgulla. This collection of statues, and indeed all those found at Tello, have one stereotyped attidude, viz., the arms crossed upon the breast, the right hand held in the left. This posture is similar to that which in Assyrian bas-reliefs (and indeed among Orientals at the present day) is indicative of the respect of an inferior to his chief, and, although it is possible its universality in the Tello figures may be because it was the conventional attitude considered proper for a statue, yet it seems more natural to seek for some other explanation. M. Heuzey, in his memoir on the subject, suggests one which certainly seems reasonable, and also enables us to understand why the largest statue of all, which, according to M. Oppert's rendering of its cuneiform inscription, is certainly that of Gudea, should be no exception to the rule.* His

* The following is M. Oppert's translation: Dans le temple d'Hercule est érigeé cette statue de Gudea "patesi" de Sirtella qui a construit le temple de Moulkit (Bel.). Il a promis de donner journellement, aussi longtemps qu'il sera gouverneur, un bath de lait, un epha de foin, et un epha de pain consacré pour detourner la malédiction devin. Il obeira à l'injunction d'Hercule; puisse-t-il, pour remplir sa promesse, exécuter son intention dans le temple d'Hercule, et que sa prière devienne vérité.

ANCIENT CHALDEAN STATUES.

theory is that all these statues were, in a certain sense, votive, that is to say they were placed in a temple or sacred place either before the image of one of the deities, or of the symbols of their divinity. Hence the attitude of humility was the sculptor's mode of expressing his religious fervour, and this view is somewhat supported when we recollect how frequently this is the position assumed by many of the figures exhibited by the Assyrian statuettes.

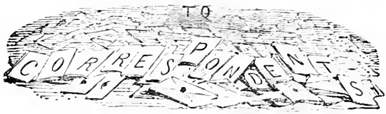
One distinctive quality of the Chaldean statues is the peculiar character of the proportions adopted by the sculptors, showing that, at least in this respect, they had not attained to the perfect canons prevalent at this period in Egyptian art. This is the excessive robustness and short or squat appearance of the figures. If, however, the execution is imperfect in this respect compared with that of other races, it surpasses them in the successful carving of the nude parts of the body and the manner in which the folds of the raiment are indicated, in these respects heralding more nearly the glories of the Greek masters than any other known prehistoric art. The only clothing shown on the larger statues is the large fringed shawl so often to be seen in Assyrian costume, but in these earlier objects the fringe is only expressed by a parallel line to show its width, instead of being ornamented as in the elaborate late Assyrian work. In all cases the shawl is shown folded across the body in a similar style, so arranged as to leave the right arm and shoulder uncovered. Some of the small bronze statuettes represent persons clothed with a short skirt, and in the bas-relief containing the battlefield scene, with the dead lying on the ground; there are figures clad in this manner carrying baskets on their heads which they support with both hands, and, strange to say, this is exactly the attitude of the statuettes found by M. de Sarzec, and also of some which have been discovered by previous explorers.

In conclusion, it may be pointed out that, excepting apparently wilful injuries, these antiquities are in admirable preservation, and therefore we may be assured that whenever further researches are made in the Mesopotamian delta, they will be amply rewarded. Scarcely a week passes but some valuable acquisition to knowledge is gathered from cuneiform inscriptions, such, for instance, as Prof. Sayce's discovery of a counterpart of one of the well-nigh unknown ancient Indian alphabets. In the British Museum are thousands of inedited tablets, which are being multiplied at a much greater pace than they can be decyphered and published, and it is now evident that we possess in these, and the far richer treasures still buried beneath the soil, more priceless records of the progress of the human race than the most ardent archæologist would have dared to hope for even but ten years ago.

A Member of the Society of Biblical Archæology.

Accident from Lightning.—A telegram from New York, a few days since, stated that a large brick building in Texarkana, Arkansas State, had been struck by lightning, and subsequently fell on an adjoining wooden building, used as a liquor saloon, completely crushing it. The saloon caught fire, and several people who were in it at the time were killed.

[Accidents of this kind are of great importance, and we should take it as a favour if any of our readers on hearing the particulars of disasters caused by lightning would kindly send us the information.—Ed.]



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs Wyman & Sons.

•• *All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

A VERY COMMON MIND TROUBLE.

[497]—I frequently *when unwell* have a species of this trouble, viz., a sudden thought to do or not to do an act. I rarely pay any attention to it, putting it down to biliousness. The strange part is I repent not paying attention to it, as, had I done so, some loss or unpleasantness would have been averted. [Always, or in certain cases, which alone are noticed?—Ed.]

John Alex. Ollard, F.R.M.S.

TEA AND COFFEE, HOT AND COLD DRINKS.

[498]—A "cold water drinker" would be glad if any of the numerous readers of Knowledge could inform him whether the drinking of tea, coffee, cocoa, &c., is preferable to that of water in its natural state, for the physiological and psychological development of man, and whether hot beverages are beneficial in cold weather?

By inserting the above you will greatly oblige,

J. Williams, Jun.

ARE TOADS POISONOUS?

[499]—I have a large St. Bernard dog which has just been poisoned. He was out with my servant, and she states it picked up a large toad, and carried it for a few yards in its mouth, when it suddenly howled and dropped the toad. It commenced to foam at the mouth, and vomit, and was very relaxed. Do you think this action can be attributed to the toad? Thanking you in anticipation,

Herbert Brown.

CALEDONIA.

[500]—Mr. Charles Stewart says in your issue of June 16, that "Caledonia" and "Gaidhile dhonna" are almost identical; the meaning being "*brown haired Gaels.*" I have always understood that the word "Caledonia" was derived from "Cavill davin," that is, "People of the woods," but as I am always open to correction, I should be glad to know the true derivation of the word "Caledonia."

W. H. Plaisher.

THOUGHT READING AND WILLING.

[501]—In your papers on "Thought Reading," &c., I should be glad if you would insert a word of caution to inexperienced persons as to the danger of such experiments as "Willing." I have seen a good deal of such trials, and think that with some constitutions they are actually prejudicial. On two occasions I have known the persons "willed" to be put actually asleep in a sort of mesmeric trance, the sleep on one occasion lasting a considerable time, and, from what I know of mesmerism by my own experience, I have no doubt that, had any force been used to arouse them, disastrous results would have followed. I have frequently known persons of nervous organization to be, to use an expressive term, "knocked up" for the rest of the day by being "willed," especially after having been (as is quite possible) forced to do a certain act against their own will. I consider that anyone meddling with these subjects without experience runs a considerable risk, and is decidedly playing with edged tools.

T. Preston Battersby, F.R.A.S.

THE ARTISTIC PERCEPTION OF ANIMALS.

[502]—With reference to the subject of letter 472, p. 118, I once had a cat which I could throw into a paroxysm of fear by slowly gliding a gaudily painted model of a Burmese boat, cut in the form of a dragon, towards her. She did not run away from it, but seemed to be fascinated—always retiring in sidelong fashion, with arched back, and much "fuffing" and "spitting." Notwithstanding repeated introductions, she never grew reconciled to the monster, and to the end of her days regarded it with horror. I think this rather strange, as the figure was utterly unlike anything in nature, and so could not, one would think, have suggested anything at all to tabby's mind. I should have expected her merely to smell it.

I have heard it stated that a cat only looks at itself in a mirror once in its life—that once being the first time it is given the opportunity. Is this so?

J. A. Westwood Oliver.

CHANGE OF COLOUR IN BLOWPIPE BEADS.

[503]—The remarks of Aug. W. Orr on p. 118, letter 473, headed as above, may possibly mislead some of the readers of Knowledge. A bead before the blowpipe flame is certainly a source of light, just as a red-hot poker in the fire is; but after the bead is taken from the flame and has cooled to an extent that it is no longer a source of light, this same bead *has colour*, and it *may change* its colour. Plainly, then, the light rays from such a coloured or colour-changing bead which reach our eyes are borrowed; in other words, we are only enabled to see the bead by means of its reflected light.

Wm. Ackroyd.

A QUERY.

[504]—Will "Pangul" (page 145, Dec. 16) allow me to write to him for information about 2nd B.Sc. London? I am obliged to depend on my own reading for the exam., and should be very grateful for any information.

J. H. Ward.

Oakley-house, Caversham-hill, near Reading.

VARICOSE VEINS AND CYCLING.

[505]—To "A Tricyclist." Without being a medical man, I may perhaps be allowed to express the opinion that varicose veins are not induced by cycling.

The action is smooth and easy (without any jars or concussions, as in walking, running, or jumping), and thus favourable to soundness even in those who have a tendency to enlarged veins.

In my own case, I seriously injured my knee at football, and long before I could walk, even a few miles, without swelling and pain, I could ride any distance at any pace without subsequent inconvenience.

Of course, a novice may over-strain himself and cause injury, in tricycling, but varicose veins, and even hernia, have, I believe, been caused by running down stairs. I know several cyclists, sorely troubled in this way (not brought on by riding) who ride in elastic stockings with comfort and pleasure, some even being prominent on the racing path.

Lacy Hillier.

FAIRY RINGS.

[506]—The circles of rank grass referred to by Mr. W. Mattieu Williams were not Fairy Rings. No one who had ever seen true Fairy Rings could have mistaken such circles of rank grass for them. Fairy Rings are very frequent on steep grassy hill sides, they are common on the South Downs, and on steep places like the Devil's Dyke, near Brighton, and on the sides of the Chiltern Hills in Beds and Herts. Who ever saw grass-cocks on such places? Fairy Rings are often only a yard in diameter, but sometimes fifty yards or more across. Has anyone ever seen such small or such large grass-cocks? Fairy Rings are often semicircular, at other times ogee-curved; I have never seen grass-cocks of these patterns. The rank grass round where grass-cocks have stood is known to everyone.

Fairy rings are caused by the growth of the fungus commonly known as the "Fairy Ring Champignon" (*Marasmius Oreades*). The rank circle of grass is caused by the decay of the previous year's agarics, and every one who has paid any attention to the subject well knows that the same circles increase in size year by year. Another fungus, named *Agaricus gestopus*, causes Fairy Rings of gigantic dimensions in grassy places, and many other fungi, large and small, cause abnormal circular growths as the circle of whorls common on decaying apples and pears, and the circles on the head caused by the ring-worm fungus.

W. G. Smith.

Letters to same effect received from E. A. H., J. Pennington, and others.

Answers to Correspondents.

[illegible] requiring early attention should reach the [illegible] the current issue of KNOWLEDGE, the [illegible] press early in the week.
HINTS TO CORRESPONDENTS.—1. No questions asking for scientific information [illegible]. 2. Letters sent to the Editor for correspondents [illegible] addresses of correspondents be given in [illegible] correspondents should write on one side only of the paper [illegible]. 4. Each letter should have a title, and [illegible] made to its number, the page on which it [illegible].

[illegible] You cannot get over the difficulty that way. [illegible] as the comet just as it would have been seen. [illegible] comet was a straight line from the sun to the [illegible] produced so as to give the usual direction of the tail, [illegible] a straight line. In other words, if the direction of [illegible] had been exactly from the sun, the tail would have [illegible] directly from the sun. Set a globe somewhere to [illegible] at any distance from it fix a straight rod aimed [illegible] directly at the globe's centre. Now see if you can find any spot from which when you look at the rod it will not seem [illegible] apparently straight towards the globe's centre. Or get a [illegible] graph showing it otherwise (if you can). E. M. KING. Very [illegible]. S. PARKER. Will, if possible, insert the article in [illegible] part, but if not, pray consider that our poverty (of space), [illegible] will forbids. HALLYARDS. (1.) Am not acquainted with [illegible] of Leo. If anything was gained by the frequent turning [illegible] of diamonds, should think the person who turned it open [illegible]. (2.) The laws of probability cannot be applied to the case of selection of names for novel. Odd coincidents must arise where there are a great number of events; and we note such coincidences when they occur, as you noted the publication of a novel [illegible] "Ralf Skirlaugh" when you had yourself written one to be called "Ralph Skirlaw." Captain Marryatt came near [illegible] a duel on account of his novel "Masterman Ready," because a Mr. Masterman Ready, quite erroneously, supposed the book was named after him. (3.) I was much pained to learn that any answer of mine had hurt you so much that it seemed as if life were no longer worth living, and turned over the back numbers to find the answer you referred to, with the painful consciousness that if so "my 'banter' must," indeed, have been [illegible] with a red-hot poker." I was rather relieved to find—[illegible] 482, col. 2—that my fearful sledge-hammering, vitriol-throwing, crushing rejoinder, had been simply worded thus: "Will you excuse me if I hint that you have evidently much more leisure than I have; if one correspondent in twenty wrote at such length, what could a poor editor do?" Surely that ought not to have produced so painful an effect. I do not see where the red-hot poker comes in. Properly to reply to and comment upon a letter which ran to four quarto pages, closely written, required more time than I could spare, and I said so, politely enough as I thought. Do you not see that the more clearly I indicated my inability to answer you as I could have wished, the more fully I showed what my wish was? I hope others who think me vitriolic, sledge-hammery, and red-hot-pokery, have [illegible] juster reason for complaint. A FIFTY-FIVE YEARS' OLD NATIVE [illegible] NEW ZEALAND. "In what direction is the resultant force generated by the various motions of the earth expended?" The various motions of the earth, resulting from the various forces to which the earth has been subjected, cannot be said to generate force. You might with reason ask how the various motions of the earth have been generated, for though astronomy can show how [illegible] of them are produced, it has not yet accounted in measure [illegible] for all, and its explanation of the various motions [illegible], including the perturbations of each form of motion, and so forth, are a very difficult subject of study. But there [illegible]. You write from so great a distance, and have to wait so long for an answer, that I should be ready and glad to try to answer your question satisfactorily; but I cannot understand it. You say, "No book on astronomy which I have ever read has touched upon this point;" and this rather relieves my mind, as showing that you have got hold of a rather out-of-the-way difficulty (or that such a difficulty has got hold of you). Then, immediately after, you say, "This theory is not my own, and if I am afraid to mention its author, it is because I remember the effects of the thought of him on poor De Morgan [illegible] nineteen years ago; it unnerved him so that he actually forgot, in discussing his subject to furnish a little of that plain and sensible argument which on other matters he displayed so well." This, again, relieves me; for I am sure you are mistaken about De Morgan being unnerved; whenever he did not furnish plain and sensible argument it was because he knew it would be perfectly useless. On the other points in your letter, you must have misunderstood me greatly, if you gather from what I say in my article on the Pyramid, in No. 17, that practical astronomy has determined the distance of Alpha Draconis (Alpha Centauri is referred to) as accurately as that of the sun; how any one can read what I there say by way of connecting the Great Pyramid and the great fifteen puzzle with the distance of Alpha Centauri, and not see that I was jesting, I fail to comprehend. Certainly the capacity some persons display in taking banter for earnest surpasses comprehension. I once wrote an article in which, in humble imitation of nature-myth theories, I advanced the hypothesis, that Tom Tom, the Piper's Son, was Thammuz, son of Kinros, the Piping one (or the Wind), and that in the misery of the unfortunate nursery Thomas, the same nature-changes were symbolised as in the old legends of the death of Thammuz. I explained also that little Jack Horner, eating a Christmas pie, was the weak winter sun, horned as with rays, at work on the clouds of the winter sky (Christmas being near the time of the winter solstice), and so forth. Reviewers gravely discussed this banter, some finding "strong arguments," others "insufficient evidence," in my article—only some one in ten recognising the real object of the paper, which was to discredit the exaggerated faith in nature-myths as interpreting almost everything traditional, from nursery tales to the Hebrew records. Since then I have felt that nothing not absolutely labelled "a goak" will be understood as such. (If I did not know for certain that I am English born—even a Cockney, if Chelsea means Cockneydom—I should imagine I must somehow be an American, for among Americans quiet jokes are understood all round, and flavour ordinary intercourse very pleasantly; no one has occasion to explain "This is 'only pretend,'" as children say.) Still I *did* think I might be suspected of joking when I found the Boss Puzzle in the Great Pyramid. Or, must students of science *never* smile? If so, I would rather give up science; but fortunately it is not so. $\left(\frac{\pi}{2}\right)^t$. (Permit me to remark in passing that unless "pie" be of moderate dimensions, dividing it by two only before raising it to the *t*th, is unwise). The question whether the nineteenth century began on January 1, 1880, or on January 1, 1801, is equivalent to asking whether eighteen centuries amount to 1799 years or 1800 years. On January 1, 1880, only 1799 years had elapsed from the beginning of the Christian era; and, according to Cocker, it requires 1800 years to complete eighteen times a hundred years.—W. A. BENNETT. The "woman haloed" and the "goddess crescent-horned" are one and the same, and much more ancient than the lady you mention. UNBELIEVING THOMAS. I rather think myself that Mr. W. M. Williams's theory of fairy rings must go by the beard. It accounts for some rings (and Shakespeare's may have been of that kind), but certainly not for all.—HEADS thinks there *is* a science of phrenology.—A. S. No medical man could advise without seeing you. Consult your family doctor, if you have one; if not, one who has good practice as a family doctor. As to general regimen—take much outdoor exercise, shorten hours of sleep as much as possible, and sleep on a mattress. "When you turn, turn out." Avoid all stimulants. Seek society which will rouse emulation, whether in sports or in studies. Read wholesome manly works of fiction, (not namby-pamby sentimentalisms), travels, history, and so forth.—THOS. ADAMS, JUN. No suitable portrait of the editor exists. Either he is too modest, or he thinks (as Emerson used to say—only pray remember Emerson was an American, and would gravely say what he did not wish to be taken quite in earnest) "that no portrait yet taken presents all the charms of the original."—R. S. MCKERRELL. See review of books on "Dress," in this or early number, as to question of belt *versus* braces. F. J. NANCE. That explanation of a top spinning is scarcely sufficient; it describes what actually happens, but hardly shows why it should happen. FRED. HARPER. "Draughts" is even more scientific than chess; but so few take interest in it.—H. A. BULLEY. Many thanks; but your article goes over ground already sufficiently treated or to be treated. W. B. KESTEVEN. Dr. Carpenter cites similar instances in his "Mental Physiology." Such cases show how much certain powers of observation may be strengthened or extended by practice. D. H. The word Khedive should properly be pronounced Kaydeevay; but it is generally pronounced Khēdive, and custom authorises this pronunciation. Both pronunciations of "pasha" are given, but most authorities place the accent on the second syllable. About Evora I do not know.

ERRATA.—The footnote to our article on "Lower Life Forms"—in review of Dr. W. K. Brooks' excellent work, "A Handbook of Invertebrate Zoology"—unfortunately passed wholly uncorrected. The verbal corrections are obvious. The book, of course, is for *Laboratory and Seaside work*, and is published by Messrs. Trübner & Co., London. We take the opportunity to add that the book contains 200 illustrations. Its price is 15s.

Our Paradox Column.

A Correspondent thinks an occasional Paradox Column might afford instruction as well as amusement. I think so too. But just now I think more of the evidence such a column might afford, that, in not admitting certain letters and theories into Knowledge, I have been guided by the honest belief that they are not strictly scientific. Now here is a letter which, oddly enough, was opened next after the one asking for paradoxes. What can one do with such communications?

THE P.D. THEORY

EDITOR, I flatter myself that the P.D. Theory has a good hold, but, mistakes are so easily made; If the Theory of the P.D. Sir has any weight in it, let it go ahead, I am sure it will find its road through all other theorys, as it is composed from a natural idea, taken nature to have only one course, path or way, nature cannot go the wrong road without a change takes place, which it cannot change its-self as there is only the one way, and that way is its-self, it has the whole within its-self, nothing can change without been mixed, nature is pure, if it were to change by been mixed, it would not be pure, nor would it be natural—nor would there be any nature; Then what would we have, (Nothing) oh no, time says there has always being something or else the light of our sun could never be ever-lasting and pure; Which denotes all things in one class to be of one class or quality; shown that all planets are of one class, and all stars are of one class, also all of one class must move round one way, there is no other way in nature; the same with comets and meteor's, every thing in nature is self-acting, the sunbeams upon our earth until it rises a vapour and spreads it like a sheet which acts as a safety-valve or else our green carpet would soon be dismantled, we would not have any light if the sun did not rise the vapour every day, as light cannot light without something to light upon, nor can we have heat without the light, or else every thing would be cold, dark and lifeless.

Sir,—I cannot see in any way the P.D. Theory has taken harm by the new photo of A. C. Ranyard comet shown in Kno.—July 14—1882 As we have only the one front view of comet, the tail might have a very short or quick radius, but according to radius so will the distance be from the centre, as gravitation has its radius or law worked from the centre; judging from its tail, it must be a full grown comet, such as seen in gone by times when they looked beautiful, old comets that appeared in olden times looked like a sun without any tail

Sir,—I would like to see Mr. R. A. Proctor, Try this system (on) one twelve months. Or give me the address of one a American astronomer, a go ahead party. J. Murray.

Science and Art Gossip.

Professor Loomis states that the heaviest rainfall is met with in the rain-belt which surrounds nearly the whole globe lying between the north-east and the south-east trade winds. Mr. W. J. Black, having been engaged in collecting records of rainfall at sea for some time back, gives an estimate of the rates per annum for this rain-belt. That for the Atlantic Ocean is calculated at 133·37 in. per annum, that for the Indian Ocean at 80·55 in. per annum, that for the Austral-Chinese seas at 107·36 in.; but none has yet been made out for the Pacific Ocean, owing to absence of observation altogether from that quarter.

Mining Statistics. The Mines Inspector for North Staffordshire, Cheshire, and Shropshire, Mr. Thomas Wynne, reports that the number of persons employed in the various mines under his jurisdiction during last year was 24,499 against 22,852 in 1880; the quantity of minerals raised was 8,641,382 tons against 7,576,400 tons; the number of persons employed to each fatal accident was 583 against 476; the number to each life lost was 518 against 206; the tons of mineral raised for each fatal accident were 205,818 against 157,842; tons to each life lost, 112,261 against 68,265. The number of mines was 240 against 245, and the non-fatal accidents were 313 against 321.

Tree Burial in New Zealand. The recent fall of an enormous puketea tree near Opotiki, New Zealand, disclosed the fact that the hollow interior from the roots to the first fork, about forty-five feet from the ground, had been filled with human bodies. A confused heap of skeletons burst out of the butt of the tree when it fell. A local paper says:—"A more extraordinary sight than this monarch of the forest lying prone and discharging a perfect hecatomb of human skeletons can scarcely be conceived. Some are nearly perfect, while others are mixed up in a chaotic mass of heads, hands, feet, and arms, indiscriminately. All the Maoris here seem to have been quite unaware of this natural charnel house, and declare that it must have been filled long before their or their fathers' time. Indeed, the appearance of the tree fully justified the supposition that it must have been some hundreds of years since this novel family vault was filled with its ghastly occupants."

Mr. Boucicault on Acting.—On the stage of the Lyceum Theatre, on Wednesday (20th inst.), Mr. Boucicault delivered to a large audience of actors and others interested in the drama a lecture on the "Art of Acting: Its Rules and Principles." The lecturer's object was to show that acting might usefully be taught like painting and other arts. With this view he dealt with his subject under the several heads of articulation, gesture, posture, and study of character, each of which he illustrated from his own experience of the stage. As regarded gesture and posture, in particular, he showed that the true principles of the art existed merely as a tradition, and had to be picked up by the conscientious actor as best he could. It was not enough to behave on the stage as one would do in real life, as the lecturer proved by the simple act of picking up his hat from the table to walk out. The actor had to remember that his every action was presented as in the frame of a picture, and that it had to be studied with reference to the effect it would produce upon the house. The art of listening, and of continuing to sustain a character, even when he had nothing to say, was therefore an important part of the actor's art, though a part, unfortunately, much neglected. Under the head of posture, the lecturer insisted upon the necessity of cultivating the "lost art of walking," an art now possessed only by uncivilised people, whose ankles had free play, and who were in the habit of carrying weights upon their heads. The study of character, he showed, ought to be "from within" and not "from without." In other words, the character ought to be drawn from the nude, and the costume fitted to it afterwards. It was also desirable, whenever possible, to study a character from life, as Charles Mathews and Farren did for their parts of Dazzle and Sir Harcourt Courtly in "London Assurance." On all the points the lecturer contended that a course of instruction, such as was followed at the Conservatoire, would be beneficial to those who desired to adopt the stage as a profession. The lecture, interspersed as it was with much genial anecdote and practical illustration, was both entertaining and instructive and at its close Mr. Boucicault received the cordial thanks of the house.

Our Mathematical Column.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.
No. VI.

By Richard A. Proctor

WE have now to establish rules for dealing with composite functions, and functions of functions.

First let us take composite functions [illegible] the sums and differences of functions, (ii.) the products of functions, [illegible] tions divided by functions

I. Let $u = v + w - y + z$, &c., where v, w, y, z, &c., are all functions of x; and when x is altered into $(x + \Delta x)$, let u be altered into $(u + \Delta u)$, v into $(v + \Delta v)$, [illegible] into $(\ + \Delta\ )$, &c. Then

$$u + \Delta u = (v + \Delta v) + (w + \Delta w) - (y + \Delta y) + (z + \Delta z) + \text{\&c.}$$

Hence, subtracting the former equation from the latter

$$\Delta u = \Delta v + \Delta w - \Delta y + \Delta z + \text{\&c.}$$

and dividing both sides by Δx, we have

$$\frac{\Delta u}{\Delta x} = \frac{\Delta v}{\Delta x} + \frac{\Delta w}{\Delta x} - \frac{\Delta y}{\Delta x} + \frac{\Delta z}{\Delta x} + \text{\&c.}$$

Now, suppose Δx to become indefinitely small, so that $\frac{\Delta u}{\Delta x}$, $\frac{\Delta v}{\Delta x}$, $\frac{\Delta w}{\Delta x}$, $\frac{\Delta y}{\Delta x}$, $\frac{\Delta z}{\Delta x}$, &c., become the differential coefficients of u, v, w, y, z, &c., with respect to x. Then we have

$$\frac{du}{dx} = \frac{dv}{dx} + \frac{dw}{dx} - \frac{dy}{dx} + \frac{dz}{dx} + \text{\&c.} \qquad \text{(A)}$$

II. Let $u =$ [illegible], as before being functions of x and [illegible] same [illegible] changes taking place in [illegible] when x is changed into $x + \Delta x$. Then,

$$u + \Delta u = (y + \Delta y)(z + \Delta z)$$
$$= yz + z\Delta y + y\Delta z + \Delta y \Delta z$$

and subtracting former from latter

$$\Delta u = z\Delta y + y\Delta z + \Delta y \Delta z$$

and
$$\frac{\Delta u}{\Delta x} = z\frac{\Delta y}{\Delta x} + y\frac{\Delta z}{\Delta x} + \frac{\Delta y \Delta z}{\Delta x}$$

Now when Δx is made indefinitely small, this becomes

$$\frac{du}{dx} = z\frac{dy}{dx} + y\frac{dz}{dx} + \text{(an indefinitely small quantity)}$$

$$\frac{du}{dx} = z\frac{dy}{dx} + y\frac{dz}{dx}$$

And [illegible] manner it may be shown that if $u = [illegible]$

$$\frac{du}{dx} = [illegible]\frac{dv}{dx} + vxz\frac{dw}{dx} + [illegible]\frac{dy}{dx} + [illegible]\frac{dz}{dx} + \&c. \qquad \text{(B).}$$

[illegible] Let $u = \frac{y}{z}$, y and z being functions of x. Then—

$$u + \Delta u = \frac{y + \Delta y}{z + \Delta z} = \frac{y}{z}\left(1 + \frac{\Delta y}{y}\right)\left(1 + \frac{\Delta z}{z}\right)^{-1}$$

$$= \frac{y}{z}\left(1 + \frac{\Delta y}{y}\right)\left(1 - \frac{\Delta z}{z} + \text{terms involving } (\Delta z)^2 \&c.\right)$$

$$= \frac{y}{z} + \frac{\Delta y}{z} - \frac{y\Delta z}{z^2}$$

$$+ \text{ terms involving } \Delta y . \Delta z,\ \Delta z^2, \&c.)$$

$\therefore$ Subtracting u, $\Delta u = \frac{\Delta y}{z} - \frac{y \Delta z}{z^2}$ + (terms involving Δz^2, &c.)

$$\text{and } \frac{\Delta u}{\Delta x} = \frac{1}{z}\cdot\frac{\Delta y}{\Delta x} - \frac{y}{z^2}\cdot\frac{\Delta z}{\Delta x} + \text{(terms involving } \Delta z^2, \&c.)$$

so that proceeding to the limit,

$$\frac{du}{dx} = \frac{1}{z}\frac{dy}{dx} - \frac{y}{z^2}\frac{dz}{dx} \qquad \text{(C.)}$$

Take next the function of a function. Suppose, for instance, that $u = \phi(y)$, where y is a function of x. Let y change to $y + \Delta y$ when Δx is some small but finite increment, and with this change let u become $u + \Delta u$, and x become $x + \Delta x$. Then we have

$$u + \Delta u = \phi(y + \Delta y)$$
$$\Delta u = \phi(y + \Delta y) - \phi(y)$$

and
$$\frac{\Delta u}{\Delta x} = \frac{\phi(y + \Delta y) - \phi(y)}{\Delta x}$$
$$= \frac{\phi(y + \Delta y) - \phi(y)}{\Delta y} \cdot \frac{\Delta y}{\Delta x}$$

Now let Δx become indefinitely small, Δu and Δy becoming also indefinitely small. Then $\frac{\phi(y + \Delta y) - \phi(y)}{\Delta y}$ becomes $\frac{du}{dy}$, in accordance with our definition of a differential coefficient, and the above equation becomes

$$\frac{du}{dx} = \frac{du}{dy} \cdot \frac{dy}{dx} \qquad \text{(D)}$$

If we note that relation (C) may be written thus,

$$\frac{du}{dx} = \frac{1}{z}\cdot\frac{dy}{dx} + y\frac{d}{dx}\left(\frac{1}{z}\right)$$

(a result [illegible] until D had been established) we see that relations A, B, and C may be combined into the first of the following rules, while D gives the second.

Rule I.—*To determine the differential coefficient of a composite function of [illegible] with respect to that variable, differentiate each component [illegible] with respect to the variable, as if the rest were constant, and add the results.*

Rule II.—*To determine the differential coefficient of a function of a function of a variable with respect to this variable, differentiate with respect to the [illegible] function, and multiply the result by the differential coefficient of this function with respect to the variable.*

It is hardly necessary to note that the differential coefficient of a constant is zero, for this is only another way of saying that a constant does not vary. It is also clear that *if the differential coefficient of a quantity is zero, the quantity must be constant*, for this is only saying that a quantity which does not vary is constant. It is, moreover, independently obvious, but comes out directly from Rule I., that *if the differential coefficient of a quantity is known, then the differential coefficient of the quantity multiplied or divided by a constant is the former differential coefficient multiplied or divided by the same constant.*

We had occasion some time back to note that *two quantities which have the same differential coefficient can only differ by a constant quantity.* We can now prove this. For let there be two quantities y and z, both functions of a variable x, which have the same coefficient with respect to x; so that

$$\frac{dy}{dx} = \frac{dz}{dx}$$

Then if $y - z = u$, we have, by Rule I,

$$\frac{du}{dx} = \frac{dy}{dx} - \frac{dz}{dx} = 0$$

wherefore u is a constant, *i.e.*, since $u = y - z$, y can only differ from z by a constant quantity.

In our next we shall give some examples of differentiation by these rules.

Problem 30. A solution which has been suggested to me of Query No. 30, page 323, vol. i., I give below:

$x^2 + y = 11$
$y^2 + x = 7$
$\therefore\ x^2 + y^2 + x + y = 18$ to this add and subtract $2xy$
$x^2 + y^2 + 2xy + x + y = 18 + 2xy$
and $x^2 + y^2 - 2xy + x + y = 18 - 2xy \begin{pmatrix} \text{let } x + y = s \\ x - y = a \end{pmatrix}$
add: $s^2 + 2s + a^2 = 36$

36 being a square number $s^2 + 2s + a^2$ must be a square or a^2 must equal 1; wherefore $s + 1 = 6$. F. H.

[Why does it follow that because $s^2 + 2s + a^2$ is a square, $a^2 = 1$? $4^2 + 2 \times 1 + 5^2 = 49 = 7^2$, and these are all whole numbers: x and y might be fractional. Ed.]

A mathematical correspondent (Mr. F. Cowley) asks me to explain why, after saying, at p. 101, col. 2, that at the beginning of the rth interval the velocity is $(r-1)\,g\tau$, and at the end of that interval the velocity is $rg\tau$, I go on to say that the space described in the interval lies between $(r-1)\,g\tau^2$ and $rg\tau^2$. He says this seems to be assuming what I have to prove, "though in reality the space so traversed is in reality $\frac{1}{2}rg\tau^2$." There is no assumption in the matter, however; the space described in a given time, t, with uniform velocity, v, is vt; so that the space described in time τ, with velocity $(r-1)\,g\tau$ is $(r-1)\,g\tau^2$, while space described in time τ, with velocity $rg\tau$, is $rg\tau^2$; we know that the space described in the rth interval (τ in length of time) lies between these values, because the velocity, is never less than $(r-1)\,g\tau$ during the interval, and never greater than $rg\tau$. Our correspondent seems to confound in some way the space described *at the end of* the rth interval with the space described *during* the rth interval. The former is of course $\frac{g}{2}\,(r\tau)^2$ (by the usual formula $s = \frac{1}{2}ft^2$. The space described during the interval is in reality

$$\frac{g}{2}\left[(r)^2 - (r-1)^2\right]\tau^2 = \frac{g}{2}(2r-1)\tau^2$$

Writing this $g\,(r - \frac{1}{2})\tau^2$ we see that it lies, as a matter of fact, just half way between the two limiting values mentioned above and in the text. In most cases where limits are mentioned in this way, all that we can assert at first is that the quantity dealt with lies somewhere between the limits mentioned, not that it lies, as it happens to do in this case, exactly midway between them.

The same correspondent asks how, after showing that the space traversed lies between two quantities, I can reasonably say that in the limit these two quantities are equal. "How can a quantity lie between two equal quantities?" I fear if Mr. Cowley finds difficulty here, the whole subject will appear very perplexing to him. Of what use would it be to show that a quantity which we want to determine exactly lies between two quantities which ultimately differ by a finite quantity? If we can show that a quantity always lies between two others, B and C, which may be written A + a and A − a', while both the quantities a and a' may be made, under certain conditions, less than any assignable quantity, *then*, and then only, we can say that under those conditions X = A? Why should we find any difficulty in the circumstance that under these conditions B = C = A?

Problem. To integrate $d\theta = \left(\frac{4x^2 + 3}{x^2 + 1}\right)dx$.

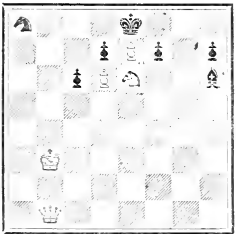
Our Chess Column.

By Mephisto.

PROBLEM No. 49.

By Leonard P. Rees.

BLACK.



WHITE.

White to play and mate in two moves.

GAMES BY CORRESPONDENCE.

We hope our correspondents will not think we have either forgotten or neglected them. We are as eager as ever to please them, but exigencies of space prevented us from doing all we wished to do. We clear up some of our arrears in publishing this week some happy specimens of games played by Correspondence through the medium of our journal:—

BETWEEN MR. E. P. WESTLAKE, OF (WOOLSTON) SOUTHAMPTON, AND MR. E. A. DILLON, OF LONDON.

King's Gambit.

White. E. P. W.	Black. E. A. D.	White. E. P. W.	Black. E. A. D.
1. P to K4	P to K 4	10. B takes Kt	B takes B
2. P to KB4	P takes P	11. B takes P (ch)	K to Qsq
3. Kt to KB3	P to KKt4	12. P to K5	R to Bsq
4. B to B4	B to Kt2	13. Kt to R3	Kt to B3
5. Castles	P to Q3 (a)	14. Q to Q5 (d)	B to K6 (ch) (e)
6. P to B3 (b)	P to Kt5	15. K to Rsq	Q to Kt4
7. P to Q4	P takes Kt	16. R to B6 (f)	Kt to K2 (g)
8. Q takes P	Kt to KR3 (c)	17. R takes P (ch)!	Resigns (h)
9. QB takes P	Q to K2		

NOTES.

(a) 5. P to KR3 deserves a slight preference.
(b) 6. P to Q4 is better.
(c) We prefer 8. B to K3.
(d) Well played; White now has a strong game.
(e) Useless. B to Q2 might have proved better.
(f) Playing in fine style, he threatens R takes P (ch), &c.
(g) Even now B to Q2 would have saved Black from impending ruin.
(h) The position is interesting. The following would be the termination if continued:—17. P takes R; 18. Q takes P (ch), B to Q2; 19. B to K6, and mate is inevitable. Or, if Black does not take the Rook, but plays 17. B to Q2, then 18. R takes B (ch), K to Bsq; 19. R to Q8 (ch), R takes R; 20. B to K6 (ch), K to Ktsq, and mate in two.

BETWEEN MR. G. WOODCOCK, OF HYTHE, AND MR. G. FREEMAN, OF LONDON.

French Defence.

White. G. W.	Black. G. F.	White. G. W.	Black. G. F.
1. P to K4	P to K3	9. R to Ksq	P to KR3
2. P to Q4	P to Q4	10. B to KB4	P to QR3 (c)
3. Kt to QB3	Kt to KB3	11. Q to Q2	B to K3 (d)
4. P takes P	P takes P	12. B takes KRP	P takes B
5. Kt to B3	B to Q3 (a)	13. Q takes P (e)	Q to Q2 (f)
6. B to Q3	Castles	14. Kt to K5	Kt takes Kt (g)
7. Castles	Kt to B3	15. R takes Kt	Resigns (h)
8. B to KKt5	B to K2 (b)		

NOTES.

(a) 5. B to K2 is better for the second player.
(b) As good as B to K3.
(c) Useless. In a match game, Gunsberg here played against Blackburne B to KKt5.
(d) Not foreseeing White's lurking enterprise.
(e) With a good game.
(f) If 13. Kt to QKt5 with the object of dislodging the B, White wins by 14. R to K5.
(g) If Q retires, then 15. R to K3.
(h) Having no resource left against White's good play.

BETWEEN MR. A. B. PALMER, OF PENGE, AND MR. G. WOODCOCK, OF HYTHE.

White. A. B. P.	Black. G. W.	White. A. B. P.	Black. G. W.
1. P to QR3 (a)	P to Q4	15. Kt to Q6	Kt to K4
2. P to QB3 (b)	P to K4	16. Kt to B5	P to QR4
3. P to K4	P to QB3 (c)	17. Castles	P to QB5
4. P to Q3	Kt to KB3	18. P takes P	Kt takes P (e)
5. B to Kt5	B to K2	19. P to K5 (f)	Kt takes KP
6. B takes Kt	B takes B	20. B takes R	Q takes B (g)
7. Kt to Q2	Castles	21. K to R2 (h)	Kt to B6 (ch)
8. KKt to B3	P to Q5	22. K to R3	Q to K5
9. P takes P	P takes P	23. Kt to K3 (i)	P takes Kt
10. P to KR4	B to Kt5	24. P takes P	Kt takes RP
11. P to KKt3	P to QB4	25. R takes B	P takes R
12. B to K2 (d)	B takes Kt	26. P takes Kt	Q takes KP (ch)
13. B takes B	Kt to Q2	27. K to Kt4 (j)	K to Rsq
14. Kt to B4	P to QKt4	28. Q to Q6	Black mates in four moves (k)

NOTES.

(a) Permissible, if soon followed up by P to K4 and QB4.
(b) This at once puts White at a disadvantage.
(c) Black ought to have taken the Pawn—i.e., 3. P takes P; 4. Q to R4 (ch), Kt to QB3; 5. Q takes KP. Kt to KB3, with a good development.
(d) We prefer 12. B to R3.
(e) Black has steadily developed his game on the Queen side, but now he would have done better to play P takes P. White cannot capture the KP on pain of losing a piece, for if Kt takes P, then Q takes Kt.
(f) White wins the exchange, but Black probably foresaw this.
(g) He now occupies a commanding position. The White Knight cannot take the Pawn, as Black would win the piece by R to Qsq.
(h) This is weak. P to B3 or B4 would have been better, to which Black might have replied with Kt to B5.
(i) This Knight cannot be defended by Q to Kt sq, as P to Q6; but he would have saved the piece by Kt to Q6, but then Black would have played 12. Q to K3(ch), K to Kt2; 25. Kt takes RP (ch), followed by Q takes Kt, with a good game.
(j) Into the lion's mouth.
(k) By R to Kt sq (ch), K to B4; Q to B6 (ch), Q to B4; Q to Q4 (ch), and mate next move.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess-Editor.*

From Squire.—We shall not use the small diagrams for original problems any more; only for copies. Glad you are pleased.

Alfred B. Palmer.—Problem received with thanks. Can you send a game you have won?

Belmont.—Of course you know that a forced mate is required which you get by 1. R to Q7 (ch).

A. A. Dent.—Solutions incorrect.

A. A. B.—Such a thing happened to us before with one of your games, for which we had actually paid a fee; but we by no means grumble at the praiseworthy enterprise of our contemporary.

Leonard P. Rees.—Thanks for problem. Hope soon to have an opportunity of pronouncing an opinion upon 10. Castles.

Correct solutions of Problem No. 46 received from Alfred B. Palmer, Kit, Berrow.

Problem No. 47. Belmont, Herbert Jacobs, Berrow, Alfred B. Palmer, Kit.

Problem No. 48. Leonard P. Rees, Belmont, Alfred B. Palmer, Squire, John Percy Isaac, Berrow, C. W. Croskey, B. Pierce, A. H. Cooke, John Watson, M. Beyfus, J. J. Kaye, E. J. J.

Our Whist Column.

PLAY THIRD IN HAND (TRUMPS).

THE [illegible] trumps, varies often importantly from the play in plain suits, though it is not easy to lay down [illegible] the difference. Usually, when you [illegible] hand, the suit has either been led by your [illegible] he returns your own lead of trumps. You [illegible] in this case, to draw trumps and bring in a [illegible] often more important to keep the lead [illegible] a trick by finessing, so that beyond the customary [illegible] A[illegible], Queen (third in hand), you would avoid finessing [illegible] play of trumps, especially to your partner's [illegible] of trumps. On the other hand, you can finesse [illegible] safely in trumps than in other suits, for a winning card [illegible] to make. And again in the third round of trumps [illegible] often be well to pass the trick, even when second in hand [illegible] or when fourth in hand is sure to take it, so as to [illegible] the last trick in trumps. These matters depend so much on [illegible] indications from the play, on the nature of the hand [illegible] trumps, and so forth, that it is impossible to lay down [illegible] rules: the best way of indicating correct principles of play is to give illustrative hands for study. It need hardly be said that the trump card has to be taken carefully into account in considering what to play third in hand. It not only alters often the [illegible] into sure play, as when King has been turned up on [illegible] right and you hold Ace, Queen, third in hand; but it may make a finesse sound which otherwise would be unsound. Thus to finesse the Knave third in hand from Ace, Knave, [illegible] without others, would be usually unsound; but if Queen or [illegible] on your right, it is sound, as you finesse against [illegible] and if the finesse fails retain the command. (Note, [illegible] that when trumps have been originally led by yourself, [illegible] to finesse against more than one card.) If your [illegible] has turned up King or Queen and leads a small trump, [illegible] from Ace Knave is not so well, for in that case [illegible] partner probably does not hold both King and Queen, and if second hand plays a small card, the odds are rather in favour of either King or Queen being on your left. With King, Knave, &c., to your partner's original lead of trumps, finessing [illegible] Knave is inexcusable. (Of course, if Queen is turned up on [illegible] right, or by your partner, you would play the Knave; but that, [illegible] of course, would not be a finesse.

In all cases, in plain suits as well as in trumps, finessing third in [illegible] must depend on the score. If the failure of the finesse in [illegible] suits would lose the game, a finesse is inexcusable; it is [illegible] if failing would leave you at the score of two [illegible] of three, or lose instead of gaining you the odd trick. On the other hand, if the failure of the finesse would leave you the [illegible] trick instead of three, while its success would leave you at the [illegible], it is nearly always right to finesse, even when the [illegible] are rather against than in favour of success.

[illegible] next we shall consider the inferences from play third in [illegible] we have already considered the inferences from the lead, [illegible] second in hand, &c.

EASY END GAME.

A holds: [illegible] 9, 6. [illegible] Kn, 5.

B holds: [illegible] 5, 2. [illegible] 10, 3.

Y holds: *Spades*—10, 8. Hearts—9, 7.

Z holds: *Spades*—Q, 3. Hearts—[illegible], 2.

B

Y Z (Dealer; *Spades Trumps*)

A

Score— { A, B, —1 / Y, Z, —2

[illegible] honours have been played by Y Z, one honour by A, so that [illegible] two by honours to Z's knowledge. A B have turned six [illegible].

[illegible] having led Diamond Knave, how is Z to play to save and win [illegible] game?

DOUBLE DUMMY PROBLEM (p. 101).

We have received two forms of solution to the problem, which [illegible] be it remembered, that the adversaries should have four [illegible] honours in every suit, yet that five [illegible] cards [illegible] be won [illegible] them.

First, sent by one correspondent only (unfortunately his name or initials not appended to the solution itself, though accompanying his letter [illegible] mislaid) runs as follows:—

THE HANDS.

A.
Diamonds—9, 7, 2, 5.
Clubs—10, 9, 8, 7, 6, 5, 4, 3, 2.
Hearts—None.
Spades—None.

B.
Diamonds—10, 8, 6, 4, 3.
Spades—10, 9, 8, 7.
Hearts—10, 9, 8, 7.
Clubs—None.

Y.
Diamonds—K, Kn.
Spades—K, Kn.
Hearts—K, Kn, 6, 5, 4, 3, 2.
Clubs—K, Kn.

Z.
Diamonds—A, Q.
Spades—A, Q, 6, 5, 4, 3, 2.
Hearts—A, Q.
Clubs—A, Q.

B

Y Z

Trump Card, Diamonds

A

NOTE.—The underlined card wins trick, and card below it leads next round.

A to lead

1	C 2	C Kn	D 3	C Q
2.	D 2	D Kn	D 4	D Q
3	D 5	S Kn	S 7	S 2
4	C 3	C K	D 6	C A
5	D 7	D K	D 8	D A
6.	D 9	H Kn	H 7	H A

Then *A* brings in his Clubs, Y and Z playing any cards whatever, and *B* retaining the long trump till the thirteenth trick. It is obvious that Y and Z are powerless. If Z leads Diamond Ace at trick 3, the order of tricks 3, 4, and 5 is simply changed, but the result remains the same. So also if Z leads a Heart or a Club at trick 3 instead of a Spade.

The other solutions, sent by J. Hargreave, T. Parminter, Loresmith, M. Vindex, H. H. Hamilton, and others, we shall give next week.

Contents of KNOWLEDGE *No.* 39.

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CONTENTS OF No. 41.

THE AUGUST METEORS.

By the Editor.

ON the nights of August 10 to 14, and sometimes till several nights later, meteors or shooting stars, belonging to the family known as the Perseides, may be generally seen, at times showing in great numbers. Humboldt remarks that, on the festival of St. Lawrence (August 10), "fiery tears" (supposed to be the saint's) fell from heaven, and he quotes Dr. Thomas Forster as saying that in a manuscript preserved in the library of Christ's College, Cambridge, written in the tenth century by a monk, the 10th of August is distinguished by the word "Meteorodes." Thomas Forster seems to have overlooked the effect of difference of style. In the seventeenth century, when the style was corrected, eleven days were dropped* to set the calendar right; in the tenth century the difference due to style amounted only to six days; so that the worthy monk's day for "meteorodes" corresponded to Aug. 16 of our time. The same meteor system may be meant, however, as perturbations may have affected the place where this family of meteoric bodies crosses the earth's orbit.

It is interesting to compare what was said about shooting stars by Humboldt, forty years ago, with our present knowledge. Then there were sensible men who saw, in the knowledge already gathered, the means of determining many points which writers in our time too often speak of as if they were recent discoveries. Then, also, there were representatives of the sterile school of science who ridiculed the results of sound reasoning, as if it were a fanciful hypothesis; men who called themselves observers, and spoke with enthusiasm of the making of observations, the collecting of observations, the classifying of observations, of everything, in fine, connected with observations, except the attempt to understand them and determine their value, which these cleverly practical persons called mere theorising.

* The day following Sept. 2, 1752, was called Sept. 14. In some popular books of astronomy, Sept. 3 is substituted for Sept. 2, and the singular statement made that calling the day following Sept. 3 Sept. 14, involved dropping *eleven* days.—*Vide* Lockyer's "Elements of Astronomy," and other such works.

Thus Olmsted at Newhaven, Conn., found that during the celebrated fall of shooting stars on the night between November 12 and 13, 1833, the fire balls and shooting stars all radiated from one and the same quarter of the heavens, namely, the vicinity of the star Gamma Leonis, and did not deviate from that point, though the star changed its apparent height and direction with regard to the compass points during the time of observation. A curious observation—to be recorded, sent to some learned society, and forgotten? Not altogether so. Olmsted had a brain, as well as eyes wherewith to observe, and he reasoned that "such an independence of the earth's rotation shows that the luminous body must have reached our atmosphere from *without*. A fanciful theory, truly, said in effect the mere observers, for they proceeded to speak of meteors as though nothing of the kind had been shown. The fact is, however, they were to be excused: Olmsted's reasoning was demonstrative only for those who could follow him; he could give reasons, he could not give understanding.

So also, the occurrence of showers on particular days of the year—that is, at times when the earth is in particular parts of her orbit round the sun—was recognised by reasoning men as proof positive that meteor systems are extra-terrestrial. Humboldt, though he was not, properly speaking, an astronomer, yet studying astronomy like other sciences, with care to obtain an insight into the facts, saw the real meaning of this particular fact.

Now, of course, what was proved half a century ago by Olmsted, Encke, and others, is the accepted teaching of science. The August shooting stars gave the first obvious and easily understood evidence on the subject. When it was noticed that the larger comet of 1862 crossed the earth's track where the August meteors are encountered, every one could understand what Schiaparelli meant when he said that bodies following in the track of that comet would appear (as they passed through our atmosphere) to follow such path as the August meteors traverse, *i.e.*, paths seeming to radiate from the constellation Perseus. The beautiful reasoning of Olmsted had been neglected; the bold fancy of Schiaparelli was at once noted: not more noted afterwards when by sound reasoning he showed that his lucky guess was a true one, than when he first threw out the idea. What followed is or should be well known. Adams, by an admirable mathematical investigation, showed that the November meteors travel in a period of $33\frac{1}{4}$ years round the sun; and it was found that Tempel's Comet of 1866 traverses the self-same track. After which, it was justly regarded as proved that these meteor systems, following in the track of two comets, are in some way associated with them, and that, therefore, probably other systems of meteors are similarly associated with comets: and other comets, in like manner, followed by trains of meteoric bodies.*

The shooting stars, which will probably be seen during the next few nights after these lines appear, may be identified with the Perseids by observing whether the paths they follow—traced straight backwards—pass through the constellation Perseus. Our Star Map for August (part 39, for July 28) shows that this constellation lies rather low down towards the north-east—a little northerly—at 9.45

* A fact singularly misunderstood by many. Thus, in Mr. Dunman's charming "Talks about Science, just issued, it is stated that, according to "Messrs. Thompson" (Sir W. Thomson) "and Tait," the tail of a comet is "a cloud of dust from the colliding masses" [of meteors] "which the head trails behind it." Mr. Tait said something of the sort—in fact, he wrote that a comet's tail is merely a shower of paving stones; but that was before he knew what astronomers had really proved.

on Aug. 10, and at 9.30 on Aug. 14. The constellation at these hours is moving ascendingly, and towards the east, remaining above the horizon all night. Meteors of the Perseid system may accordingly be seen at any time of the night: in greater number, but with shorter paths near Perseus: more scatteredly, but with longer paths at a distance from that constellation. As the moon will be new on Aug. 13, the opportunity for observing the August meteors this year is very favourable.

Scattered members of the August system may be seen for several days after the track of the main body has been crossed. But, as the direction in which the earth travels changes about one degree per day, science cannot admit that, as Mr. Denning opines (who has done excellent work in the observation of meteors), members of the August system can be recognised by still radiating from the proper "radiant" of this system several weeks before and after the time of central passage. To say that a shooting star on September 14, for instance, radiated from the same centre as one seen on August 14, when the earth's course was thirty degrees different, is, for the mathematician, equivalent to saying, not that they belonged to the same, but that they belonged to different meteor systems.

ENGLISH SEASIDE HEALTH-RESORTS.

By Alfred Haviland, M.R.C.S., F.R.M.C.S. Lond.

WINTER TEMPERATURES.

The winter isotherms link together health-resorts very remote from each other: for instance, we find those on the North Coast of Wales—Bangor (58), Beaumaris (59), Penmaenmawr (60), Llandudno (61) and Rhyl (62)—participating in the same mean January temperatures that characterise the South Coast, between the isotherms 40° and 42°, within which lie places having a high repute as winter resorts, for instance:—the Isle of Wight (33), Bournemouth (34), Weymouth (35), Lyme Regis (36), Sidmouth (37), and Exmouth (38). This fact is of great moment to persons living in Central England, to whom the distance from their homes to the South Coast would often entail a prohibitory expense. Again, we find between the isotherms 42° and 43° the moister climates of Dawlish (39), Teignmouth (40), and Torquay (41), linked, so far as temperature is concerned, with the more bracing and drier resorts of the North coast of Devon and the coast of Somerset, viz.:—Linton (50), Blue Anchor (51), Burnham (52), and Weston-super-Mare (53). On the East coast there is a remarkable uniformity of the winter temperatures, as will be seen on observing how closely the 37° isotherm follows the contour of the coast, and thus link Hythe (25), Folkestone (24), Dover (23), Deal (22), and Ramsgate (21), with the health-resorts of the Yorkshire coast, which latter, however, have the greater advantages of being further removed from the Continent, and a greater sea area in front of them.

The influence of the Irish Sea on the winter climate of the whole of the west and north coasts of Wales is well shown in the chart. Those resorts which lie on the coast of peninsular Cornwall have the mildest winter climate; for they are not only the most southern, but have the immense sea area of the Atlantic before and around them; even in the coldest month, January, they enjoy a mean temperature betwen the 44° and 45° isotherms, the latter of which is out of the map, as its curve is found between the Land's End and the Scilly Isles. These resorts are Falmouth (44), Penzance (45), Sennen (46), and St. Ives (47).

Buchan remarks, with regard to the effect of the English Channel on the course of the isothermals, that its greater shallowness, its proximity to the Continent (whose winter temperature is lower than that of Great Britain), and its immediate connection with the North Sea (through the Straits of Dover) waters are colder than the Atlantic at this season; it has a much less powerful influence in warming the resorts along the south coast of England than the Irish Sea has on those which enjoy the mild climate it transports to them. The rapid diminution of temperature from the Land's End eastwards to Kent is one of the most marked features of the winter temperature. The mean temperature of Helston (Cornwall), in January, is 45° 1', from which it falls to 40° 5' at Bournemouth, and to 38° 1' at Canterbury.

With regard to the observation that the waters of the North Sea are colder than those of the Atlantic, we would observe that, from observations made at Scarborough for the last five years, the average January temperature of the sea amounted 41° 2 Fahr.

We should be glad to receive further information with regard to the temperature of the sea, as it is a most important factor in the climates of our health-resorts.

Communications on this or any other subject should be addressed to the Editor.

The Summer (July) Isotherms.—We have just seen how the southern seaside health-resorts are bracketed with the Northern during the winter by means of the isotherms produced by the gulf stream; we shall now see how the two opposite coasts of England are, as it were, brought together by the *sun-heat isotherms.* In the first place, we notice that these summer isotherms arch northwards over the land, showing that the sun-heat's influence is felt in higher latitudes than over the sea, where in fact we find the distances between each isotherm have been considerably lessened by the cooling influence of the equable sea temperature.

Beginning from the VI. zone, we find that nearly all the south-west resorts lie to the south of the 63° isotherm, and that a greater part of Devon and the whole of Cornwall lie between it and the 61°. We must also note the effect of the large masses of land in the IV. and V. interlatitudinal zones in extending the sun's influence over the large area embraced within the 63° isotherm, and further observe how, in the central position of the latter zone, the mean temperature for July reaches to 64°. The Climate Chart, at p. 163, sufficiently explains which of the several resorts on the east and west coasts of England and Wales share the same isothermal zones, and obviates further description.

We have now seen what resorts, owing to their position on the sea-board, enjoy the warm, moist air from the gulf stream; we must now point out which of them have their climate influenced by the bracing airs of the North Seas. It must be remembered that the winds do not, as a rule, in these latitudes blow in straight lines for any considerable distance from the several points of the compass, either over England, Wales, and Ireland, or over Scotland; but that they rather perform circuits around certain areas of low barometric pressure, and it is possible that a wind which makes its way as a north-west wind through the North Channel and over the Irish Sea to the coast of Cumberland may, after passing over 60 or 70 miles of land, find its way as a westerly wind in the Vale of York, and assume a south-westerly direction before it reaches the coast of the North and East Ridings of Yorkshire; when this is the case, which is by no means unfrequent, the south-west wind has the character of a cold and frosty current in the winter. Any ordinary chart of the world will plainly show how, during the prevalence of winds from the North-West to the north-east by the north, the resorts on both sides of our country which lie within II. and III. interlatitudinal zones, enjoy not only the purest but the driest of sea winds, which have blown over an almost boundless area of sea; and it will be seen hereafter that these resorts, which we have just shown differ little from the southern in their winter temperatures, have climates of remarkable tonic power, which, when other factors are present, such as rock-bound coasts, &c., acting as force-breakers to the wind, conduce to the prevention in youth of the development of that dreadful disease, consumption, which in the ten years 1861-70 killed 529,425 persons.

THE HUMOUR OF THE ARYAN RACE.*

An American writer, Miss Elizabeth Robins, has recently been working in a branch of ethnology entirely new—viz., the study of the humour of the Aryan nations; and the articles she has published on that subject are replete with new facts, the result of much knowledge and acute observation. They suggest, moreover, fresh lines of inquiry, and some account of them may not prove uninteresting to the readers of Knowledge. The primary object of all historical studies is to arrive at a conception of the growth of the human race, and to recognise in its earliest efforts and strivings the mighty source from which our present civilisation has been evolved. In such investigations it is with profound satisfaction that we discover the evidence of the working of the mind of man, and the monuments of antiquity have little value to us beyond the human interest they possess. Now, there is no faculty of man so purely human as that of humour, wherefore its study has an attraction for us that some others do not present. But it is not easy to trace with the historic development of mankind. Even now wit and pleasantry are difficult to apprehend, and fly Proteus-like from him that pursues; but of the earlier ages of our history much is lost that would enlighten us, and what remains is but little understood. Yet Miss Robins' articles throw much light on this by-way of ethnological science.

From the time when the Hindus crossed the snowy Himalayas from their primordial home, and settled by the banks of the Seven Rivers, they have maintained the mental characteristics that quickly distinguished them; and thus the Hindu of to-day represents well his ancient ancestors The dreary calm engendered in him by the climate in which he lived caused the Hindu to repine at the activity the requirements of life entailed, and his ideal Elysium was a state of perfect passivity and rest. "There never was a nation," says Professor Max Müller, "believing so firmly in another world, and so little concerned about this." This weary spirit bore fruit in the Buddhist doctrine of Nirvana, which taught the Hindu to look forward to his absorption into Atman, the One Great Self, when the toil of existence should cease, as the chief and final good. Such a metaphysical belief as this, when the essence of progress is wanting, and the tone of mind that led to it, have left a deep impress on Hindu civilisation, and have marked its literature with a special character. The Vedas of the Hindus, as Miss Robins points out, contain many sublime passages; their law-books are filled with wisdom; their epics celebrate the deeds of great heroes, and their dramatic works have a strong affinity to ours; but even in these the quiescence of the Hindus prevents the great lights of tears and laughter, the glory of the literature of other nations. In other words, they have never realised the higher pleasures and greater pains that are the lot of more sensitive men. They were apt, in their metaphysical speculations, to laugh at the folly of mankind for rejoicing or despairing in a world where there was no reality; and their humour is often so bitter and misanthropical, that it is often not easy for Western readers to distinguish that which is humorous from that which is grave. Miss Robins considers the story of Baital Pachisi to be the masterpiece of Sanskrit humour, of which it is distinctly typical. It represents the subjection of human power and wisdom to the Vampire, the representative of all that is vile, and it is withal so entertaining that it has been very popular.

Unlike their kinsmen in Asia, who with the lotus-eaters have "no joy but calm," the northern Aryans have met in their migrations with hardship and cold; and learning to value that gift of life for which they have fought so hard, they have been invigorated by labour and rewarded by its fruits. The ancient Greeks, settled in the land of Hellas, in "that fair clime where every season smiles," speedily assumed the first place in European civilisation. They enjoyed a vigorous life, in the open air; and, communing much with nature, they became lovers of the beautiful, which with them was the external form of the good. It was thus that the inhabitants of Olympus were assimilated to themselves, and became the types of the higher life of the Hellenic genius. But the Greek gods were not humorous in the sense in which we understand the word now. They were mirthful, it is true, and laughed loudly at the grotesque appearance of Pan, and at his mad tricks, but their amusement was chiefly derived from external objects and ridiculous deceptions. But the early Greeks had serious aims, and did not think the comic worthy of attention, for which reason, says Aristotle, the archon did not until late assign a chorus to the comic poets. The humour of the Romans resembled strongly that of the later Greeks, but it was of a rougher nature, consisting chiefly of satire, often bitter of its kind, with much buffoonery and broad fun.

Passing to the colder climes of northern Europe, the Scandinavian and Teutonic races depended on the chase for their livelihood, and were hardened by the toil that attended it. The old Scandinavians, stormful Jarls and Vikings, wild huntsmen and sea-goers, imbibed a taste for distant and dangerous adventure, and became brave and fearless, sharp, vigorous, and original. No pessimists they, like the Hindus, no philosophers, like the Greeks, but men with whom the stream of life ran tumultuous and cataract-like. They were rough and homely men, with big hearts and rugged exteriors, and loudly could they laugh as they quaffed their mighty ale over stories of combat bravely done. And their gods were like themselves. Even Odin, the all-father, "the terrible and severe god," could drink like a Norseman. Thus he says

> "Drunk I was,
> I was over drunk,
> At that cunning Fialars."

But the god Loki, of whom Miss Robins has given a vigorous sketch, is the type of the Norse genius, the incarnation of mischief, full of jesting and mummery, cunning and fond of his own amusement. And his history is that of the pleasure-seeker, a quick descent from amusement to vice; and the mirthful scoffer becomes "the calumniator of the gods, the contriver of all fraud and mischief, and

* "Hindu Humour—Loki—Mischief in the Middle Ages." By Elizabeth Robins. *Atlantic Monthly*, 1881-82.

the disgrace of gods and men." "Loki is first god, then god and devil combined, and finally devil *pur et simple*."

In her article on "Mischief in the Middle Ages" Miss Robbins carefully delineates the humorous side of the English people. The middle English had a great fund of quaint humour, and a fine capacity for enjoyment. They had also a lively appreciation of the ludicrous and grotesque, and were fond of punning devices and mottoes. The mischievous nature of the Norseman, too, was in the people, but we have not space to go into the evidence which Miss Robbins has collected. "As distinct as the mythology of Greece or Scandinavia," says she, "was the fairy mythology of mediæval Europe. It borrowed from the one grace and sensuous recklessness, from the other ruggedness and humour, and formed a whole of sprightly mischief." The fresh humour of fairy-land is indeed the charm of mediæval literature.

It is curious to note in these articles how the spirit of the nations has been influenced by the circumstances and climates in which they have lived, for the humour of the Hindus was inspired by fatalism, that of Greece by philosophy, of Scandinavia by hardship and warfare, and that of England by the romantic and progressive spirit of the Anglo-Saxon race. JOHN LEYLAND.

FORMS OF CLOUDS.

BY THE EDITOR.

THERE are few more interesting and instructive subjects of study, especially at this season of the year, when so many persons have daily before them a wide stretch of sea horizon, than the clouds—whether they be the light feathery clouds called cirrus, which lie often more than ten miles above the earth's surface; or the cumulus clouds, like great masses of cotton-wool, which form on a summer's day at heights probably varying between half-a-mile, or less, and two, or, at the outside, three miles from the surface; or stratus clouds, forming a vast sheet extending to the horizon, or near it; or the various forms of cloud which accompany storms, whether of wind or rain or thunder.

In the first place, it is interesting to compare our first ideas as to the forms of cloud-masses with those which arise so soon as we reason a little on the subject. It is to be noticed that the cloud-strewn sky is always full of illusions, whatever the shapes of the clouds may be, and that, in certain cases, we are under the influence of an absolute illusion quite beyond the power of any reasoning to correct.

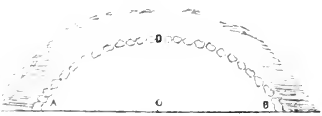


Fig. 1.

When we look at a distant landscape, and see behind hills and trees and buildings, the clouds in a sky—or an absolutely cloud-covered sky apparently extending upwards from the horizon itself, we are unable to resist the illusion that the surface which thus forms a background to objects at which we look horizontally, is itself either vertical or nearly so. Thus, to take the case of a sky over which clouds are freely scattered. If we think of the clouds overhead at all, the idea we form of the sky canopy is that its shape in section is somewhat like what is shown in Fig. 1, where the rounded clouds fully outlined are supposed to be cumulus and the others to be cirrus. If we limit our attention to parts of the sky near the horizon, we are very apt to imagine that the cloud-surface seen at A or B—which often appears continuous even when the clouds overhead are widely scattered—is upright.

Now, in reality, on a day when the air in which cumulus clouds are suspended (to use an inexact but convenient term) is very clear, as it often is, the cloud-surface which is the background to hills, trees, and buildings forming the landscape in any direction, is much more nearly horizontal than vertical. The shape of the cloud canopy,

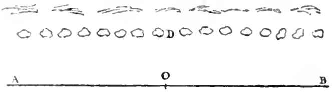


Fig. 2.

instead of being what is represented in Fig. 1, is more like what is represented in part only (for very obvious reasons) in Fig. 2, where, however, the layer of cirrus clouds is scarcely shown high enough.

The real shape of the under surface of a layer of clouds two miles above the surface of the earth is, of course, what is shown in section in Fig. 3, where D is supposed to be the point over head,—if only AB be drawn long enough or OD short enough. But it would be impossible to show

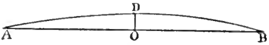


Fig. 3.

this properly on any scale available in the pages of KNOWLEDGE. If EO*c* represents the surface of the earth, ADB the surface two miles above that of the earth, and AOB the horizon plane of the spectator at O, the distance AO can be determined as follows:—Draw the diameter DC*d*, which is roughly about 8,000 miles; then we know that

the square of AO is equal to the rect DO, O*d*.
$= 2 \times 8{,}000$

if we take the mile for our unit of length. Thus

$AO = \sqrt{16{,}000} = 127$ miles.

If we had taken the true diameter of the earth, we should have made AO equal to 126 miles,—the difference being not worth noticing. Thus we ought, in Fig. 3, to have AO more than sixty times as long as DO; so that if DO were a quarter of an inch long—and a shorter distance would be inconveniently small—AO would be nearly 16 inches, and AB would want only about five inches of a yard. On the scale of Figs. 1 and 2, in which the height OD is one inch, the points corresponding to A and B of Fig. 1 should be each more than five feet from O.

Thus the surface of the cloud-layer which forms the background of a distant landscape is very nearly horizontal in this case. It is still more nearly horizontal if the clouds are lower. Suppose, for instance, the clouds half-a-mile high. Then, putting OD in Fig. 4 equal to half-a-mile, we get $AO = \sqrt{4000} = 63$ miles, or AO is 126 times as great as DO.

In the case first considered, with the cumulus clouds two miles high, it can be readily shown (we do not trouble our readers with the proof) that the angle at which the cloud

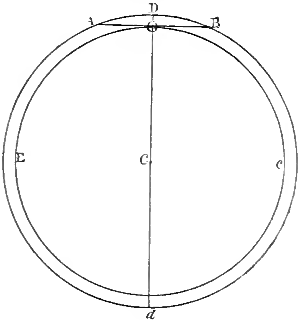


Fig. 4.

surface (which seems to meet the horizon almost vertically at A and B) is really inclined to the observer's horizon plane, is an angle of only about $1\frac{3}{4}$ degrees. In the latter case, this angle is only about 54 minutes, or nine-tenths of a degree.

If we take the quadrant BAD in Fig. 5, divide it into three parts in E and F, and FB again into three parts in *e* and *f*, then the tenth part of B*f* is a degree, and BA*d* represents the larger of the angles just mentioned. Thus,

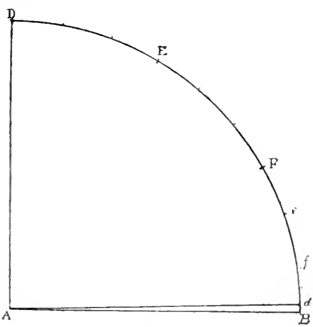


Fig. 5.

when cumulus clouds hang about two miles high in clear air, the cloud-bank near the horizon, Fig. 5, instead of being nearly vertical (or like AD), as it seems to be, is inclined like A*d* to AB. When the clouds are half-a-mile high, the inclination is only half of even this small angle.

Since, then, the cloud surface to which we pay most attention, that near the horizon, is seen thus aslant, instead of squarely, or nearly so, as we seem to see it, we can understand how much room there is for illusion as to the true forms both of separate clouds and of cloud masses. Such illusions we shall next proceed to consider.

(To be continued.)

LEARNING TO SWIM.

By Natator.

EVERY ONE admits that we ought all to be able to swim; yet, if you ask the first ten men you meet whether they can swim, you will find that at least five cannot, and of women (who can learn to swim much more easily than men) not one in ten can swim. Yet, out of a hundred men in all classes above the very poorest, ninety-nine have the chance of teaching themselves to swim with perfect safety, and quite easily, for one part at least of every year; and nearly the same proportion among women have similar opportunities.

It seems to me the reason why, despite the talk which goes on every year in the summer and autumn months about learning to swim, so few who might do really achieve the easy task, is that erroneous ideas are formed respecting the thing to be learned. A skilful swimmer, professional or otherwise, describes the art of swimming as eventually it should be acquired by the learner. He tells a man or boy who cannot support himself for a moment in the water—except, perhaps, by floating on his back—that he must go through such and such movements. Here is a learner's first instruction, extracted *verbatim* from an old magazine:—"Suppose a person standing up to his breast in water, and about to strike off in swimming: the hands are placed close to each other, with the palms undermost near the breast, the body is thrown forward in the water the hands are thrust out, and when the arms are fully extended, they diverge horizontally (the backs of the hands being turned towards each other), describing curves" [excellent description], "until they are brought round under the armpits and again extended. Whilst the arms are describing their curves, the legs are drawn forwards under the body, the knees being separated as much as possible, and the toes turned outwards, and whilst the arms are regaining their extended position, the legs are extended backwards and outwards, the soles of the feet being turned outwards." Now this is very pleasant to read. So the learner, standing up to his breast, puts his hands close together, the palms undermost near the breast, throws his body forward in the water, and presently comes up spluttering, having accomplished no part of the suggested operations except "describing curves" very vaguely and very uncomfortably.

The fact really is, that the first efforts of the learner should be of a much less ambitious kind. No one ever yet learned to swim all at once; and many are prevented from learning to swim at all by the circumstance that *every one fails* who tries to do what most books on swimming tell him to do, and what professors of swimming pretend to expect him to do.

In the first place, the learner should not stand breast high in the water, at least on a sloping shore, or where there is any stream. Not many years ago, some simple lessons on swimming, beginning with some such advice as we have quoted above, led a beginner to his grave: for, tumbling forwards in trying to carry out the instructions, he began to flounder, and floundering into deeper water, was drowned. In a bathing-place with level floor, a learner may safely take his first lessons with the water up to his armpits when he stands upright. But on a sloping shore and even then he must be well assured that the slope is uniform and gradual, and the bottom such as he can stand on firmly) he should be content to stand in water some three or four inches below the armpits. If there is a stream, he will do well to fasten round his waist a stout cord, attached to some thoroughly trustworthy post on the bank. The same also at sea, if there is any tide or current, or any but the gentlest undulations. It is better also to be with persons who can swim. In fact, avoid all danger. You will not learn the worse for being safe.

So much premised, note that the first thing to be learned —the first, but after it is learned everything else comes easily—is the art of retaining the balance in the water. It is *better*, if you want eventually to be a really good swimmer—that is to have good style and pace—to avoid at first all attempts at actual swimming: it is *essential* if your opportunities do not allow you to be so ambitious, and you want chiefly to learn confidence in the water.

Lean gently forward, with the face towards the shore, extending the arms forward and outwards, with the palms down, fingers and thumb close, and the hand, thumb, and fingers hollowed so as to form a sort of shallow cup. In this shape the hands have great power to help you in balancing yourself. Lean further and further forward moving your hands about a little, so as to feel the water and also their power on the water, until your feet begin to be no longer able to support you. By this time your shoulders are immersed, and you feel the lifting power of the water, but you are not properly balanced right and left. One shoulder or the other dips as you tumble forward, and as your feet leave the ground your head goes under, which is not what you want. After a flounder or so (which itself has a good effect in teaching you, unconsciously, how water acts on a floating body) you are ready for another trial. This time, resolve that, on whichever side you find your body dipping, you will use your cup-shaped paddle (the hand held as described) on that side, with strong downward and rather outward action. You will find this very effective in tipping you up the other way: and you will flounder quite as badly as before. After doing this a few times, now one now the other side dipping first, and being too effectively stopped, resolve to use both your hand paddles, first the one first needed to save its side from going down, then, as the other side begins to dip, the other, and then if you have time (most probably you won't, but that, as our Editor says, is a detail) the one first used. You will now rather wobble than flounder. You finally come to grief, of course, because your method of using your hand paddles is too energetic. You put out too much strength to save you from your first dip on one side and so you dip over to the other side; you correct that dip too strongly, and so dip the other way. Your next care then is to moderate your balancing movements. You resolve that as you dip over you will make only a slight effort for recovery. To your surprise you find even this reduced effort tips you over; but now, if you still keep your attention directed to the alternation of the paddling action, you make more wobbles than before, before finally floundering over. You continue these experiments, reducing the action at each new trial, and learning more and more how very slight is the proper action for correcting the tendency to dip for want of true balancing. At last it dawns upon you that balancing in the water is very different from balancing in the air. The slightest movement of the hand serves to restore the balance, when disturbed; anything beyond destroys the balance. So soon as this lesson has been learned—most likely this will not be till after several days—the beginner can balance himself readily, without at first advancing, or turning, or using his legs, which as they leave the ground in these experiments may be left in any position they may naturally assume, while the learner gives all his attention to acquire ease and readiness in balancing the body by gentle movements of the arms and hands. After that will come the time for learning other things—amongst them the art of swimming, which is something more than balancing the body afloat in the water.

(*To be continued.*)

HOW TO GET STRONG.

TO EXPAND AND DEEPEN THE CHEST.

THE contrivance illustrated in Fig. 1 is due to the ingenuity of Dr. Sargent, of Boston, Mass. It is an excellent chest-expander. Over the pulleys PP cords pass from the weights to the handles A and B. The ropes are just long enough to let the handles be about a foot above the head when the weights are on the ground. Standing now between and directly under the handles, erect, the chest well filled, and the arms straight, grasp the handles, and slowly draw the hands along the course shown by dotted curves, raising the weights about 2 ft. from the ground. Let the weight slowly return to the ground, and repeat the process *ad libitum.*

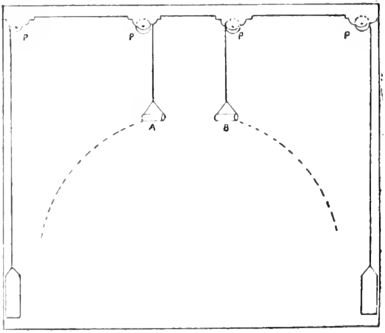


Fig. 1.

The weight can be graduated to suit the strength of the person using this apparatus. The exercise should in no degree strain the strength, while it is continued say for about five minutes. Mr. Blackie remarks that no better present could well be devised for one of weak or narrow chest than one of these appliances. Note, however, that though the picture shows a somewhat elaborate arrangement, this is not at all essential to the effective nature of this method. Two pulleys will serve as well as four, the weights may be anything whatever, dumb-bells, clubs, bags or straps with books in them—anything. No pulleys at all need be used if none can be conveniently obtained, but a couple of short stout reels, with long brass-headed nails passing easily through the holes of the reels, will serve very well, the nails being driven about an inch into a suitable wall. In all these matters, a little ingenuity will readily enable anyone to rig up something which will practically serve as well as the best carpentered construction.

Another plan, also Dr. Sargent's, deepens the chest as effectively as the preceding expands it. In Fig. 2, B and C are two bars (broom handles, or the sticks for single-stick will serve very well) suspended by a cord which

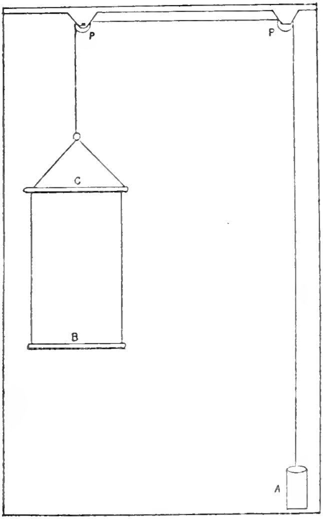


Fig. 2.

passes over two pulleys PP (but one will serve, or the reels used in the last exercise), to a weight A. When A is on the ground, the bar B is about a foot above the head. The following are Dr. Sargent's directions (unfortunately these body-strengthening folk, drill-sergeants, fencing-masters, *et hoc genus omne*, write not very clear English):—Standing, not under B, but about a foot to one side of it, and facing it (he means, of course, a foot in front of B, and facing it), grasp its ends with both hands, and keeping arms and legs straight and stiff, and breathing the chest brimful [!], draw downwards until the bar is about level with the waist; let the weight run slowly back and repeat, *ad libitum*. (It will be seen that the contrivance does not require the rod C, any more than it essentially requires two pulleys.)

In a former paper, we remarked that, instead of the cords with weights, elastic extensors could be used, by attaching them to high nails and hauling upon them. After trial, we withdraw this statement. The exertion required when extensors are used varies too much to be comparable with the steady work of pulling up weights: it is a serious fault, too, of all work with extensors that the effort required increases from beginning to end of the pull.

Lastly, for chest work, though many of the other exercises for obtaining symmetrical development will tell on the chest also, try the following with light—say six pounds'—dumb-bells. Holding the head and neck back so as to look at the ceiling, the dumb-bells hanging at the sides, knuckles out, carry the arms, without bending the elbows, outwards and upwards until they are in a horizontal line, then onwards in the same wide sweep until they are vertical, lowering the hands then gradually until the dumb-bells nearly rest on the shoulders; carry them backwards by the same movements exactly reversed. Repeat this ten or twelve times—twenty or thirty if you conveniently can; but keep the chest well expanded all the time, holding in the breath during the effort—if possible during the whole series of efforts (only not continuing to hold the breath when actual pain begins to be felt). This exercise has a splendid effect in making the chest full and deep: it also greatly strengthens the lungs.

THE USE OF DRUNKENNESS.*

By W. Mattieu Williams.

IN the early argumentative struggles between the advocates of total abstinence from alcohol and their opponents, the latter believed they settled the question by affirming that "these things are sent for our use," and therefore that it was flying in the face of Providence to refuse a social glass. This and many similar arguments have subsequently been overturned by the abstainers, who have unquestionably been victorious "all along the line," especially since Dr. B. W. Richardson has become their Commander-in-Chief.

In spite of this, I am about to charge their serried ranks armed with an entirely new weapon forged by myself from material supplied by the late Dr. Darwin, my thesis being that the drunkenness which prevails at the present day is promoting civilisation and the general forward progress of the human race.

Malthus demonstrated long ago that man, like other animals, has a tendency to multiply more rapidly than the means of supporting his increasing numbers can be multiplied; he and his followers regarded this tendency as the primary source of poverty and social degradation. Darwin, starting with the same general law, deduces the very opposite conclusion respecting its influence on each particular species, though his antagonism to Malthus does not prominently appear, seeing that his inferences were mainly applied to the lower animals. Darwin shows that the onward progress, the development, or what may be described as the collective prosperity of the species, is brought about by over-multiplication, followed by a necessary struggle for existence, in the course of which the inferior or unsuitable individuals are weeded out, and "the survival of the fittest" necessarily follows: these superior or more suitable specimens transmit more or less of their advantages to their offspring, which still multiplying excessively are again and again similarly sifted and improved or developed in a boundless course of forward evolution.

In the earlier stages of human existence, the fittest for survival were those whose brutal or physical energies best enabled them to struggle with the physical difficulties of their surroundings, to subjugate the crudities of the primaeval plains and forests to human requirements. The perpetual struggles of the different tribes gave the dominion of the earth to those best able to rule it; the strongest and most violent human animal was then the fittest, and he survived accordingly.

Then came another era of human effort gradually culminating in the present period. In this, mere muscular

* From the *Gentleman's Magazine*.

strength, brute physical power, and mere animal energy have become less and less demanded as we have, by the aid of physical science, imprisoned the physical forces of nature in our steam boilers, batteries, &c., and have made them our slaves in lieu of human prisoners of war. The coarse muscular, raving, yelling, fighting human animal that formerly led the war dance, the hunt, and the battle, is no longer the fittest for survival, but is, on the contrary, daily becoming more and more out of place. His prize fights, his dog fights, his cock pits, and bull-baiting are practically abolished, his fox hunting and bird shooting are only carried on at great expense by a wealthy residuum, and by damaging interference with civilised agriculture. The unfitness of the remaining representatives of the primæval savage is manifest, and their survival is purely prejudicial to the present interests and future progress of the race.

Such being the case, we now require some means of eliminating these coarser, more brutal or purely animal specimens of humanity, in order that there may be more room for the survival and multiplication of the more intellectual, more refined, and altogether distinctively human specimens. It is desirable that this should be effected by some natural or spontaneous proceeding of self-extinction, performed by the animal specimens themselves. If this self-immolation can be a process that is enjoyable in their own estimation, all the objections to it that might otherwise be suggested by our feelings of humanity are removed.

Now, these conditions are exactly fulfilled by the alcoholic drinks of the present day when used for the purpose of obtaining intoxication. The old customs that rendered heavy drinking a social duty have passed away, their only remaining traces being the few exceptional cases of hereditary dipsomania still to be found here and there among men and woman of delicate fibre and sensitive organisation.

With these exceptions, the drunkards of our time are those whose constitutions are so coarse, so gross and brutal, that the excitement of alcoholic stimulation is to them a delicious sensual delirium, a wild saturnalia of animal exaltation, which they enjoy so heartily that every new raving outbreak only whets their appetite for a repetition. While sober they actually arrange and prepare for a forthcoming holiday booze; work and save money for the avowed purpose of purchasing the drink and its consequent ecstasies, which constitute the chief delights of their existence. When a professional criminal has "served his time," and is about to be released from prison, his faithful friends club together to supply him with the consolation of an uninterrupted course of intoxication; the longer its duration the greater his happiness and the deeper his obligations of gratitude to the contributing pals.

We know that such indulgence has swept away the Red Indian savage from the American continent, and prepared it for a higher civilisation, as the mammoth and grisly bear have made way for the sheep and oxen; and this beneficent agent, if allowed to do its natural work, will similarly remove the savage elements that still remain as impediments to the onward progress of the more crowded communities of the old world. If those who love alcoholic drinks for the sake of the excitement they induce are only supplied with cheap and abundant happiness, our criminal and pauper population will be reduced to a minimum.

It is commonly supposed that because nearly all criminals are drunkards, therefore drunkenness is the chief cause of crime. This is a confusion of cause with effect. Crime and drunkenness go together because they are concurrent effects of the same organisation. Alcoholic stimulation merely removes prudence and brings out true character without restraint or disguise. The brute who beats his wife when drunk would do so when sober if he dared and could; but what we call the sober state is with him a condition of cowardly depression and feebleness due to the reaction of intoxication. If a number of quarrelsome men assemble and drink together, they finish with fighting. If a similar number of kindly-disposed men drink together, they overflow with generosity, profuse friendliness, and finally become absurdly affectionate. The citizen who would have subscribed but one guinea to a charity before dinner will give his name for five after the "toast of the evening."

My general conclusion is that all human beings (excepting the few dipsomaniacs above-named), who are fit to survive as members of a civilised community, will spontaneously avoid intemperance, provided no artificial pressure of absurd drinking customs is applied to them, while those who are incapable of the general self-restraint demanded by advancing civilisation, and cannot share its moral and intellectual refinements, are provided by alcoholic beverages with the means of "happy despatch," will be gradually sifted out by natural alcoholic selection, provided no legislative violence interfere with their desire for "a short life and a merry one."

[In these remarks, Mr. Williams omits to notice yet another advantage of drunkenness: besides killing the drunkard himself it tends to prevent the increase of his kind. Unfortunately, the "happy despatch" of the drunkard involves too often much misery to many who are not drunkards.—Ed.]

Reviews.

MODERN DRESS.*

A CAPITAL little book, of which we should like to quote nearly the whole if space permitted, and it were quite fair. Dr. Pearse considers clothing in its relation to animal heat, cleanliness, circulation, respiration, and muscular development; he also touches on the methods by which infection may be conveyed by means of clothing. The following remarks on the question of braces *versus* belts will be interesting to many correspondents who have written about them, and give a good idea of our author's style. "The use of braces in weakly men makes them stoop. They naturally press upon the chest, and men would find their chests much freer without them. To those who are not accustomed to wear braces they are not only uncomfortable but cause great physical uneasiness. The objections to belts are of a different character. By being tight round the abdomen, they interfere with the natural process of respiration" [also with the process of circulation], "and if any special exertion has to be gone through they are doubly injurious. By preventing the enlargement of the abdomen, which occurs naturally at every inspiration, and more particularly when straining, they press injuriously the contents of the abdomen against its walls. This increased pressure during active exertion on parts which are not protected by the belt frequently causes rupture. No one would think of putting a tight band round a horse if he wanted it to run a race, and why should it be put round the human body under similar cir-

* "Modern Dress; and Clothing in its Relation to Health and Disease." By T. Frederick Pearse, M.D. (London: Wyman & Sons.)

WEATHER CHARTS FOR WEEK ENDING SUNDAY, AUG. 6.

Sunday, July 30th. Monday, July 31st. Tuesday, Aug. 1st. Wednesday, Aug. 2nd.

Thursday, Aug. 3rd. Friday, Aug. 4th. Saturday, Aug. 5th. Sunday, Aug. 6th.

In the above charts the dotted lines are "isobars," or lines of equal barometrical pressure, the values which they indicate being given in figures at the end, thus—30·4. The shade temperature is given in figures for several places on the coast, and the weather is recorded in words. The arrows fly with the wind, the force of which is shown by the number of barbs and feathers, thus :— ⟶, light; ⟶, fresh or strong; ⟶, a gale; ⟶, a violent gale; ⊙ signifies calm. The state of the sea is noted in capital letters. The * denotes the various stations. The hour for which each chart is drawn is 6 p.m.

cumstances, or during violent muscular exercise? Working men have got into the habit of wearing these belts, but they little know the danger and disadvantages which they put themselves under. . . . The best method of supporting the trousers is to wear a belt round the abdomen below the level of the hip-bones, and passing between the top of the hip and the prominence of the thigh-bones. This is also the most comfortable method of suspending the trousers, and if worn in this position it cannot unduly press upon the abdomen."

Some views of our author are open to discussion, but in the main his views are such as all persons of sense will agree with him in. We must demur to Dr. Pearse's statement that the toes, unless altered by wearing pointed boots, are as shown in fig. 8, p. 51. He will find no single foot in ancient or modern statuary with the toes directed straight forwards (when the feet are set together). In the Victory of Melos (the so-called Venus of Milo) the slant of the toes is marked, and we may be sure the model had not worn pointed boots.

THE PUBLIC HEALTH.

THE Registrar-General's weekly return shows that the annual rate of mortality last week in twenty-eight of the largest English towns averaged 19·6 per 1,000 of their aggregate population, which is estimated at 8,469,571 persons in the middle of this year. In London 2,577 births and 1,399 deaths were registered. Allowing for increase of population the births were 21, and the deaths no fewer than 397, below the average numbers in the corresponding week of the last ten years. The annual death-rate from all causes, which had been equal to 18·1 and 17·7 in the two preceding weeks, rose last week to 18·8. During the first four weeks of the current quarter the death-rate averaged only 18·0 per 1,000, against 20·8 and 25·0 in the corresponding periods of 1880 and 1881. The 1,399 deaths included two from small-pox, 40 from measles, 17 from scarlet fever, nine from diphtheria, 63 from whooping-cough, 1 from typhus fever, 16 from enteric fever, 2 from ill-defined forms of continued fever, 108 from diarrhœa and dysentery, and 6 from simple cholera; thus, 294 deaths were referred to these diseases, being 255 below the corrected average number in the corresponding week of the last ten years. Different forms of violence caused 56 deaths; 45 were the result of negligence or accident, among which were 23 from fractures and contusions, 2 from burns and scalds, 10 from drowning, and 6 of infants under one year of age from suffocation. The death of a female in [illegible] Hospital was [illegible] when under the [illegible]. The 24 deaths from fractures [illegible] two [illegible] each aged six years, [illegible] female 57 run over by [illegible] 2 [illegible] male 30 (intoxicated), fell from [illegible] 5 [illegible] car; male 18, crushed between railway [illegible]; male 29, run over on Midland Railway [illegible] street; male 55, fell from scaffold; [illegible] male 1, fell from window; male 2, fell down st[illegible] 34, fell down ship's hold; male 11, blow by [illegible] of bricks; male 50, by fall of bricks; female 17 hours, by [illegible] blow; male 63, by injury; female 2, by fall; [illegible] by injury. An inquest was held in each of these [illegible] except the last two, which were certified by registered [illegible] practitioners. In Greater London 3,254 births and 1,671 deaths were registered, equal to annual rates of 34·7 and 17·9 per 1,000 of the population. In the Outer Ring 19 deaths were referred [illegible], 14 to measles, 11 to scarlet fever, and 11 to whooping-cough. No fatal case of small-pox was registered.

The St. Gothard Tunnel. — After many contradictory reports as to whether locomotives propelled by electric energy were to be used in the St. Gothard Tunnel or not, we (*Electrician*) hear again that the attempt is to be made, and that experiments, for which the sum of 180,000 fr. is set apart, are now being made at Berne with this object.

To the student of heraldry and genealogy book-plates are as interesting and valuable as the escutcheons on old church brasses and [illegible]. How many cases there are in which we should not have known to whom a book had once belonged, if it had not been that it contained an old plate with the arms of the owner inside its cover, although unaccompanied by any name or any other clue. I have in my possession several plates that bear on them only the arms of their owners, without either motto or name. Then, again, book-plates are valuable as in some instances they have become the only reliable examples of the arms of a family or an individual. Then there comes into account the pleasure of hunting and collecting them. How many happy half-hours has one spent among the second-hand book-shops and stalls of London and the country looking over old volumes in search of them! — Mr. Walford's *Antiquarian Magazine*.

"Flint Jack." — Dr. Brewer, in that marvellous compilation of his "The Dictionary of Phrase and Fable," writes: "Edward Simpson, an occasional servant of Dr. Young, of Whitby, so-called because he used to tramp the kingdom vending spurious fossils, flint arrow-heads, stone celts, and other imitation antiquities. Professor Tennant charged him with forging these wares, and in 1867 he was sent to prison for theft." Let me take this opportunity of advising those of your correspondents who may not happen to have this work from which I have just quoted, to at once procure [illegible]. I have two reasons for giving this advice, and I have [illegible] (1) It will tend to lighten the labours of the learned and [illegible] of Knowledge, which, in my opinion, is a very [illegible] vital consideration; and (2) The information [illegible] seeking after is, in fifteen cases out of twenty, to be found in this work. — J. W. Howell. [Albeit, not fully in this [illegible] correspondent wanted to know when and where Flint Jack [illegible] — Ed.]

Discovery of Ancient Ruins in New Mexico. — The Boston [illegible] reports that important discoveries of the largest ancient [illegible] yet found on this continent, which extend for a distance of [illegible] miles up and down the banks of the Las Animas River, about [illegible] miles from Durango, in Rio Grande county, N. M., have recently been made. Post Office Inspector Cameron, who visited the ruins lately, believes the ancient villages were occupied by the M[illegible] Indians, and not by the Aztecs, as is generally supposed. He speaks of one covering a stone ruin 400 feet by 150 feet, which at one time evidently was three stories high. The walls are five feet thick. There were about 150 rooms in the building, of ten feet square each. An enterprising Yankee who has pre-empted as government land the ground on which the ruins stand, has been doing a fine business [illegible] relics to visitors. A discovery thought important by the gentlemen of the Bureau of Ethnology was lately made there of thirteen human skeletons in a subterranean chamber of the building mentioned. This had evidently been used as a burial [illegible]. They were wrapped up carefully in a kind of coarse cloth, and bore a close resemblance to Egyptian mummies. This cloth was [illegible], and woven with as much skill as if done at the present day, which is considered not the least interesting part of the discovery. The skeletons were perfectly preserved and clean. They were unmistakably those of Indians. A quantity of pottery of the best make was also found in this tomb.

Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

⁂ All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday*.

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig*.

FAIRY RINGS *v.* RINGWORMS.

[507]—The large fairy rings on the South Downs, described by Mr. W. G. Smith (506), have been explained over and over again as the result of special manuring in the boundary track of tethered animals. I do not dispute this explanation, especially as I know they are most abundant near the edges of the chalk cliffs, where animals are tethered to prevent them from straying over the precipice. The difficulty I endeavour to remove is that of the small rings. Mr. Smith misquotes me, in describing the rings I observed as *merely* "circles of rank grass." I distinctly state that these rings had "at times a crop of small fungi dotted over them." Mr. Smith asks whether anybody has ever seen haycocks only 3 ft. in diameter. I have seen many thousands, and have made a hundred or two of such size myself. Have just measured one made a month ago, and left to test my theory. It measures 3 ft. 2 in., and was intended as a typical sample of the small heaps usually made in the first gathering of the windrows by a single outreach of the hay-rake. If rain follows each gathering, they are not disturbed until it ceases. The theory of spontaneous outspreading of fungi is old and well worn, one of the "many attempts at explanation" to which I alluded. It is very superficially based on the analogies named by Mr. Smith—the small circular specks or rings which are formed when the *mycelia* or filamentous stems of a fungus radiate from a centre and fructify at their radial terminations. These circles are, however, limited to dimensions fairly comparable to those of the ringworm fungus quoted by Mr. Smith.

Toadstools have no geometrical instinct causing them to describe circles of fifty feet in diameter, or even of three feet. They simply flourish where their omnipresent spores alight upon ground containing the special manure that serves them as food. Every cultivator of edible fungi, from Dr. Badham downwards, knows that the droppings of animals at certain times, *i.e.*, just when tethering is most needed, supply such manure. If I am right, the drip from a heap of rotting grass does the like, but, as I stated at the conclusion of my note, further observation is demanded for the confirmation of this hypothesis. W. Mattieu Williams.

FAIRY RINGS.

[508]—I have for many years taken a great interest in the formation of the fairy rings, but cannot accept Mr. Mattieu Williams' theory of the same. I resided for a considerable period near a large dairy farm; a field on the same was quite thickly studded with these rings, of all sizes. The grass forming the rings was of a dark green, in some very coarse, in others very soft and silky; the centre of the rings was large tufts of grass. The field has never to my knowledge been mown, nor yet have heaps of manure, cocks of hay, &c., ever lain on it.

Meadows adjoining, which are mown occasionally, and in which I have often seen the hay-cocks lying for a length of time saturated with wet, are quite free from the rings. I think some other theory must be advanced to convince me, and others, that such is the cause of fairy rings. J. Dexter.

[Several other letters received on this subject, to the same general effect, from J. Symes, Unbelieving Thomas, K. Derling, M. Hathaivey, &c. Ed.]

A CALCULATION.

[509]—The question of Pyramus, in your number of June 23, is not sufficiently explicit. He does not say under what conditions the advances are returnable, nor how long the members continue their subscriptions.

Presuming the advances are made as soon as £500 is in hand, and that they are returned by equal monthly payments, the first monthly payment commencing three months after the date of the advance, and that the members continue subscribing £12 per annum, payable monthly, until all the 500 have received advances, then the number of advances for each of 19 years will be respectively—

12	13	14	16	17	18	
19	22	23	25	26	30	
31	33	35	37	38	41	42

in all 492 advances of £500 each. The £1 monthly subscription will be required for two months longer, during which sufficient money will be received to provide for seven additional shares, with a balance in hand of £183. 6s. 8d.

The account at the end of the 231st month will stand thus:—

Amount advanced	£250,000	0	0
Returned	135,993	6	8
Due	114,006	13	4
Amount in hand	993	6	8
	£115,000	0	0

equal to subscriptions for 230 months. The calculations leading to this result are at your service, if you would like to see them, but being somewhat lengthy, I will not now trouble you with them.

Walworth, July 20, 1882. J. Wareham.

BREATHING THROUGH THE NOSE—TURKISH TOBACCO.

[510]—Mr. Hume in his letter (No. 444, p. 79) shows the necessity of breathing through the nostrils, and I heartily agree with him. He is, however, not quite correct in his explanation of the soothing effect of tobacco-smoke upon me, as it has always been my custom to breath in the manner he advocates, and find it difficult to manage the operation in any other way. Again, I cannot corroborate Mr. Hume's opinion that the nose acts as a filter to the fumes of acid, because, though dust or any solid substance would be separated in that way, yet anything of a gaseous nature would be as little retarded as common air. It is quite probable that a portion of the fume would condense within the nasal organ; but this would only *lessen* the evil, and not eradicate it. Whatever is the true cause of the soothing effect of tobacco-smoke, it is not due to filtration; if it were so, there would be no need to smoke, as keeping the mouth closed would be sufficient.

Another correspondent (No. 445, p. 79) endeavours to show that I am "a little bit out" in regard to the tobacco used by the Turks for the Nargilé. I am always ready to be convinced that I am wrong, when I find that the experience of a majority is contrary to mine; but for the present I will persist in what I have stated in my former letter. And I am not alone in my belief, as several Englishmen residing in Constantinople had warned me against the noxious Tombeki before I tried the experiment myself. Théophile Gautier, in his "Constantinople of to-day," says, "that the Tombeki is of a darker colour than the other kinds, and is so strong that it cannot be smoked until after two or three washings." Perhaps I had the misfortune to make the trial upon *un*-washed Tombeki; or it may be that the keeper of the Café played his "little joke on the infidel"—who can tell? "A Constant Reader" recommends me to try our English forms of tobacco. Does he think it probable that I would attempt a trial of Tombeki, if I was not already well accustomed to the use of English tobacco? For his information, I may say that I am no tyro in the practice of smoking, and have used nearly all kinds of the weed that can be obtained in England or abroad. The Turk may enjoy his Nargilé, but give me my English pipe, and I guarantee to find as much solace in it as the Turk does in his.

"Another case of neglected opportunities!" says my friend. I wonder has he never neglected any himself? His belief that the Turks are temperate in *all* things, seems to ignore (or neglect) the existence of Harems. W. O. Prosser, F.C.S.

BRAIN TROUBLES.

[511]—As yet I have noticed no cure mentioned in your journal for the "Brain Troubles" that have justly received attention in it. Upon this subject perhaps I may speak with authority, as I am well accustomed to various forms of brain trouble.

Of course, the most important indications are to restore the health, if lost, and to keep the bowels fairly loose. It is a good plan to wear flannel next the skin throughout the year. A variety of out-door exercise is essential. But from personal experience I am convinced that there is nothing to be compared with mathematics, say, an hour's tussle with geometrical problems two or three times a day. In this way I have astonished myself with the cures I have effected.

Above all things, avoid strychnia (or nux vomica) and quinine, and the like. I have known even stomachic tonics, such as chamomile, do much harm. H. S.

[We quite agree with H. S. about the mind-quieting qualities of mathematics; but mathematical studies are not to the taste of all, and would only worry many. They are in my own case wonderful pain-soothers. The toughest parts of my treatise on Cycloidal Geometry were written when I was suffering intense pain from renal calculus, to which until the last few years I was much subject.—Ed.]

[512]—The quotation of your correspondent, W. M. M. (letter 468, p. 117), very accurately describes a trouble from which I suffered terribly five or six years ago, but of which I completely cured myself. In my case it took the form of doubts as to the safety of deeds, letters, &c., which were in my care and could not be replaced if lost, as to the correctness of technical and other details in documents prepared by me, as to whether I had really turned off the gas in my bedroom at night, and a number of similar matters, such as a man in sound mental health attends to daily without finding in them any cause for anxiety or worry. In each of such cases, no doubt, any neglect or omission might have led to serious consequences, and the thought of the possibility of these results following weighed upon me so that I at length became quite unable to accept the testimony of my senses to the fact that I had done what I intended to do in any matter of importance. I attribute the mischief solely to "nervousness" arising from excessive brain labour. My professional work and many of my every-day social duties were fast becoming an unbearable burden, and I felt that I had before me the prospect of failure in life, when, upon the advice of a friend, I adopted a simple expedient which led to my cure. I promised him and myself that on a certain day I would do everything I had to do carefully, once for all, and then absolutely leave it, let the consequences be what they would. I did so on that day, on the next, and so on, reporting to my friend periodically that I had faithfully kept my promise. At first I had an arduous struggle, but I felt it was then or never, and I persevered; nothing happened to me and I gradually gained control of myself, and at last I was completely free from my fetters.

I hope my experience may be useful to others. Mintaka.

BICYCLES.

[513]—I am not sure whether the subject of "bicycles" is much in your line as the Editor of Knowledge; but as the matter I write of possesses a mechanical interest, you will, I doubt not, whether you insert my letter or not, give it your usual courteous consideration, and say whether you think my ideas correct.

In the best bicycles both wheels are mounted on ball bearings, as these run more easily. But in machines of a commoner kind, the front wheel only has ball bearings, while the hind one is mounted on cone bearings. Cone bearings are much stiffer than balls; that is, there is more friction. Now this, Sir, is the point to which I wish to draw your attention. The hind wheel of any ordinary 54 in. bicycle is never less than about 18 in. Hence it revolves three times as fast as the front wheel, and, other conditions being the same, would have three times the friction at its bearings. From this it would seem that the order of things with regard to the bearings should be reversed, and that the hind wheel should have ball bearings, and if we must have cones at all they should be in front. I have never put the case to anyone in this light, but I have more than once asked why ball bearings are put on the front wheel rather than on the other. The answer I received was, that there is more weight on the front than on the hind wheel. This I admit, but I do not think there is such a difference in pressure on the bearings as will justify anyone in asserting that the front wheel has more friction than the hind one. The friction due to pressure varies as the pressure. We can assign to each wheel its share of the pressure.

I measured a 54-in. roadster to-day. The distance between the centres of wheels was 36 in., while the saddle was only 11 in. behind the centre of the front wheel. Hence the pressures on the wheels are as 25 : 11, or very little more than 2 to 1. And since this is not so great as the relation between the friction due to revolution of the wheels, I think it does not justify the practice of putting ball bearings in the front instead of in the hind wheel.

Having stated my case, I should be glad, Mr. Editor, if you would kindly give me your opinion, and if I am in error, show me the error. Thanking you beforehand for the trouble you have taken in reading my letter, I am, Thos. B. Walker.

Answers to Correspondents.

**** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded; nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

G. JARRATT. Full reports of the Association lectures and papers would scarcely fit in with the plan and purpose of KNOWLEDGE. They might be (though even that is doubtful) exactly described, but unless this meeting differs very much from others, they would not be very simply worded. What I hope to do is to give the essence of the more interesting communications. I may probably attend this meeting. Hitherto I have been deterred from attending such gatherings by the general prevalence of the cant of science and what may be termed, without disrespect, scientific snobdom. The real purport and purpose of scientific research, as well as the true value of scientific discoveries, seem often overlooked at these meetings, while the guiding principle seems to be, "Claw me and I'll claw thee." The great object which the association should set itself is the humanising of science. Even those of our best scientific workers who have consented to help (our Darwins, Spencers, Mills, &c., have kept persistently aloof) have appeared at their weakest "in this association." Still good work has been done at these gatherings on occasion; let us hope it may be so on this occasion.—G. E. A. The inscription is not on the top of the boss, but, as should have been stated in the paper, on the sloping side. If the date be genuine (and the letters were there certainly fifty-eight years ago), and if the accretion from the calcareous water continuously passing over it a film of only one-twentieth of an inch has been arrested, the measure of rate of deposit will err rather by being too low than too high. JOS. OFFORD. Many thanks. The subject has great interest for me. The pictures, if not too expensive to engrave, would be very acceptable.—DIFFICULTY. I should say, "Give it up"; if, then, you find it can be done without trick, send it to me, with solution, for a problem in KNOWLEDGE. *I give it up.* A. (1) You perplex me. In one sentence you say you know scarcely anything of astronomy or physics; in another you decide very positively and authoritatively (also quite wrongly, but that is scarce worth mentioning) a question which can only be dealt with by astronomers and physicists. You speak very flatteringly of my knowledge and Dr. Ball's; but speak of our obstinacy in adhering to the idea that the earth was once red hot, or white hot; asking, then, whether gases could consolidate without cooling, even allowing they were gases at first: a question which really shows that you have not a [illegible] conception of what is at issue. "Another century will expose the fallacy;" in other words, you are a century ahead of the astronomers of to-day; yet later on, "One more silly question; does the moon revolve in the same relation to the earth as the earth does to the sun? . . . I feel quite ashamed of my stupidity." The answer to the question is, of course, "No;" but . . . *is* it [illegible] and are you stupid? If you really thought so, would you [illegible] Dr. Ball and myself we are building on a "miserable delusion?" 2. My "private sentiments" about vivisection are tolerably well known. I abominate cruelty to animals as much as you can; it indicates an utterly detestable nature; but I consider those who would stop scientific inquiries, primarily directed to the diminution of pain and the saving of human lives, because they cannot be conducted without pain to animals (assuming all possible care taken to avoid and, where possible, prevent pain) to be cruel in much greater degree than the craven who wilfully torture animals. If one dear to me were suffering under a painful disease, and I were told that there was a good chance, or even any chance at all, that by an experiment conducted on an animal a means of cure might be found, I know that I should say let the experiment be tried as quickly as possible; give as little pain as possible; if not inconsistent with the nature and object of the experiment, use anæsthetics; and, if the experiment be such that the animal would suffer afterwards, destroy it immediately after the result of the experiment has been secured. I *know* I should decide thus, and—pardon me for saying it—I am certain that under similar circumstances you would decide so too. Now, what right have you or I to decide so, in a case where a human sufferer is very dear to us, father or mother, husband or wife (as the case may be), brother, sister, son, daughter (grown up, young, or infant), and to denounce a practice which, as conducted by every student of science worthy to be called man, is simply the generalisation of the special act I have considered? Do you think the sufferers among the multitudes unknown to you, among the poor, in hospitals, and so forth, have no friends or relatives who think more of their real sufferings than of the problematical tortures (or say even they were real) of chloroformed animals? Think of those dearest to you in suffering, and ask how you would decide, were such a question put to you as I have suggested; when you have quite made up your mind that you would execrate the man who should try the experiment for your dear one's relief, you may begin to objurgate the general practice; but *not* as a tender-hearted being, in my judgment.—J. E. OKILL. You are as extreme about abstinence from stimulants as A. about vivisection. It is sheer nonsense to say in the face of all experience that there is no innocent use of stimulants, and that, whatever be taken, there will be a craving for more which very few can withstand, "for we know scientifically that each drop is but a link in the forging of the chain which may probably bind and drag them down to poverty or insanity." Nine out of ten who take wine, or beer, or spirits in moderation, do not know what craving for liquor means, at least by any experience of their own. During two parts of my own life (in 1859–60, in 1879–81) my daily consumption of liquor has been in excess of what would be considered prudent by medical men; and at other times (for nine months in 1866-67, for eighteen in 1877–78, and recently for short periods) I have taken no stimulants at all, and for the rest of the time, since I was sixteen or seventeen, I suppose not a day has passed that I have not taken either a glass or two of wine, or a pint or so of ale, or a glass or two of spirits and water per diem. In all those years, now nearer thirty than I could wish, I have never known what *craving* for liquor is. I have often felt exceeding thirsty, when taking much exercise, with the feeling that I would much rather drink a glass of ale than a glass of water, and that it would do me more good: but I have never felt a craving even for a glass of ale, and (being told ale was not good for me) I suppose I have not taken so much as half-a-dozen glasses of ale per annum for the last ten years. It is the same with nearly all men I know; they can be very moderate, or totally abstain, or take a plentiful allowance, just as they may choose. If the weaker brethren want the stronger to go without stimulants for their encouragement, well and good. I don't believe much in those weaker brethren *being* encouraged. When they want an excuse to backslide, they are pretty sure to find one. But, if it were made clear to me that I could do them good by joining the ranks of the professed abstainers, I would do it,—provided I found it agree with me; otherwise, not.—J. PARKER FOWLER. See preceding reply. If, however, you find my "airing my views," (and I suppose Airy airing his) about the transit of Venus, akin to the display of Blue Ribbon by the pledged ones, I should fancy argument useless. But experience has again and again shown that common-sense restrictions have in the long-run much more effect than extreme measures. Drunkenness is never quite so rife anywhere as where teetotal movements have for awhile been most successful.—J. GOMPERTZ MONTEFIORE. I also was rather perplexed by the statement that Edward, called Plantagenet, was the twenty-fifth king of England. I suppose in French histories of England they count the Saxons, Danes, &c. Perhaps they call Alfred the first king of England, or, starting from Egbert, drop out some. I know of no English history in which Edward, surnamed Plantagenet, comes out twenty-fifth. L. E. L., M. REARDEN. Please repeat botanical question. M. R. desires to know where in London there is an extensive retail mart for books of general literature, light reading, works out of print. M. R. thinks that as regards whist, and games of chance generally, ignorance is bliss. —*De gustibus, &c.* I find in whist capital rest after work; the more I play it the less it seems to me a game of chance.—J. PARKER FOWLER. Thanks for experiment in willing game. The third showing a danger attending such experiments is worth noting, but we have admitted a letter calling attention to that point.—G. HOBSON. We have subjects more pressing than organ playing.—SIGMA. I doubt if study occasions the mind trouble described by W. M. N. Steady mind work rather tends to cure it.—E. C. K. Yes; Venus can be clearly seen on the sun's face without a telescope. Of course, a smoked glass would be necessary.—A SCOTCH SUBSCRIBER. Messrs. Coxwell & Glaisher reached a height of about $6\frac{1}{2}$ miles, though French aeronauts are disposed to deny this. At a height of 7 miles the atmospheric density is reduced to about one-fourth; the density of hydrogen at atmospheric pressure is only about 7-hundredths, say one-fourteenth that of air, so that, supposing the balloon did not allow the hydrogen to expand, as with the diminished pressure it would tend to do, there would still remain ascensional power at a height of seven miles, but, of course, very much less than at the earth's surface. The lifting power at the earth's surface is equal to about 13-14ths the weight of the balloon's content in air at sea-level; at a height of seven miles it amounts but to about 5-7ths the weight of the same content in air of one-fourth the density at the sea-level, or is less in the same degree that 5-28ths are less than 13-14th or 26-28ths. It is thus less than a fifth of what it had been at the earth's surface.—W. Cave Thomas. Many thanks for abridgment. It relieves from a difficulty.—Squirt will be much obliged by any information about table fountains.—E. H. Pressure varies directly as the height of the barometer.—W. Southall. A botanical account, by a botanical writer, shortly.—J. C. L. The peculiarity you notice is due to aberration. So far as precession is concerned, the R.A. of Sirius is steadily increasing throughout the year by about $2\frac{1}{2}$ sec.; but as, owing to aberration, Sirius appears to move in a small ellipse, whose major axis is $40\frac{1}{2}''$ or $2\frac{2}{3}$ sec. in length, the steady increase due to precession is converted into an apparent alternate increase and diminution, the increase being the greater.—Lux. The *cause* of the earth's tilt is unknown; but it cannot be that you suggest. If any terrestrial cause were to carry the seas to the northern hemisphere, the tilt would not be appreciably altered.—S. P. A slip for Israel, no doubt.—J. E. Brodie sends us accounts of the Gas-light and Coke Company showing that the residual products, including coke, do not amount (as Mr. W. M. Williams said in his article on Electromania) to half the cost of the manufacture of gas, and in Bristol not to 40 per cent.

ELECTRICAL.

J. H. Ward.—1. Be careful to well soften the iron wire. 2. Three layers of No. 18 or 20 cotton, covered and paraffined, will suffice for the primary coil. 3 The secondary coil should be well insulated from the primary by several layers of paraffined paper. You may use No. 36 or 38 wire, but it should be silk-covered. It is no economy to use cotton-covered wire, because the insulation necessary to compensate for the poorness of its insulating properties more than neutralises this or any other counter advantage. The length of the secondary wire will depend upon the kind of spark you require. If you want a short, thick spark, make a comparatively short, thick coil, but if you desire a long, sharp spark, then the length of your coil must be greater in proportion to its diameter. A very convenient proportion is to make the total diameter about one-third of the length. 4. The paper you send is not the best; you will find it better to use one layer of paraffined foreign note paper; with silk-covered wire this will be quite sufficient. Have you determined to make your coil of uniform thickness from end to end?

THE TELESCOPE.

Geo. Harrison. You are quite right about δ Herculis. *Culpa nostra.* On the very day on which your queries were received we had been writing a description of another star, and, in a manner absolutely inexplicable to us, seem to have repeated part of such description in our reply to yourself. The comes is really, as you say, nearly vertically over the larger star. Our statement that the position angle has only varied some 22° during the last eighty-two years is, however, strictly correct.—J. N. Colley. You have got hold of one of the old Gregorian telescopes, with metal reflectors. The loss of light in this form of instrument is very serious indeed, as it has to undergo double reflection (with its consequent great absorption), besides its transmission through the eyepiece. This may, possibly, be aggravated, in the case of your own acquisition, by the dirtiness of the mirrors. If they are clouded or speckled, you may buy a little citric acid and water and a very soft wash-leather as a means of removing impurities; but, we must repeat, the fundamental principle of the instrument itself must always cause a serious loss of light.—Comet. You do not even now furnish the information whether your telescope is mounted (so to speak) at the *top* of the polar axis, or on one side of it. If the former, you must, perforce, turn the instrument round to reach the pole, as you can never place your telescope parallel with the polar axis. You had better buy Nos. 386 and 389 of the *English Mechanic* for the rudimentary information you appear to require.

Dr. Stanford E. Chaille, a prominent New Orleans physician, has published an article in a medical journal to show the effect of the Mississippi floods on the health of the city. He presents the mortality statistics of twelve overflows, including in each case the deaths for the year, and for the preceding year, and for the following one. After a careful examination of the history, facts, and opinions, he concludes that these "fail to indicate that the partial inundations of New Orleans have ever influenced unfavourably its mortality, whether by yellow fever, by cholera, by malarial fevers, or by diseases generally. On the contrary, the evidence, though imperfect and not fully conclusive, justifies the inference that the deposit and decomposition of filth, and any other promoters of disease which may be due directly to inundations, are more than counterbalanced by the flood, which first covers up the soil, from whence springs so much disease, and then helps to cleanse it."

Science and Art Gossip.

Since the hot season began, sixty-four ship captains have died of yellow fever at the different Cuban ports.

The Census Bureau of Japan reports for 1881 nearly 900,000 births and about 600,000 deaths.

The latest enumeration of Japan's military forces show 43,700 men in the standing army, including the Imperial Guard, and 58,000 Reserves.

An inexhaustible mine of corundum stone, the next hardest known substance to the diamond, has been discovered in Butts County, Ga. It resembles the sapphire, is susceptible of high polish, and is valuable in many ways.

Cholera increases slowly in and about Tokio and Yokohama, Japan. Its ravages are not confined to the poorer classes, several high officials having been attacked. The daughter of Prince Arisugaua, the Emperor's uncle, died after a brief illness.

Swans on the Thames.—The officials of the Crown and Dyers' and Vintners' Companies have just completed the numbering and nicking of the swans on the Thames between Southwark-bridge and Henley. There are now upwards of 400 old birds and cygnets on the upper reaches of the river, nearly 300 of which are the property of the Crown, the remainder being owned by the Vintners' and Dyers' Companies.

Tea Cultivation in New Zealand.—Some time since the Acclimatisation Society of New Zealand invited Mr. Reid, a gentleman connected with the cultivation of tea in India, to make experiments with tea-plants grown in the gardens of the society at Auckland. Mr. Reid did so, and has lately made his report, which is eminently satisfactory, and shows that the plant can be most successfully cultivated in that district.

Mr. Proctor's Lectures on Astronomy.—In reply to several questions, the Editor begs to state that he has agreed to deliver at several places, during the forthcoming lecture season, lectures selected from the following list:—1. Birth and Growth of Worlds; 2. Life and Death of Worlds; 3. The Sun; 4. The Earth-like Planets; 5. The Giant Planets; 6. The Moon; 7. Comets and Meteors; 8. The Star Depths; 9. The Transits of Venus; 10. The Giant Pyramids. All of these can be illustrated with the oxy-hydrogen lantern (where procurable) from Mr. Proctor's collection of more than a thousand photographic slides. The first seven (only) can be illustrated by means of paintings on canvas.

Saving Life.—In consequence of the numerous fatal accidents brought under the notice of the Royal Humane Society by the want of the knowledge of swimming, the committee have resolved to grant a silver medal annually to many of the leading public schools for proficiency in the art with a view to saving life. Rules have been drawn up for the guidance of the head-masters who have signified their cordial approval of the scheme. It is not contemplated to make the medal a personal decoration, as it is considered that that would tend to depreciate the medals of the society intended for saving life from drowning at personal risk. The rules state in effect that a medal will be awarded to each selected school, the competition to be open to all the boys, subject to the approval of the head-master, and to take place in the river or bathing-place used by the school, and to be carried out under the supervision of the head-master, or such umpire as he may appoint. Each boy to have one trial under certain specified conditions. The medal and its accompanying testimonial inscribed on vellum is to be awarded to the boy who obtains the greatest number of marks in the trials.

A Supposed Meteor.—Mr. N. S. Drayton, of Jersey City, writes as follows to the editor of the *Scientific American*:—"On the the evening of the 6th, while engaged in 'sweeping' the vicinity of Ursa Minor for double stars, my attention was drawn to a bright object about the size of a star of the second magnitude moving slowly from west to east. It passed within a degree of Polaris and continued steadily on its course eastward, disappearing from view in the neighbourhood of Capricornus. In colour this object, a meteor, doubtless, was deep red, without scintillations or train of any kind, and its slow movement was in marked contrast with the rapid flashing of the common 'shooting star.' It was visible to me fully three-fourths of a minute, varying but slightly in brightness during that time. In the closeness of my attention to its movement I neglected to note the time of its appearance, but judge it to have been near half-past ten. Perhaps there were other of your readers who observed the phenomenon, and can add more specifically to my testimony."—N. S. Drayton—Jersey City Heights, *July* 8, 1882.

Pharos at Alexandria. — In a letter to the *Times* Mr. [illegible] referring to the Pharos at Alexandria, con[illegible] according to Weil, on the authority of Ijas, in 1472, [illegible] Arabic writer states that in that year a lighthouse was [illegible] by Kaitbai, near the old one. It communicated with [illegible] a dyke, and was provided with a house for [illegible] a platform from which strange [illegible] at the distance of a day's sail, so that time [illegible] the guns with which the tower was sup[illegible]. The ancient lighthouse must have [illegible] at some period between the years 1425-1427, [illegible] who was there at that time, states that "near [illegible] there is a fine high tower, on which there [illegible] mirror, &c."; in the middle of that tower "there [illegible] account is confirmed by Makrizy (1360-1442) [illegible] were seated around the mirrors to give warning [illegible] of an enemy. Abd Allatif (1161-1231) also tes[illegible] a mosque in the tower. It does not appear by [illegible] that the tower of to-day stands on the founda[illegible] the Pharos of Sostratus, which, however, must be hard by, [illegible] not difficult to determine.

Monument to Sir E. Landseer. The name of Sir Edwin [illegible] to be commemorated in St. Paul's Cathedral [illegible] slab over his grave in the crypt, where his [illegible] rest near those of Sir Joshua Reynolds, Sir [illegible] Lawrence, Benjamin West, Fuseli, and George Dawe, the [illegible]. A mural tablet of marble, sculptured by Mr. W[illegible] been placed about twenty paces from the grave of [illegible] a bay on the south side, in which is John Rennie's [illegible] next to that where Sir Christopher Wren was buried. [illegible] part of the monument is a medallion portrait in profile, [illegible] by corbels on which appear copies of the heads [illegible] lions in Trafalgar-square. Above the medallion is [illegible] enriched with fern leaves, and over this a painter's [illegible]. The lower part of the monument is a bas-[illegible] of the best known of the painter's works [illegible] "Chief Mourner" which was doubtless chosen [illegible] feeling of sympathy between man and animals [illegible] Sir Edwin Landseer's pictures. Beneath, [illegible] the family crest, the head of an eagle holding a [illegible]. The inscription, in small incised and gilded [illegible] "Sir Edwin Landseer, R.A., son of John Landseer, A.R.A. Born March 7, 1802. Died October 1, 1873. This monu[illegible] is erected by his surviving brothers and sisters. 'He hath made every thing beautiful in his time.'"

Bees at South Kensington. — The eighth exhibition of bees and [illegible] produce, hives, and bee furniture was begun on Thursday, August 3rd, at the Royal Horticultural Gardens, South Kensington, by the British Beekeepers' Association. The exhibition will close on [illegible]. The wet season this year has not been favourable for the production of honey but, owing to the exertions of the associa[illegible] the local societies, the keeping of bees by cottagers is on [illegible]. Medals, certificates, and money prizes were com[illegible] 45 distinct classes grouped under the headings of [illegible] supers, honey, comb-formation, cottagers' classes, foreign and colonial classes, comestibles, miscellaneous, and [illegible] competition. The display of hives was very large and inte[illegible]. In a tent erected in the grounds the driving competition [illegible]. Prizes were given to the competitors who in the neatest, [illegible] and most complete manner drove out the bees from a [illegible], and captured and exhibited the queen bee. Neither [illegible] nor the judges wore veils. The driver approaches the [illegible] blows a little brown-paper smoke into the entrance. The [illegible] fright, and a remarkable instinct leads them to gorge [illegible] with honey sufficient for two or three days' provision [illegible] to the exodus which they foresee. In this dull [illegible] the insects are harmless. The manipulator [illegible] the hive upside down and places an empty hive at an angle of about 45 degrees above it. Then he drums on the lower [illegible] with his hand — the bees march into the upper [illegible] the honey behind them. This the honey is [illegible] (with the exception of the stirrup-cups which the provi[illegible] creatures have drunk) and the bees are preserved alive. [illegible] swarms may also be similarly made, thus saving loss of [illegible] in waiting for the bees to swarm in the natural way. The [illegible] thing is to [illegible] that each swarm is provided with an [illegible] or potential queen, since she alone is capable of continuing the race. The workers are females condemned by nature and their [illegible] to a conventual life. The drones are the males, created [illegible] that one should be selected by the queen of his or another hive, and should perish immediately after becoming the object of her violent affection. The unchosen drones are killed or driven out to starve when their brief season is past.

Our Mathematical Column.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

No. VII.

By Richard A. Proctor.

In our last lesson we established the general rules for differentiating composite functions, and functions of functions. We now give some examples of the application of these rules. To illustrate the first rule, take the following cases:—

Required the differential coefficient of $a+x-x^2$ with respect to x. The differential coefficient of a is 0; that of x is 1, that of $-x^2$ is $-2x$. Hence

$$\text{if} \quad y=a+x-x^2$$
$$\frac{dy}{dx}=1-2x.$$

Again put $\qquad y=(a+x-x^2)\sin x$.

Then the differential coefficient of $(a+x-x^2)$ is $(1-2x)$, and the first portion of the required coefficient is therefore

$$(1-2x)\sin x.$$

Again, the differential coefficient of $\sin x$ is $\cos x$. Hence the second part of the required coefficient is

$$(a+x-x^2)\cos x.$$

We add, according to our first rule, and so we get

$$\frac{dy}{dx}=(1-2x)\sin x+(a+x-x^2)\cos x.$$

Next, to illustrate the second rule, though we shall presently have to go back to the first:—

Let $\qquad y=(\sin x)^n$.

Here y is a function of $\sin x$. So that by second rule we treat $\sin x$ as if it were the quantity with respect to which y is to be differentiated. We know that if y were equal to x^n, its differential coefficient would be $n\,x^{n-1}$. Hence in this case we have for the first factor of our coefficient $n\,(\sin x)^{n-1}$. But the rule tells us we are to multiply this by the differential coefficient of $\sin x$, that is by $\cos x$. Hence we have finally

$$\frac{dy}{dx}=n\,(\sin x)^{n-1}\cos x.$$

Take another case.

Let $\qquad y=(a^2+x^2)^{\frac{1}{2}}$.

Here y is a function of (a^2+x^2). Hence by the second rule we treat (a^2+x^2) as if it were the quantity with respect to which y is to be differentiated. If y were equal to $x^{\frac{1}{2}}$ we know that its differential coefficient would be $\frac{1}{2}\,x^{-\frac{1}{2}}$, or $\dfrac{1}{2x^{\frac{1}{2}}}$. Hence the first factor of the required coefficient is $\dfrac{1}{2\,(a^2+x^2)^{\frac{1}{2}}}$. We are to multiply this by the differential coefficient of (a^2+x^2), that is by $2\,x$. Therefore we have finally

$$\frac{dy}{dx}=\frac{2\,x}{(a^2+x^2)^{\frac{1}{2}}}=\frac{x}{\sqrt{a^2+x^2}}.$$

Yet one more case of the second rule.

Let $\qquad y=\dfrac{1}{\sin x}$

We know that if y were equal to $\dfrac{1}{x}$ or x^{-1} its differential coefficient would be $-x^{-2}$, or $-\dfrac{1}{x^2}$. Hence the first factor of the required coefficient is $-\dfrac{1}{(\sin x)^2}$. We must multiply this by the differential coefficient of $\sin x$, that is by $\cos x$. Thus we get finally:

$$\frac{dy}{dx}=-\frac{\cos x}{(\sin x)^2}=-\cos x\operatorname{cosec}^2 x.$$

This is one of the results already obtained. But observe specially that the differential coefficient of the reciprocal of any quantity may be shown in precisely the same way to be the reciprocal squared multiplied by the differential coefficient of the quantity taken negatively. For example:—

$$\text{If} \qquad y=\frac{1}{a^2+x^2}$$
$$\frac{dy}{dx}=-\frac{1}{(a^2+x^2)^2}\times 2\,x=\frac{-2\,x}{(a^2+x^2)^2}$$

And now finally (so far as the present lesson is concerned) let us take a case in which both of our rules are applied, but more directly dealt with under sub-rule C, for the case of a function divided by a function. We will deal with it both ways, as more effectively illustrating this part of our subject.

Let $$y=\frac{\sin x}{\cos x}$$

By the first rule we get at once the first portion of the required coefficient. For, treating $\cos x$ as a constant, we take the differential coefficient of $\sin x$, that is, $\cos x$, and get the first portion, viz., $\frac{\cos x}{\cos x}$ or 1.

For the second part we treat $\sin x$ as a constant, and have to multiply it by the differential coefficient of the other factor $\frac{1}{\cos x}$.

By what was shown in the preceding case, this is

$$-\frac{1}{\cos^2 x}\times -\sin x, \text{ or } \frac{\sin x}{\cos^2 x}.$$

This multiplied by $\sin x$ gives for the second portion $\frac{\sin^2 x}{\cos^2 x}$. Hence the required differential coefficient is

$$1+\frac{\sin^2 x}{\cos^2 x}=\frac{1}{\cos^2 x}$$

This would be obtained at once from rule C, which states that where one function is divided by another, the differential coefficient is equal to

$$\frac{\text{numerator's dif. coefficient}}{\text{denominator}} - \frac{\text{numer.}\times\text{denominator's dif. coefficient}}{(\text{denominator})^2}$$

or we may, as more symmetrical, put the differential coefficient of a fraction in the form—

$$\frac{\text{numerator's dif. coef.}\times\text{denom.} - \text{denominator's dif. coef.}\times\text{numer}}{(\text{denominator})^2}$$

We have now had a good deal of rule-stating and rule-illustrating. In our next we shall apply some of the rules to a few problems of maxima and minima. Probably some readers who have begun to grow weary may be induced, when they see the value of the rules, to master them more thoroughly than they have yet done.

Our Chess Column.

By Mephisto.

SEVENTH GAME IN THE MATCH BETWEEN MESSRS. A. A. BOWLEY AND W. T. PIERCE, OF BRIGHTON.

Giuoco Piano.

White. A. A. Bowley.	Black. W. T. Pierce.	White. A. A. Bowley.	Black. W. T. Pierce.
1. P to K4	P to K 4	17. P to K5	P takes P
2. KKt to B3	QKt to B3	18. P takes P	Q to B3 (e)
3. B to B4	B to B4	19. B to B2	R to Qsq
4. P to QB3	P to Q3 (a)	20. B to Q4	Kt to Kt3
5. P to Q4	B to Kt3 (b)	21. P to K6	Kt to K4
6. B to K3 (c)	B to Kt5	22. P takes P (ch)	K takes P
7. B to QKt5	P to QR3	23. B to K4	Q to K3
8. B to R4	P takes P	24. Q to B2 (f)	P to Kt4
9. P takes P	B to R4 (ch)	25. QR to Ksq	QKt to B3
10. Kt to B3	P to QKt 4	26. QB takes Kt (g)	Kt takes B
11. B to Kt3	Q to B3	27. B to B5	Q to QB3
12. Castles	QB takes Kt	28. R to K3 (h)	KR to Ksq
13. P takes B	B takes Kt	29. B to Q7 (i)	R takes B
14. P takes B (d)	KKt to K2	30. Q to R7 (ch)	K to Bsq
15. K to Rsq	Kt to R4	31. Q to R8 (ch)	K to B2
16. R to KKtsq	P to R3	32. Q to R7 (ch)	

Drawn (j).

NOTES.

(a) Inferior to 4Kt to B3.

(b) 5. P takes P is to be preferred.

(c) 6. P takes P, Q to K2 (best). (If P takes P or Kt takes P, Black loses a Pawn.) 7. P takes P, Q takes P (ch). 8. Q to K2, Q takes Q. 9. B takes Q, P takes P, and White's game is slightly to be preferred.

(d) White ought to have taken with the Queen, as the exchange of Queens would be in his favour, considering he has a strong centre and two Bishops.

(e) If Q takes P, then B to Q4 with a strong attack.

(f) White's play is very good, but he now misses his chance. He ought to have played 24. P to KB4, which would have won, i.e.:

24. P to KB4	24. P to QB4 (We see nothing better.)
25. B takes Kt	25. R takes Q
26. QR takes R and White will win in a few moves.	

The Black Queen is threatened by B to Q5, and in reply to Q or K moving, White will play R takes Kt P, &c.

(g) Probably played absent-minded, for B takes QKt wins a piece.

(h) White cannot take the Knight on account of Q takes P (ch) followed on R interposing by R to Q8 (ch), and winning the Queen. 28. R to Kt3 would also have been bad on account of 28. Kt takes P. 29. B to K4, Kt takes R, 30. Q to Kt3 (ch) would be useless, as the Black Queen would cover on B5.

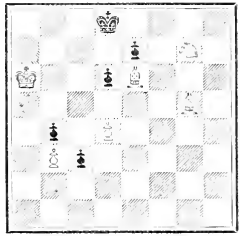
(i) An ingenious move, which secures a draw.

(j) Black cannot depart from his position, for if he played K to K3, then Q to Kt6 (ch) would win the Queen, i.e., K to Q4. Q to K4 (ch). K to Q3. R to Qsq (ch), and wins. Again, if 32 K to B3, then Q takes RP (ch), and on Kt interposing, Q takes KtP (ch). K to B2, Q to B5 (ch), &c.

PROBLEM No. 50.

By Alfred B. Palmer.

BLACK.



WHITE.

White to play and mate in four moves.

SOLUTIONS.

End Position, No. 46, by Leonard P. Rees, p. 139.

1. R to Q7 (ch)	1. K takes R
2. Q to B7 (ch)	2. R or Kt interposes.
3. Kt to B6 (ch), &c.	

Problem No. 47, by Muzio, p. 139.

1. Kt to Kt2	1. K to B4
2. R takes P	2. K to Kt4
3. R to K5 mate	
	(a) 1. K to Q3
2. Kt to B4 and B mates	
	(b) 1. B takes P
2. Kt (ch) and 3B mates.	

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess-Editor.*

Leonard P. Rees.—Thanks for Problem and Game. You are right about Problem No. 45. Thanks for your offer, but the indebtedness is really on our side. We, however, accept, under the condition that "we make thee judge," for which purpose we would send you all solutions received.

Ffynone Club.—Colour of men is merely a matter of mutual understanding, but for convenience of notation it is preferable for the first player to have White.

Berrow.—Problem received with thanks.

Alfred B. Palmer.—Game received with thanks.

Correct solutions received of Problem No. 48: Herbert Jacobs, J. A. Bower and C. H. Lylle, J. K. Milne, Tefsir, Edward B. Norton, Geo. H. Bonner, W. A. Lee. No. 49:—Alfred B. Palmer, Schmenke, J. J. Kaye, John Watson. From Squire, J. K. Milne, J. G. (Dublin), A. R. Johnson, G. Woodcock, Kit, Berrow, A. H. Cooke, E. J. J., Geo. H. Bonner, W. A. Lee.

W. Mead.—No, we have not forgotten.

E. C. H.—Solution wrong.

A Reader wishes to play a game by correspondence.

Our Whist Column.

By "Five of Clubs."

I[illegible] [illegible]sting game, which appeared some eight [illegible] "Westminster Papers," Mr. F. H. Lewis (to w[illegible] [illegible]ders have already been indebted for several [illegible]munications), played hand Y. The play is [illegible] first ten rounds, the inferences plain and [illegible] remaining cards in plain suits could all be [illegible]ir players. Thus A knows that Y cannot have the [illegible] (or he would have played it at trick 3), so that Z [illegible] in Spades, it must lie with B. He knows that Y [illegible] each a Club—it matters not which has the winning [illegible] like manner that A holds the remaining Spade, [illegible] Y knows his partner holds the remaining Club, [illegible] hold each a Spade; and Z knows the same about Y.

THE HANDS.

A.
Hearts—7, 6, 3.
Clubs—8, 6.
Diamonds—K, 8, 4, 3.
Spades—A, K, 10, 5.

Y.
Hearts—A, Kn, 4.
Clubs—K, Kn, 7, 3.
Diamonds—Q, 6, 5.
Spades—7, 6, 4.

B

Y Z

Trump Card, Heart Nine

A

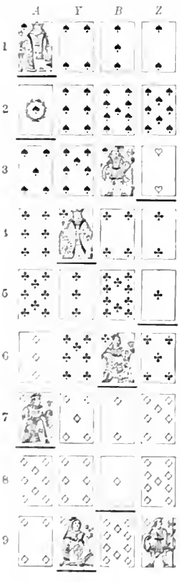
B.
Hearts—K, 8, 5.
Clubs—Q, 10, 4.
Diamonds—A, 10, 2.
Spades—Q, Kn, 9, 3.

Z.
Hearts—Q, 10, 9, 2.
Clubs—A, 9, 5, 2.
Diamonds—Kn, 9, 7.
Spades—8, 2.

Score:— { *A, B,* = 4 / *Y, Z,* = 4

THE PLAY.

Note.—The card underlined wins the trick, and card below leads next round.



REMARKS, INFERENCES, &c.

1 and 2. *A* leads from his best and longest suit.

3. It is unfortunate for *Z*, with four trumps, to have to ruff; but of course he is wise in doing so at the score, and indeed if the score had been different.

4. *Y* does not hold the Queen.

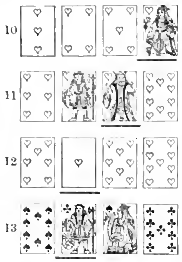
5. As *Y* returns the lowest Club, he holds two more at least. He cannot have played his only remaining Club, for *Z* holds probably two more, certainly not more than two, and *B*, having played the Ten, cannot have any cards left but the Knave or Queen, or both; even in the latter case, a club would be with *Y*, and if there is one there must be another, or *Y* holding two only after first round would have returned the highest. *Y* notes that *B* has not the nine of Clubs (see notes on trick 11).

6. Thus as *Z* does not lead the Queen, *A* places the Queen in B's hand, and discards from his originally weaker suit of the two plain suits remaining.

7. *B* does rightly—at the score—in leading from the suit from which his partner has discarded; it is the best chance of giving *A* a trick by ruffing. *A* does not hold the Queen.

8. It is clear *A* holds the Four, the winning card being with *Y* or *Z*.

9. *B* has very little choice. Leading Spade Queen would be manifestly bad, as *A* (original leader of the suit) holds the only remaining card in it, so that either *Y* or *Z* can ruff, the other making a convenient discard. A trump lead is not likely to do any good, the trumps being



probably pretty equally divided, and the game sure, unless *Y* and *Z* hold both Ace and Queen, and make them separately. As the score and play stand, it is better that either *Y* or *Z* should lead trumps than *A* or *B*.

11. From the lead of the 10, *Y* knows that *Z* does not hold the King, for if he held it he would have played it, unless, besides the Ten, he had held another. But in this case his trumps would been originally King, Queen, Ten, Two, another, in which case (even after being forced) he could certainly have led trumps earlier. Now the King being with the enemy, who hold the remaining Spades, *Y Z* are bound to lose if *Y* takes trick 11. For then, if he leads the Knave of trumps, the King will take it, and a trick in Spades go to *A B*; while if he leads the Knave of Clubs, it will be ruffed (for *A* has already renounced, and *B* does not hold the other Club), and the King of trumps will make the odd trick. *Y* takes the only course to win. Whether the finesse succeed or fail as a finesse (it fails, be it noticed), *A B* must lose both the remaining tricks. This is obvious enough when the cards held by the four players after the tenth round are placed on the table; but how many a game has been lost in such a position by taking a trick at the wrong time.

DOUBLE DUMMY PROBLEM (Page 104).

The second form of solution of this problem, referred to in our last, runs thus:—

Club, trumps.

A—C. 10, 6, 5, 4; D. 10, 9, 8, 7, 6, 5, 4, 3, 2.
Y—C. A, K; H. Q, Kn; D. A, Q; S. K, Kn, 10, 9, 8, 6, 5.
B—C. 9, 8, 7, 3, 2; H. 10, 9, 8, 7, 6, 5, 4, 3.
Z—C. Q, Kn; H. A, K, 2; S. A, Q, 7, 4, 3, 2; D. K, Kn.

Note.—The underlined card wins trick, and card below it leads next round.

A	*Y*	*B*	*Z*		*A*	*Y*	*B*	*Z*
D 2	D Q	C 2	D Kn					
C 4	C K	C 3	C Kn					
C 6	H Kn	H 3	H 2	or	D 3	S 6	C 7	S 2
D 3	D A	C 7	D K		C 5	C A	C 8	C Q
C 5	C A	C 8	C Q (*a*)		C 6	S 8*	H 3	S 3
					D 4	D A	C 9	D K
					C 10	H Kn	H 4	H 2

(*a*) Whether *Y* plays a Heart or Spade, *A* is bound to bring in his Diamonds.
* It does not matter what *Y* plays. The working of the above is Loresmith's.

Royal Robber.—Thank you for your kind and encouraging note. We share your admiration for Mr. Lewis's great Whist-playing skill. We hope too, with you, that he may now and then send a double dummy problem for solution.

NOTICES.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, AUGUST 18, 1882.

Contents of No. 42.

Science and Art Gossip.

At the request of several of our readers, who consider that these notes on Science and Art should be made a more prominent feature, we propose in future to give "Science and Art Gossip" the foremost place in our pages. We shall be glad to receive from contributors, correspondents, and subscribers generally, notes on matters of interest, suitable for these columns, briefly (as well as plainly) worded, and as exactly as possible described. We apprehend from past experience that a selection will have to be made; but trust none who may send notes will be annoyed if want of space should prevent insertion.

The Trustees of the Gilchrist Educational Trust have arranged for courses of "Science Lectures for the People," during the ensuing winter, in five towns of central Lancashire, in five Scotch towns, and in Leicester, Lincoln, Chesterfield, Doncaster, York, Reading, and Banbury. The lecturers who will take part in them are Dr. Carpenter, F.R.S. (the Secretary to the Trust), Professor Balfour Stewart, F.R.S., Professor W. C. Williamson, F.R.S., Dr. Martin Duncan, F.R.S., Rev. W. H. Dallinger, F.R.S., Mr. W. Lant Carpenter, B.Sc., F.C.S., Dr. Andrew Wilson, F.R.S.E., and Mr. R. A. Proctor.

The report on the proposed grant to the French Minister of Posts and Telegraphs of a sum of £3,600, in view of the meeting of electricians, has been sent to the French Senate, after having been adopted by the Chamber of Deputies. This meeting will take place in October. One of the reasons alleged for the delay is the necessity of installing the magnetic instruments now in course of construction for the observatory of Paris. The assent of the French Senate is stated to be beyond a doubt.

Carrier Pigeons for Naval Service.—The Secretary of the German Navy has resolved to employ carrier pigeons in the coasting service, all the experiments with them made by the Prussian Government on the coast of the North Sea, since 1876, to establish communication with the lightships lying off the coast having been successful.

The Syllable "-ing" in Place-Names.—Two of the most important military roads are known as "Emming" Street and "Watling" Street, names which they no doubt bore not only during the Roman occupation, but probably before. The word "street" appears to be surplusage, and "Watling" a corruption of Keltic *gaoidilbach-eang* (*i.e.*, *eanach*), signifying the Gaelic or Irish road, running from south-east to north-west, as illustrated by applying the name Watling-street to the Milky Way, which has a course nearly parallel to it. [This is a rather startling statement. The course of the Milky Way changes from hour to hour, with reference to the compass-points.—Ed.] "Erming" may be from the Keltic *eirim-eang*, a riding road, one for the use of horses; and, possibly, it is the most ancient of our commercial roads, opening a communication between the Phenician traders and the inland parts. The forms "Watlinga" and "Erminga" are, probably, survivals from the Roman names "Watlinga via" and "Erminga via."—Mr. Walford's *Antiquarian Magazine*.

The Royal Aquarium Winter Electric Exhibition.—We hear with great pleasure that the managers of the Royal Aquarium, Westminster, taking advantage of the conveniently central and accessible position of the Aquarium, have made arrangements to hold an exhibition, illustrating the latest applications of electricity to public and domestic requirements. It is intended that the exhibits shall, as far as possible, be subjected to practical and useful tests, with the view of ascertaining the actual and relative values of the various systems and apparatus shown. Thus a preliminary programme has been arranged for testing the different kinds of incandescence lamps, for the best system of which a prize of one hundred guineas will be offered. It is proposed that each exhibitor entering this competition should be allotted a chandelier of 100 lights, the details of arrangement being left to the respective exhibitors, while the directors of the exhibition will retain the entire control of the various chandeliers. A record of all renewals rendered necessary will be made, the different causes of such renewals being noted; from time to time, photometric measurements will be taken, and the power absorbed in producing the light will be accurately ascertained. The duration of lighting during the proposed term of the exhibition will be about 800 hours, and, as it is intended to make the necessary tests frequently, a very accurate estimate of the relative values of different systems will be obtained. In a similar way, information will be gained in reference to storage batteries, and a prize of one hundred guineas will be offered for the best system, including batteries, adapted for a central depôt, and small portable wires to feed six incandescence lamps. In all, £1,000 will be distributed in prizes, under the direction of a carefully-selected scientific jury. We wish the enterprise the success which it well deserves.

Fasting in Acute Rheumatism.—Dr. Wood, Professor of Chemistry in the Medical Department of Bishop's College, Montreal, reports in the *Canada Medical Record* a number of cases in which acute articular rheumatism was cured by fasting, usually from four to eight days. In no case was it necessary to fast more than ten days. Less positive results were obtained in cases of chronic rheumatism. The patients were allowed to drink freely of cold water, or lemonade in moderate quantities if they preferred. No medicines were given. Dr. Wood says that from the quick and almost invariably good results obtained by simple abstinence from food in more than forty cases in his own practice, he is inclined to believe that rheumatism is, after all, only a phase of indigestion, to be cured by giving complete and continued rest to all the viscera.

Scientific Observatories at the North Pole.—In a recent paper, describing the observatories that are about to be established in the Polar regions by the German and other Governments, Professor Neumayer said that the Cumberland Strait Station is notable for its position near the magnetic North Pole, it being also not very far from the centre of the magnetic forces of the earth. The difficulties of this situation, consisting in the disturbances produced by the magnetic currents, are obviated by peculiarities in the construction of the instruments to be employed there. He also stated that a conference of the directors of meteorological stations is to be held at Copenhagen to consider the desirability of laying a telegraph cable from Canada through the region traversed by the great storms of the American continent, so as to make it possible to foretell the future weather for five or six days, whereas, at present, the weather predictions of the *New York Herald* are of little practical value.

Converting a Negative into a Positive.—Captain Bing, of Paris, has devised an ingenious method of making a positive on glass from a negative, and on the same glass. The back of the negative is covered with soluble bitumen or asphalt and then illuminated through the negative. After an exposure sufficient to render the light portion insoluble, the remainder of the asphalt is dissolved off with any of the usual solvents, leaving a positive. The silver negative is then dissolved off with the chloride of copper and a fixing agent, such as cyanide or hypo.—*Scientific American.*

To Keep Silver-plated Articles Bright.—Frank L. James, Ph.D., M.D., Prof. Chem. and Tox., St. Louis Coll. of Phys. and Surgeons, writes to the *Scientific American*. Articles of silver and silver-plated ware rapidly tarnish when kept in rooms where gas is used for illuminating purposes, and everywhere in cities like St. Louis, Pittsburg, Cincinnati, &c., where the air is constantly filled with sulphurous vapours. My cabinet of silver-plated specimens, instruments, and water pitchers used to give no end of trouble this way. This is all avoided now by dipping the articles occasionally in a solution of hyposulphite of soda. Large articles, like pitchers and salvers, should be wiped off with a rag dipped in the solution, and dried with a soft towel. A rub with a bit of chamois leather makes them as brilliant as new.

The American Association.—The American Association for the Advancement of Science will meet at Buffalo, N.Y., August 23.—*Scientific American.*

"L'Electricité," in an article on the progress of electrical science, remarks that in all the most striking of recent advances it is improvement rather than invention that comes to the front, and that no compromise or equivocation can deny justice to the real original discoverers. "Bell does not efface Reis, in spite of the recent Chancery suit: Faure cannot destroy Planté; and Swan, Edison, and the others cannot suppress the anterior labours of Changy."

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

By Amelia B. Edwards.

VI.—THE HYKSHOS CALENDAR AND THE EXODUS ACCORDING TO THE CONSECUTIVE THEORY.

Having seen how closely the relative dates of the Tanis Tablets, the accession of Ahmes, the expulsion of the Hykshos, and the entry and Exodus of the Hebrews can be brought into correspondence with the synchronous theory, which merges thirty years of the reign of Rameses II. in the reign of Seti I., we will next examine how far the relative dates of these same events are compatible with the consecutive theory, which counts the first regnal year of Rameses II., from the decease of Seti I., B.C. 1405. For this purpose (it being obviously unnecessary to go step by step over the ground a second time) a chronological table of the two schemes of reckoning will answer every purpose, and enable us to compare the plausibility of both hypotheses. It must be noted, however, that certain of our dates have to be regarded as compulsory. Whether we do, or do not, admit the thirty synchronous years of Seti and Rameses, the XVIIIth and XIXth dynasties must always begin, according to Mariette, in B.C. 1703 and B.C. 1462; the Tablet of Sān must always count 400 years from some point in the reign of Nubti to some point in the reign of Rameses II.; and the Exodus must always take place 430 years after the entry of Jacob and his household into the land of Egypt.

APPROXIMATE CHRONOLOGY OF THE EXODUS.

Synchronous. B.C.		Consecutive. B.C.
1836	Birth of Joseph	1806
1806	Joseph raised to power	
1800	Era of Nubti	**1800**
	Joseph raised to power	1776
1799	Seventh year of plenty	1769
1797	Second year of famine	1767
1796	Entry of Jacob into Egypt	1766
?	Accession of Apapi (last Hykshos king)	**?**
1727	Commencement of the National War	**1727**
1726	Death of Joseph	
1703	Accession of Ahmes I., and commencement of XVIIIth Dynasty	**1703**
1697	Expulsion of the Hykshos	**1697**
	Death of Joseph	1696
1462	Beginning of XIXth Dynasty, and accession of Rameses I.	**1462**
1456	Accession of Seti I.	**1456**
1435 (As co-Pharaoh)	Co-royalty of Rameses II.	1435 (As Prince-regent only.)
1405	Death of Seti I., and accession (in full) of Rameses II.	**1405**
1400	Fourth centenary of Nubti	**1400**
1368	Death of Rameses II., and accession of Menephthah	1338
1366	Exodus of the Hebrews	1336

The above table, it must be understood, is drawn up simply to show that, *whether computed synchronously or consecutively*, the great events of these important 500 years of the world's history might quite possibly have happened in strict accordance with the relative spaces of time recorded upon the Egyptian monuments, and in the early books of the Bible. The difference between the two methods of computation is a difference which affects Joseph's place in history, and leaves a margin of thirty years for the date of the death of Rameses II. According to the one hypothesis, Joseph interprets Nubti's dream six years before the establishment of the Hykshos Calendar; according to the other, he interprets the dream twenty-four years after the establishment of the Calendar. By the first reckoning, the reign of Nubti does not necessarily cover a space of more than fifteen years: by the last, Nubti must be credited with a reign of certainly not less than thirty-eight years, there being just thirty-eight years between the institution of the calendar and the end of the famine. The Bible, indeed, implies that the same Pharaoh who had raised Joseph to power was yet upon the throne when Jacob died seventeen years later; and that it was he who sent his elders and servants, and a great company of horsemen and chariots, to escort the mummy of his Prime Minister's father with all honour to his place of burial in the cave of Machpelah, in the land of Canaan, beyond Jordan; a sepulchre, by the way, which has never been violated, and in which—held sacred alike by Jew and Moslem—the remains of Jacob undoubtedly repose to this day. Again, the one scheme supposes Joseph to have seen only the commencement of the war of liberation, and to have died during the reign of Apapi; whereas the other scheme causes him to outlive the whole struggle, to witness the downfall of Apapi, and to die in the seventh year of Ahmes, just one year after the expulsion of the last remnants of the Hykshos. Lastly, the synchronous theory brings the Fourth Centenary of the Era of Nubti into the thirty-fifth regnal year of Rameses II. (B.C. 1400); while the consecutive theory, adhering to the same date for that event, brings it into the fifth regnal year of Rameses II. The two schemes are, therefore, equally possible, and perhaps equally probable, though neither is proven. I give them merely for what they are worth. Of the actual date at which these events happened we know nothing. The particular years which I have assigned to them, first synchronously and then consecutively, are advanced neither theoretically nor controversially; nor in any sense save that of expediency. I repeat that they are assigned only with reference to each other, and not as definite dates in relation to the period in which we live. The whole scheme—or rather the twofold scheme—might be shifted two or three centuries up or down the scale of ages without affecting its probability or its coherence.

I may here observe that nothing shows the loose and uncertain state of Egyptian chronology more strikingly than the curious diversity of opinion which exists among the learned in regard to the date of the accession of Rameses II.; a king of whom it may be said that the events of his reign are as well known to us, and as well authenticated, as the events of the reigns of Trajan or Titus. The following table (which does not represent all the opinions that might be quoted) differs by 72 years in the highest and lowest estimates:—

		B.C.
Rameses II. began to reign, according to	Mariette	1405
	Lepsius	1388
	Wilkinson	1355
	Bunsen	1352
	Brugsch	1333

Leatheroid.—Leatheroid is a new article made of paper. It consists of a number of thicknesses of cotton paper wound one upon another over a cylinder. The remarkable qualities of strength and adhesion it possesses are derived from a chemical bath, through which the paper is drawn on its way to the cylinder. It is moulded wet, and retains its form. When dry, it cuts like raw hide.

MATTHEW ARNOLD ON KNOWLEDGE.*

When we talk of knowing Greek and Roman antiquity, which is what people have called humanism, we mean a knowledge which is something more than a superficial humanism, mainly decorative. "I call all teaching *scientific*," says Wolf, the critic of Homer, "which is systematically laid out and followed up to its original sources. For example, a knowledge of classical antiquity is scientific when the remains of classical antiquity are correctly studied in the original languages." There can be no doubt that Wolf is perfectly right, that all learning is scientific which is systematically laid out and followed up to its original sources, and that a genuine humanism is scientific.

When I speak of knowing Greek and Roman antiquity, therefore, as a help to knowing ourselves and the world, I mean more than a knowledge of so much vocabulary, so much grammar, so many portions of authors, in the Greek and Latin languages. I mean knowing the Greeks and Romans, and their life and genius, and what they were and did in the world; what we get from them, and what is its value. That, at least, is the ideal, and when we talk of endeavouring to know Greek and Roman antiquity as a help to our knowing ourselves and the world, we mean endeavouring so to know them as to satisfy this ideal, however much we may still fall short of it.

The same as to knowing our own and other modern nations, with the aim of getting to understand ourselves and the world. To know the best that has been thought and said by the modern nations, is to know, says Professor Huxley, "only what modern *literatures* have to tell us; it is the criticism of life contained in modern literature." And yet "the distinctive character of our times," he urges, "lies in the vast and constantly-increasing part which is played by natural knowledge." And how, therefore, can a man, devoid of knowledge of what physical science has done in the last century, enter hopefully upon a criticism of modern life?

Knowing the best which modern nations have thought and said is not knowing their *belles lettres* merely. To know Italian *belles lettres* is not to know Italy, and to know English *belles lettres* is not to know England. Into knowing Italy and England there comes a great deal more, Galileo and Newton amongst it. The reproach of being a superficial humanism, a tincture of *belles lettres*, may attach rightly enough to some other disciplines; but to the particular discipline recommended when I proposed knowing the best that has been thought and said in the world, it does not apply. In that best I certainly include what in modern times has been thought and said by the great observers and knowers of nature.

The great results of the scientific investigation of nature we are agreed upon knowing, but how much of our study are we bound to give to the processes by which those results are reached? The results have their visible bearing on human life. But all the processes, too, all the items of fact, by which these results are established, are interesting. All knowledge is interesting to a wise man, and the knowledge of nature is interesting to all men. It is very interesting to know that from the albuminous white of the egg the chick in the egg gets the materials for its flesh, bones, blood, and feathers, while from the fatty yolk of the egg it gets the heat and energy which enable it at length to break its shell and begin the world. It is less interesting, perhaps, but still it is interesting, to

* From an article on "Literature and Science," in the *Nineteenth Century* for the present month.

know that when a taper burns, the wax is converted into carbonic acid and water. But as we go on learning and knowing, the vast majority of mankind feel the need of relating what we have learnt and known to the sense which we have in us for conduct, to the sense which we have in us for beauty.

Knowledges which cannot be directly related to the sense for beauty, to the sense for conduct, are instrument-knowledges; they lead on to other knowledge, which can. A man who passes his life in instrument-knowledges is a specialist. They may be invaluable as instruments to something beyond, for those who have the gift thus to employ them; and they may be disciplines in themselves wherein it is useful to every one to have some schooling. But it is inconceivable that the generality of men should pass all their mental life with Greek accents or with formal logic. My friend Professor Sylvester, who holds transcendental doctrines as to the virtue of mathematics, is far away in America: and therefore, if in the Cambridge Senate House one may say such a thing without profaneness, I will hazard the opinion that for the majority of mankind a little of mathematics, also, goes a long way. Of course, this is quite consistent with their being of immense importance as an instrument to something else; but it is the few who have the aptitude for thus using them, not the bulk of mankind.

The natural sciences do not stand on the same footing with these instrument-knowledges. Experience shows us that the generality of men will find more interest in learning that when a taper burns, the wax is converted into carbonic acid and water, or in learning the explanation of the phenomenon of dew, or in learning how the circulation of the blood is carried on, than they find in learning that the genitive plural of *pais* and *pas* does not take the circumflex on the termination. And one piece of natural knowledge is added to another, and others to that, and at last we come to propositions so interesting as the proposition that "our ancestor was a hairy quadruped, furnished with a tail and pointed ears, probably arboreal in his habits." Or we come to propositions of such reach and importance as those which Professor Huxley brings us, when he says that the notions of our forefathers about the beginning and the end of the world were all wrong, and that nature is the expression of a definite order with which nothing interferes.

Interesting, indeed, these results of science are, important they are, and we should all be acquainted with them. But what I now wish you to mark is, that we are still, when they are propounded to us and we receive them, we are still in the sphere of intellect and knowledge. And for the generality of men there will be found, I say, to arise, when they have duly taken in the proposition that their ancestor was "a hairy quadruped, furnished with a tail and pointed ears, probably arboreal in his habits," there will be found to arise an invincible desire to relate this proposition to the sense within them for conduct and to the sense for beauty. But this the men of science will not do for us, and will hardly, even, profess to do. They will give us other pieces of knowledge, other facts, about other animals and their ancestors, or about plants, or about stones, or about stars; and they may finally bring us to those "general conceptions of the universe which have been forced upon us," says Professor Huxley, "by physical science." But still it will be knowledge only which they give us; knowledge not put for us into relation with our sense for conduct, our sense for beauty, and touched with emotion by being so put: not thus put for us, and therefore, to the majority of mankind, after a certain while unsatisfying, wearying.

If there is to be separation and option between humane letters on the one hand, and the natural sciences on the other, the great majority of mankind, all who have not exceptional and overpowering aptitudes for the study of nature, would do well, I cannot but think, to choose to be educated in humane letters rather than in the natural sciences. Letters will call out their being at more points, will make them live more. And letters will not in the end lose their leading place. If they lose it for a time, they will get it back again. We shall be brought back to them by our wants and aspirations. And a poor humanist may possess his soul in patience, neither strive nor cry, admit the energy and brilliancy of the partisans of physical science, and their present favour with the public, to be far greater than his own, and still have a happy faith that the nature of things works silently on behalf of the studies which he loves, and that, while we shall all have to acquaint ourselves with the great results reached by modern science, and to give ourselves as much training in its disciplines as we can conveniently carry, yet the majority of men will always require humane letters, and so much the more as they have the more and the greater results of science to relate to the need in man for conduct, and to the need in him for beauty.

FUTURE SOURCES OF OUR FOOD SUPPLY.

By Percy Russell.

III.—AUSTRALASIA (*Continued*).

Queensland is, to a great extent, a subtropical region, and the strength of the leading agriculturists of the colony is concentrated on the production of sugar and coffee, rice, &c., and the like. Still, much good wheat is raised, and there are extensive areas—elevated plateaux —where wheat can be grown to great advantage, as it is in the Punjaub. The area of the colony is 669,520 square miles, but in 1880 only 112,290 acres were under crop. The live stock included 179,152 horses, 3,162,752 head of cattle, and nearly 7,000,000 of sheep. The population was 226,000.

Tasmania embraces an area of 26,215 square miles, of which 110,788 acres were under crop, showing a higher relative rate of agricultural progress than Queensland. The population was at the period under review 114,762, and the live stock return was as follows:—25,267 horses, 127,187 horned cattle, and 1,783,000 sheep. It is generally agreed that Tasmania in many respects bears a very close resemblance to England; and this resemblance is, in respect to its flora, very complete. I mean, of course, the flora artificially introduced by the processes of settlements. The abundance of fruit of all kinds produced is enormously in excess of home wants, and vast quantities are exported to the neighbouring colonies, and might be exported with special advantage to England, if the necessary mercantile machinery could be properly organised.

Passing from the continent to New Zealand, that Britain of the south, as it has been happily called, we find that the total area is 67,419,107 acres, of which only 917,701 acres are under crop, 324,933 being devoted to wheat. The live stock returns include 137,768 horses, 578,430 horned cattle, 13,069,338 sheep, over 200,000 pigs, and more than a million of poultry. The total population on April 3, 1881, was 489,909; it therefore follows that in round numbers, to every individual man, woman, child, or infant, there are in the colony more than twenty-five sheep! As to vegetable products, the soil of New Zealand is specially well suited to all fruits or vegetables raised in Great Britain, while the indigenous grasses in the interior are of a fine quality for feeding purposes, and sustain in excellent condition the millions of sheep which constitute much of the real wealth of these nature-favoured regions. The famous Canterbury plains are well known for the excellent quality and high yield per acre of the wheats there grown; while all around the tortuous coast-line, reckoned at full 3,000 miles, there abounds fish of fine quality, fit for table, and in numbers practically unlimited. Thus we may particularise the hapuka, a large, cod-like fish, king-fish, sole, dory, flounder, and very many others, to say nothing of oysters and various crustacea. In fact, the harvest of the sea would undoubtedly make a conspicuous figure in the food resources of these islands, were it not that the harvests of the land are so extravagantly ample as to render fish of quite secondary account—like the fine honey of the West Australians, it is too common to be of much commercial account.

We have now rapidly sketched the food-raising capacity of the Australasian colonies in a rough and superficial manner, but sufficiently to demonstrate that there, indeed, production is not only in the ascendant, but must remain so for many years to come, and, meanwhile, has for its only check such mechanical difficulties as still prevent us benefiting in our home food markets by the unlimited superabundance of all the principal food-stuffs—to use an expressive if uncouth phrase—that our antipodean friends now find emphatically a burden on their hands. To emphasise the existing state of things let us now take the aggregate estimate furnished by the best official sources of production in the Austral world in relation to population and territory. First, then, the total area of these bounteous regions amounts to 3,103,903 square miles, with an aggregate population of 1,499,258 males. The land under actual cultivation was at the period in question 6,371,238 acres, and the agricultural produce amounted to 36,346,950 bushels of wheat, 17,766,875 bushels of oats, 3,506,191 of barley, and 6,335,239 of maize. In addition to all this, there were produced 424,155 tons of potatoes, nearly 1,000,000 tons of hay, and 1,871,861 gallons of wine. As to the flocks and herds belonging to this singularly favoured community, just a million and a half strong, or, including females, 2,715,792 all told, we find the horses were 1,064,655; cattle, 7,878,782; sheep, 65,915,765; pigs, 822,337; making a grand total of 75,681,539. A further analysis of these astounding returns brings out the remarkable and suggestive fact, that while, taking the total population at 2,715,792, there were only ·875 persons to the square mile, the flocks and herds stood at 24·38! The revenue raised by these peculiarly favoured colonists for the year 1879 amounted to £15,927,488, and in 1880 had increased to £17,069,016, while the value of the imports amounted to £45,060,666, and that of the exports to £48,866,168! In other words, the value of the trade per head of the inhabitants, infants included, was then about £35 per annum. It is melancholy to contrast such a state of things with that prevailing among ourselves at home. Australasia probably gives an example of universally diffused real wealth, not only unknown in any other country of the world, but historically unparalleled. It must be remembered, too, that this extraordinary development of production has come about naturally without any special concerted efforts on the part of the colonists to show to the world what *could* be done in regions where the mass of the people were really enfranchised and the true lords of the soil. It is easy to imagine how much even this enormous productiveness of the Austral colonies would be directly stimulated if national systematic efforts were made here to organise proper markets for the reception of their surplus food-products, and if special lines of steamers were established to bring regular supplies. At present, there are many serious difficulties of detail in the way of this consummation, but let us trust that the time is not distant when the British householder, aided by the practical popularisation of mechanical and chemical science, may find his best security against high food rates in the fact that his beef and mutton are fed at the Antipodes, and that some of his best bread and his choicest fruits are the products of South Australian fields and Tasmanian or New Zealand orchards.

(To be Continued.)

WHAT WILL BE THE FORM OF THE TRICYCLE?

By John Browning,

Treasurer of the London Tricycle Club.

The number of tricycles known by different names has now reached over 300. These may be divided into two great classes: front-steerers and rear-steerers—or those machines which have the steering-wheel in front of the rider and those in which it is behind. It is but little known that Starley first brought out the Salvo as a hind-wheel steerer. After a few months he changed the construction to a front-steerer.

Soon after this, in the next season, the popular Meteor form came into vogue. This was extensively copied under various titles; but during last season and the present most of the makers who were making only hind-steering machines have produced new patterns of good front-steerers, while, as far as my knowledge extends, the makers who were making front-steering machines have confined their attention strictly to that type of tricycle. This leads us evidently to infer that machines having hind steering-wheels will become an extinct type in the immediate future.

Against this inference stands the fact that the fastest machine we have, the "Humber," is a rear-steerer, and that all the novel machines which have been introduced this season—the "Monarch," the "Arab," the "Rucker," and the "Sterling"—are of this construction.

Now, the "Monarch" may claim to be the tricycle reduced to its simplest possible form, having no more bearings than a bicycle. It is a true double-driver, both driving-wheels doing equal work. It can be made exceedingly light, and it is an admirable hill-climber, possibly the best known.

The "Rucker" is the first rear-steerer produced with the pedals in the right place, that is, under the rider, and behind the centres of the driving-wheels. It is a true double driver, and it has the best steering-gear of any machine made.

The Stirling, as well as its great novelty of driving the pedals backwards to urge the machine forward, by which friction is avoided and power in leverage from the direction in working is gained, has the seat suspended by straps from a frame, which is attached to the machine by strong helical springs. The same frame also carries the handles. With this machine, bad macadam—that terror of the tricyclist—may be ridden over and scarcely felt.

With machines, then, of the hind-wheel steering type, possessing such important advantages, it may well be asked—why are front-steerers gaining ground almost exclusively? There is a tolerably general belief that tricycles with hind steering wheels are unsafe when riding down hill. It seems to me that the makers have themselves to thank for this belief: they mostly make the hind steering-wheel too small, and they always, for the sake of appearance, put the steering-wheel too close to the rider. This is in every way prejudicial to the working of the machine. By making the steering wheel larger a better contact is obtained and more hold is taken of the ground.

This point has been admirably carried out in the well-known "Facile" bicycle. Again, by making the backbone which carries the hind steering-wheel about nine or ten inches longer, the wheel would keep down better on the ground when running down hill; it would also pass more easily over obstructions on a rough road, and it would communicate much less vibration to the rider, because when rising itself it would, being farther from him, raise him through a smaller height. The longer the backbone is the better the machine will carry luggage, and it should be mentioned in this connection that, when laden with luggage for touring, a hind-wheel steering tricycle is made steadier and safer, and steers better, while the very reverse obtains with the front-wheel steering machines.

This season I have been riding only rear-steerers, with great pleasure and benefit myself, and I cannot help thinking that if manufacturers will make the two small, yet all important, alterations in them I have indicated, that they have a great future before them. It may be that they will require a little more time and attention to learn to ride them well than front-wheel steering machines, yet that will not be begrudged by those who wish to become experts, if they know that an advantage is to be gained thereby.

Hind wheel steering machines are the most graceful in appearance, having nothing of the Bath-chair about them, and they are by far the easiest to mount and dismount from. They can be made lighter than front-steering machines, and lend themselves more readily to novel variations in construction. Every front-steering tricycle resembles strongly the first front-steerer introduced, the Salvo, whilst no such similarity exists among rear-steerers.

It may be that from being more readily ridden without any science, and from its being a stronger machine and more proof against ill-usage, that the greater number of the cheaper class of tricycles will be front-wheel steerers; but, as the desire will increase to catch up with their more nimble-footed brethren, the bicycles, while preserving as far as possible their own advantages, I think it most probable that the hind-wheel steering machines will be the high-class tricycles of the future.

PHOTOGRAPHY FOR AMATEURS.

By A. Brothers, F.R.A.S.

PART XII.

The portrait of a friend taken by one's self, even if less perfect than one done in the carefully-arranged light of the professional photographer's room, is certain to possess more interest from the fact of its being our own work; and the amateur will have no difficulty in finding material on which to exercise his skill.

The desire to take portraits we may say is almost universal with the beginner in photography; and we propose now to show how he may obtain the best results. Something more than a map of the face is required, and it is not sufficient to place the sitter in the open air and without further preparation "take" the picture. The sitter should never be placed in full sunlight. Preferably the light should come from the north, and it should be arranged that one side of the face should be in shade. The outline of the nose should be seen against the cheek. The proper effect may be assisted by placing a screen on the shade side, and too much light from the top may be avoided by holding a screen covered with some light material over the head, and by careful arrangement of the two screens the best effect may be easily seen. Assistance may be required to uncap the lens, but if the screen be provided with a long handle, the operator may do without an assistant.

A word or two about *focussing* may be useful here. With portrait lenses all parts of the subject cannot be in perfect focus, therefore we must take an average, and this is best obtained by seeing that the eye nearest the lens is perfectly sharp, and the rest of the subject will be in fair average focus. The hands often give some difficulty. See that the sitter does not sit directly facing the camera, and that the hands are not too far forward. Let the figure be turned partly to the side if the hands are to be included, and see also that they are suitably "posed." The hands form an important part in a well-arranged portrait. A vignette presents few difficulties.

The background is an important matter. Foliage sometimes may be utilized, but if only a vignette be required, a large sheet of brown paper fixed at a suitable distance may be sufficient The tone or colour of the background should be selected to suit the effect desired. Backgrounds painted on both sides in different colours can be purchased, and are very suitable. Sometimes a porch or conservatory may be utilized. Of course, with the quick gelatine plates, no head-rest will be required. Neither is it necessary to use a portrait lens, as in a good light a landscape lens will give very good results, although if the amateur possess the portrait lens he would use it for vignettes. The landscape lens should be preferred if foliage or other surrounding objects are to be introduced, owing to the greater depth of focus which such lenses give.

Excellent portraits may sometimes be obtained in an ordinary room, careful attention being given to lighting the subject. The sitter should not be too near the window, and the dark side of the face can be relieved by means of a reflector, which may be a sheet of white paper held at a suitable distance.

Before proceeding to print a portrait, the negative should be carefully examined, and all defects should be removed by means of lead-pencil or with some suitable pigment in water-colour, the object being to stop out the defects to the depth of the surrounding parts. Considerable skill is required to "retouch" a negative. There can be no doubt that a "retouched" portrait may be made smoother and prettier than an untouched print. Whether such retouching is legitimate may be a matter of question, but as the practice is now universal, an untouched portrait when placed beside one "improved" is apt to be compared unfavourably; therefore, if the amateur desire his work to be placed side by side with retouched portraits, he must work upon his negatives to produce the fashionable effect. The retouching is effected by working on the negative with lead-pencil cut to a very fine point and then rubbed on fine sand or emery paper. The negative must be rested on a suitable stand, with a strong light reflected through it. Obvious defects must first be removed, and then the skill of the retoucher must be exercised to produce the desired smoothness. This is done by carefully filling in the transparent places; and if increased high lights are required, the lead pencil is applied to darken the parts. Our advice is to do as little as possible beyond removing real defects; a perfect photograph ought not to require the assistance of the artist, and it should be the aim of the photographer to produce good photography.

Retouching on the negative should not be attempted until the varnish is quite hard. Pencils of different degrees of hardness will be needed, HHH, HH, HB, and B are all useful, and they should be of the best quality of lead.

Vignettes require careful attention in printing. A piece of cardboard should have an aperture cut roughly to the shape of the portrait required, but somewhat smaller. This cardboard shape should be placed about a quarter of an inch from the negative, outside the printing-frame. A piece of tissue-paper pasted over the aperture will soften the light and produce the vignette effect.

It might be supposed that the expansion of paper by moisture would be equal in all directions. Experience shows that this is not the case. It will sometimes be found after the prints are mounted that some are larger than others. This, of course, in a portrait, is a serious defect, as it makes the face too long or too broad, as the case may be. The prints having all been cut to the same size, it is easily seen when they are mounted if the paper in use produces the defect; and should such be the case, the prints must be allowed to become dry before mounting, and then, if the starch be applied quickly, the paper has not time to fully expand before it is attached to the mount. The defect referred to should be looked for, as unless the prints are compared with each other, it may escape notice, and the portrait would possibly be found to be defective in some way, and the true cause not be suspected.

Reviews.

GUIDE TO SOUTHAMPTON.*

This is a useful and cheap little guide to Southampton, written expressly for the visit of the British Association for the Advancement of Science (the particulars of which are given below). It contains an interesting sketch of the ancient history of Southampton; an account of the streets and public buildings, parks, quays, chapels, and so forth; a sketch of the shipping companies connected with the port; and a sufficient description of excursions, drives, and walks in the neighbourhood.

THE BRITISH ASSOCIATION.

The arrangements for the fifty-second annual meeting of this association, which is about to be held at Southampton, extending from Wednesday, the 23rd inst., to Thursday, the 31st, are now completed, and an elaborate official programme has been issued. The first general meeting will be held on Wednesday evening at the Victoria Skating Rink, when Sir John Lubbock will resign the chair to Dr. C. W. Siemens, and the president-elect will give his inaugural address. On Thursday evening there will be a *soirée* in the Hartley Institution at the invitation of the Local Executive Committee; on Friday evening a "Discourse on the Tides," by Sir William Thomson, M.A., in the Skating Rink; on Monday evening a discourse on "Pelagic Life," by Mr. H. N. Moseley, M.A., at the Skating Rink; on Tuesday evening a *soirée* at the Hartley Institution on the invitation of the Mayor and Corporation; and on Wednesday afternoon the concluding general meeting at the Skating Rink. The several sections will meet daily at 11 o'clock in the morning from Thursday to Tuesday, both inclusive, in various public buildings. The general committee will meet on the 23rd for the election of the President and sectional officers; on the 28th, to appoint officers for 1883 and the place of meeting in 1884; and on the 30th, when the report of the committee of recommendations will be received. On Saturday afternoon, the 26th, there will be five half-day excursions to various places of interest in the neighbourhood, including one to Broadlands and Romsey, where Lord Mount-Temple will entertain the visitors, and another to Netley Abbey and Hospital, where a garden-party is to be given by the Surgeon-General and officers of the Army Medical Department. On Thursday, the 31st, four whole-day excursions are arranged, some on water, and some on land. The Bishop of Truro will preach a sermon at St. Mary's Church on the morning of Sunday, the 27th, when the members and associates, with the Mayor and Corporation, will attend the service, and on the same morning the Rev. C. Pritchard, Savilian Professor of Astronomy at Oxford University, will preach at All Saints' Church. Canon Basil and Mrs. Wilberforce give a garden-party in the deanery grounds on Monday, the 28th, and on the evening of the same day the Provincial Grand Master of Hampshire and the Isle of Wight will offer a Masonic welcome to visiting brethren. The Queen has assented to an application for the members of the association to visit Osborne after her departure for Scotland, which will probably be about the 25th inst. Various other arrangements of a minor character have been made to give a proper reception to the Association during its visit. Outside the immediate engagements of the Association, a lecture to the operative classes is to be given in the Skating Rink on Saturday evening by Mr. John Evans, D.C.L., on "Unwritten History, and how to read it," the chair being taken by Dr. Siemens, the new president.

* "Guide to Southampton and Neighbourhood." By Thos. W. Shore, F.G.S., F.C.S. Published by Gutch & Cox, Southampton. Price Eightpence.

A LUMINOUS SHARK.

By C. F. Holder.

Among the later outgrowths of scientific investigation we find the theory of abysmal light, intended to explain the presence of eyes in many of the deep sea forms, their existence supposed to be conditional upon the presence of light in the greater depths of the ocean. The Ascidians and Alcyonarians are well known as wondrous light givers. The form of the former we are most familiar with is the oval ball that seems growing upon a stem, and waves to and fro with the tide like a veritable plant; it is, however, a highly organised animal. Some of the Ascidians are free swimmers, and live in colonies; such is the Pyrosoma, one of the most remarkable of all phosphorescent creatures, as well as one of the largest. In appearance they resemble an elongated empty barrel, about 5 ft. long as a maximum, with one end closed, the other open, a provision that insures movement in a given direction. The means of propulsion seems incomprehensible, but it is easily explained, however, upon an examination of the animal. Each individual in the colony draws in water from the outside and ejects it into the interior, where it finds a common outlet at the open end, the current rushing out forcing the aggregation of Ascidians along in the direction it happens to take. The surface is completely covered with curious filaments that appear to wave to and fro. Such is the general appearance of the creature in the daytime, but in the night or abysmal depths of the ocean it presents an entirely different sight, gleaming and glowing with a wondrous golden light, that penetrates the water for twenty or thirty feet around it, and resembling more than anything else a cylinder at white heat, vibrating waves seeming to pass over it in quick succession, producing many different tints of yellow and gold. As may be surmised, at a distance of one hundred feet or more they resemble worms three or four feet in diameter, of wavy, nebulous matter, the centre burning brightly. The appearance of numbers of these wondrous creatures in the water is an extraordinary sight, and looking down into the depths we seem to be looking into space. Every break of the water is the signal for myriads of beautiful creatures to spring into life, as it were, the sea fairly igniting the minute granules in the depths below sparkling and scintillating in the reflection. Great constellations seem revolving in erratic courses, now rising and falling, meeting each other, the lights intermingling, while smaller phosphorescent jelly fishes, like stars of lesser magnitude, revolve about them, completing the curious scene. The light given out by the Pyrosoma is not confined to the water, but is reflected above it, covering everything with a pale, ghostly light. The sails of vessels are lighted up by it, and cast dark shadows about, while within four or five feet of the animal a newspaper can be read with perfect ease.

But the most curious light-giving forms discovered are the fishes. Among the bony fishes of great depths, the families Scopelids, Sternoptychids, and Stomatids have long attracted attention, on account of the rows of bright spots that occur upon their sides, now found to be luminous. These are found especially upon the fishes *Chauliodus Sloani, Stomias boa, Scopelus Humboldti*, &c. In the *Ichthyococcus ornatus* and *Scopelus Rafinesquii* they are specially abundant. In one species of the former a large luminous spot occurs upon the front of the head.

The distinguished naturalist of the *Challenger* expedition, Willemoes-Suhm, now deceased, saw Scopelus phosphorescent in the night, of which he says: "One of them hung in the net like a shining star as it came out of the darkness. Possibly the seat of the light is in the [illegible] side organs, and it may be that this phosphorescence is the only source of light in the great depths of the sea."

The thought that in the dark abysses of the deep sea every animal carries its lantern, as the miner carries his lamp on his head, is a very fascinating one; and, indeed, Herr Willemoes-Suhm observed several other fishes that were provided on the smooth [illegible] on the head-beard with a "remarkably large sense organ." [illegible] has also remarked of the genus *Hemiramphus* that it bears a strongly glittering phosphorescent pustule on the tip of its [illegible]

LUMINOUS SHARK ([illegible]). FISH WITH PHOSPHORESCENT SPOTS (*Ichthyococcus ornatus*).

A[illegible] discovered by the *Challenger* expedition was the [illegible] dark fish from two miles beneath the surface. [illegible] were two luminous spots; a narrow elongated one [illegible], and a small, short organ nearer the eye.

An[illegible] *Macropus*, had long fringed barbels; lumi[illegible] maxillary, small and round. This was found [illegible] coast in 2,150 fathoms.

A [illegible], Bathyophis, found over three miles below the surface, had long barbels, small luminous organs above the middle of the upper jaw, and a number of others along each side of the abdomen, also on the tail and outer ventral rays.

In the Ipnops the body was long, covered with cylindrical scales, and devoid of luminous organs. The head was depressed, long, and [illegible], its entire upper surface occupied by a remarkable phosphorescent organ that was longitudinally divided into two symmetrical halves.

The most remarkable light-giving fish, however, is a shark, a species of *Scymnus*, and allied to our morse of the southern coast, discovered by Dr. Bennett in Australian waters. The light in this case was universal. In relation to his find, Dr. Bennett says:

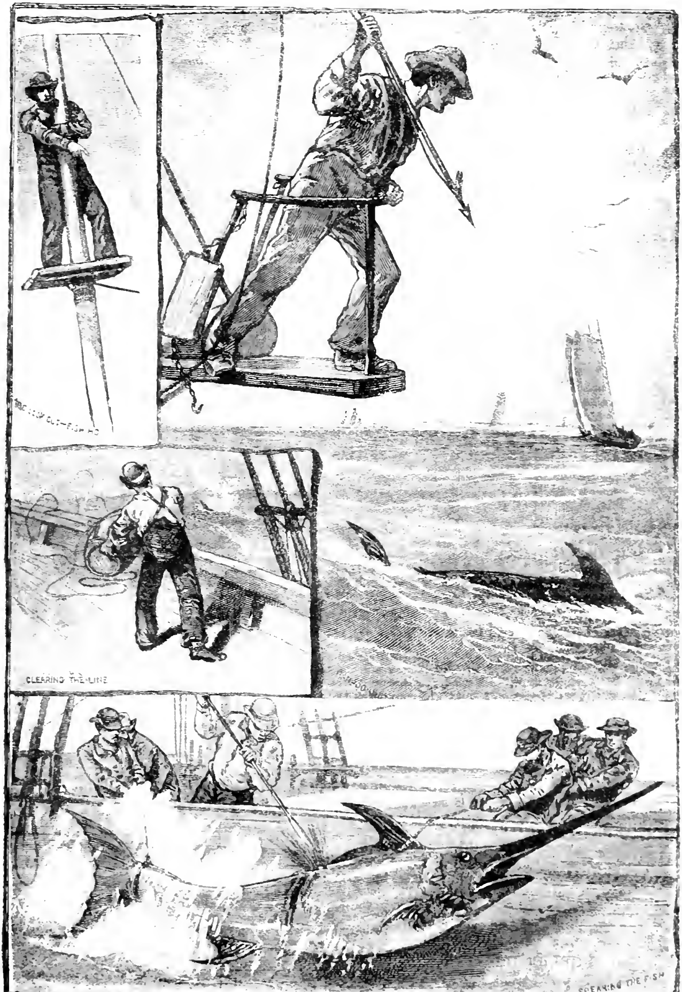
"When the larger specimen, taken at night, was removed into a dark apartment, it afforded a very extraordinary spectacle. The entire inferior surface of the body and head emitted a vivid and greenish phosphorescent gleam, imparting to the creature, by its own light, a truly ghastly and terrific appearance. The luminous effect was constant, and not perceptibly increased by agitation or friction. I thought at one time it shone brighter when the fish struggled, but I was not satisfied that such was the fact. When the shark expired (which was not until it had been out of the water more than three hours) the luminous appearance faded entirely from the abdomen, and more gradually from other parts, lingering the longest around the jaws and on the fins.

"The only part of the under surface of the animal which was free from luminosity was the black collar around the throat; and while the inferior surface of the pectoral, anal, and caudal fins shone with splendour, the superior surface (including the upper lobe of the tail fin) was in darkness, as also were the dorsal fins, back, and summit of the head.

"I am inclined to believe that the luminous power of this shark resides in a peculiar secretion from the skin. It was my first impression that the fish had accidentally contracted some phosphorescent matter from the sea, or from the net in which it was captured, but the most rigid investigation did not confirm this suspicion, while the uniformity with which the luminous gleam occupied certain portions of the body and fins, its performance during life, and decline and cessation upon the approach and occurrence of death, did not leave a doubt in my mind that it was a vital principle essential to the economy of the animal. The smallness of the fins would appear to denote that this fish is not active in swimming; and, since it is highly predaceous, and evidently of nocturnal habits, we may perhaps indulge in the hypothesis that the phosphorescent power it possesses is of use to attract its prey, upon the same principle as the Polynesian Islanders and others employ torches in night fishing."—*Scientific American.*

THE CHARMS OF SWORDFISHING.

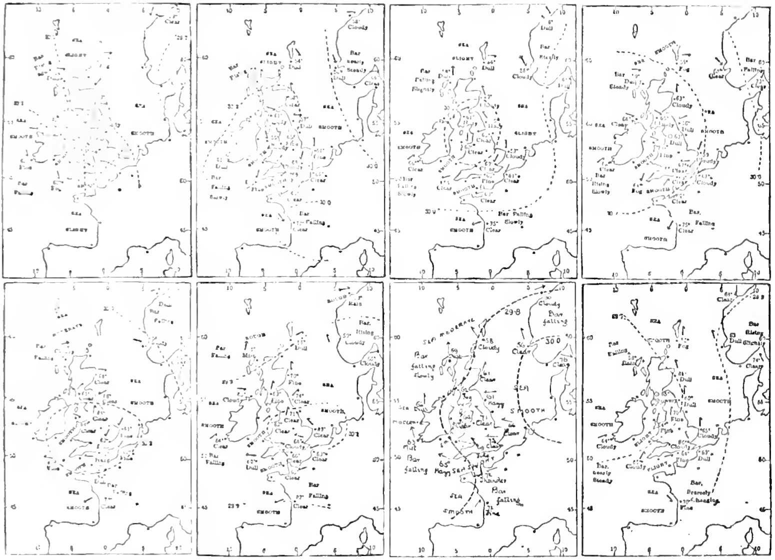
NOW that whaling has to so large an extent ceased to be the important industry it once was, the most exciting sport which the hardy fishermen of Nantucket and Martha's Vineyard find left to them is the catching of swordfish. The name of this fish describes its most peculiar feature, the possession of a long and sharp sword attached to the snout, and, although it cuts but a small figure beside the whale in point of size, it does not yield to the more ponderous denizen of the deep in the reckless daring with which it fights for life when attacked. A schooner designed for the capture of swordfish is provided with a "pulpit," which is the name given to a little platform built on the extreme point of the bowsprit, about three and one-half feet in height, and having a semi-circular iron strap, supported by stanchions. When a fish is sighted by the look-out, who stands on a sort of platform affixed to the head of the foremast, the vessel is brought as near as possible, and then the captain takes his place on the "pulpit," armed with a harpoon. The barb of the harpoon, which is about six inches in length, is backed with an iron pocket in which the iron shank rests, and the shank is attached to the vessel by a short line, by which it is freed from the fish when he is struck. In order to secure a great swordfish the barb must be driven right through him. Then when the shank comes out and the line is pulled taut, the barb "toggles on," as the fishermen call it—that is to say, it catches on the other side, and no effort of the victim will free him from the line. When the fish feels the sharp iron penetrating his flesh, he usually springs half out of the sea, then plunges back into the depths and makes off so fast that water has to be poured over the line attached to the harpoon as it runs out from the boat to prevent its catching fire. When the fish finally comes to a standstill, the men begin to draw in the line. Sometimes all will go well until the monster is brought alongside, while again the fish, after being drawn well in, will dash off afresh with such speed that the men hauling the line will be shot over the side into the sea. Even when he has finally been dragged near the vessel, the fish may suddenly summon all his energy and rush upon the craft with a violence which will shake it from stem to stern, and if he succeeds in hitting it with his sword, may drive a hole through which the water will pour in. Gradually, however, his strength is exhausted with the constant loss of blood, and at last he is hauled alongside, when two iron "landers," resembling boat-hooks, and having curved steel hooks at the extremities, are handed over the side and thrust into his gills. By the use of these his great head is held, while a stalwart sailor climbs down over the side with the "thumper," a weapon between a tomahawk and a sledge-hammer, and gives him a series of ponderous blows between the eyes, despite his struggles. Then a great hook is got over his



SWORD-FISHING OFF BLOCK ISLAND.
(From Sketches by Joseph Becker.)

WEATHER CHARTS FOR WEEK ENDING SUNDAY, AUG. 13.

Sunday, Aug. 6th. Monday, Aug. 7th. Tuesday, Aug. 8th. Wednesday, Aug. 9th.



Thursday, Aug. 10th. Friday, Aug. 11th. Saturday, Aug. 12th. Sunday, Aug. 13th.

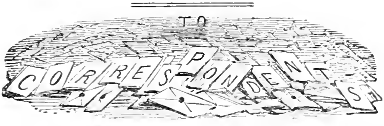
In the above charts the dotted lines are "isobars," or lines of equal barometrical pressure, the values which they indicate being given in figures at the end, thus—30·4. The shade temperature is given in figures for several places on the coast, and the weather is recorded in words. The arrows fly with the wind, the force of which is shown by the number of barbs and feathers, thus:— ⟶, light; ⟶, fresh or strong; ⟶, a gale; ⟶, a violent gale; ⊙ signifies calm. The state of the sea is noted in capital letters. The • denotes the various stations. The hour for which each chart is drawn is 6 p.m.

wide, extending, crescent-shaped tail, the throat halyards are brought into requisition, and he is hoisted aboard, although he may yet make one or two desperate flaps before he dies. When several fish are sighted at once, a crew will not wait for the death of one before attacking another, but buoy him by means of a water-tight barrel, having a ring attached to two lines wound tightly around it. This is bent into the line as it is run out by the fish, and then the barrel is thrown overboard. The fish is always puzzled to make out what this means, but all his struggles to escape from it prove fruitless, and at last the barrel floats calmly upon the water, pointing out to the fishermen where their victim lies. A good-sized swordfish is 15 ft. in length, and weighs about 700 lb. Fine, juicy steaks are secured from it, which command a good price in the market, and a schooner which has good fortune off the Nantucket coast can carry to Boston a load which will well repay the crew.

THE PUBLIC HEALTH.

THE Registrar-General's weekly return shows that the annual rate of mortality last week in 28 of the largest English towns averaged 20·1 per 1,000 of their aggregate population, which is estimated at 8,169,571 persons in the middle of this year. The six healthiest places were Derby, Halifax, Brighton, Bristol, Cardiff, and Plymouth. In London 2,546 births and 1,370 deaths were registered. Allowing for increase of population, the births exceeded by eight, whereas the deaths were no fewer than 353 below, the average numbers in the corresponding week of the last ten years. The annual death-rate from all causes, which had been equal to 17·7 and 18·8 per 1,000 in the two preceding weeks declined again last week to 18·4. During the first five weeks of the current quarter the death-rate averaged only 18·1 per 1,000, against 21·3 and 24·7 in the corresponding periods of 1880 and 1881. The 1,370 deaths included 1 from small-pox, 33 from measles, 38 from scarlet fever, 15 from diphtheria, 57 from whooping cough, 1 from typhus fever, 13 from enteric fever, 118 from diarrhœa and dysentery, and 6 from simple cholera; thus, 282 deaths were referred to these diseases, being no fewer than 235 below the corrected average number in the corresponding week of the last ten years. Different forms of violence caused 47 deaths; 39 were the result of negligence or accident, among which were 17 from fractures and contusions, 3 from burns and scalds, 13 from drowning, and 4 of infants under one year of age from suffocation. The 17 deaths from fractures and contusions were thus caused:—Male, aged 15 years, and female, 5, run over by van; males, 58 and 72, run over by cart; male, 34, crushed by van; male, 21, crushed under horse; male, 61, run over on Great Eastern Railway; male, 20, run over on Midland Railway; male, 48, run over on railway at Gunnersbury; female, 52, fell down stairs (intoxicated);

male, 2, fell from chair; male, 41, by fall in passage; male, 19, fell from scaffold; males, 2 and 4, by fall; male, 14, injured by machinery; and male, 4, by blow. An inquest was held in each of these seventeen cases. Seven cases of suicide were registered. In Greater London 3,288 births and 1,671 deaths were registered, equal to annual rates of 35·1 and 17·8 per 1,000 of the population. In the Outer Ring twenty-one deaths were referred to diarrhœa, including ten in the district of West Ham. Four fatal cases of diphtheria occurred in Harrow sub-district.—*Times.*



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of KNOWLEDGE: *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

*** *All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

STIMULANTS AND WORK.

[514]—I have just read your quotation from the Abbé Moigno (page 142) and your own comments thereon. I have tried experiments very similar to those you describe, with exactly the same results; in fact, so far as intellectual work is concerned, I might describe my own experience by direct plagiarism of your words.

Besides these, I have tried other experiments which may be interesting to those who, without any partizan fanaticism, are seeking for practical guidance on this subject.

As many of your readers may know, I have been (when of smaller girth) an energetic pedestrian, have walked over a large part of England, Scotland, Wales, and Ireland, crossed France twice on foot, done Switzerland and the Tyrol pretty exhaustively; in one walk from Paris taking in on the way the popular lions of the Alps, and then proceeding, *viâ* Milan and Genoa, to Florence, Rome, Naples, and Calabria, then from Messina to Syracuse, and on to the East. All this, excepting the East, on foot. At another time from Venice to Milan, besides a multitude of minor tours, and my well-known walk through Norway.

In the course of these, my usual average rate, when in fair training, was 200 miles per week. The alcohol experiments consisted in doing a fortnight at this rate on water, scrupulously abstaining from any alcoholic drink whatever, and then a fortnight using the beverages of the country in ordinary moderate quantity. I have thus used British ales and porter, Bavarian beer, French wines, Italian wines, Hungarian wine in the Tyrol, Christiania öl, &c., according to circumstances, and the result has been the same, or with very little variation. With the stimulant I have, of course, obtained a temporary exhilaration that was pleasant enough while it lasted, but after the first week I found myself dragging through the last few miles, and quite able to appreciate the common habit of halting at a roadside "pub" or wine-shop, for a drink on the way. No such inclination came upon me when my only beverage was water, or water plus a cup of coffee for breakfast *only* (no afternoon tea). Then I came in fresh, usually finishing at the best pace of the day, enjoying the brisk exercise in cool evening air. Physical work of this kind admits of accurate measurement, and I was careful to equalise the average of these experimental comparative fortnights.

The result is a firm conviction that the only beverage for obtaining the maximum work out of any piece of human machinery is water, as pure as possible; that all other beverages (including even tea and coffee) ginger-beer, and all such concoctions as the so-called "temperance drinks," are prejudicial to anybody not under medical treatment. To a sound-bodied man there is no danger in drinking any quantity of cold water in the hottest weather, provided *it is swallowed slowly.* I have drunk as much as a dozen quarts in the course of a stiff mountain climb when perspiring profusely, and never suffered the slightest inconvenience, but, on the contrary, have found that the perspiration promoted by frequent and copious libations at the mountain streams enabled me to vigorously enjoy the roasting heat of sun-rays striking so freely and fiercely as they do through the thin air on the southward slopes of a high mountain.

I am not a teetotaler, and enjoy a glass of light wine, but always take it as I sucked lollypops when a child, not because "it is good for my complaint," or any such humbug, but simply because I am so low in the scale of creation, as imperfect, as far from angelic, as to be capable of occasionally enjoying a certain amount of purely sensual indulgence, and of doing so from nothing higher than purely sensual motives.

If all would admit this, and freely confess that their drinking or smoking, however moderate, is simply a folly or a vice,* they would be far less liable to go to excess than when they befool themselves by inventing excuses that cover their weaknesses with a flimsy disguise of medicinal necessity, or other pretended advantage. In all such cases the physical mischief of the alcohol is supplemented by the moral corruption of habitual hypocrisy.

W. MATTIEU WILLIAMS.

* [All the rest of Mr. Williams's letter is so very sensible and so very much to the point, that I must confess I read with extreme surprise a sentence which implies what I cannot but regard as utterly wrong, and worse than wrong. My esteemed friend in his extreme love of honesty and plain speaking, wants those who do as he does, to push honesty to a point which is, I take it, uncommonly near humbug and hypocrisy. In the first place *all* need not admit even that their taking daily a little wine or spirit, or ale, or cyder, is a mere indulgence, for it is certain there are tens of thousands who honestly believe the moderate use of alcoholic stimulants to be essential to their health, and there are thousands who have proved this by carefully watched experiment. But if we set these on one side and consider only those who take an occasional glass or smoke an occasional cigar, because they like it, because it gives them a certain amount of pleasure, doing them so far as they can judge no harm whatever, why should these, of whom I confess I am one, admit and freely confess that their drinking, however moderate, is simply a folly or a vice? Where does the folly or the vice come in? It seems to me uncommonly sensible to take any pleasure which hurts no one, including one's self. I am in the habit of regarding a man who denounces his fellows for taking innocent pleasures, and calls those pleasures follies or vices, as a mischievous hypocrite,—generally as a man who strives to hide real wickedness, by which I mean wrong-doing to others, or selfish disregard for their interests, by pretended zeal about trifles, which are not even triflingly wrong, but perfectly innocent. The man who warns one whom he knows to be weak from the social glass I respect; the man who tells another whom he knows to have a good average amount of common sense and strength that he is a fool or vicious if he takes a social glass, I assume at once to be a humbug and a hypocrite, for in no other way can his action be explained: and experience shows the interpretation to be systematically correct. What, then, should we think of a man who says as much of himself? But, apart from this, the general principle that pleasures are follies or vices merely because they are pleasures of the senses only, is an outrage on common sense. Life is full of pains and sorrows, cares, anxieties, and occasions for self-sacrifice; it also affords opportunities for many pleasures of all classes—emotional, sensorial, intellectual; not to take these when one may without injury or loss to others or one's self, is the only folly I see in connection with them, to whatever class they may belong. To imagine there is wisdom in rejecting them—unless it be for the sake of others—is utter folly; to imagine that a Being of infinite wisdom, who so made us that we cannot live our lives without sorrow and suffering, takes pleasure in seeing His creatures reject such innocent pleasures as lie in their way, seems to me much nearer blasphemy than much that goes by that name. —ED.]

THE LIBRATION OF SENSATION.

[515]—In my little book, "The Revised Theory of Light," I showed that the received explanation of the phenomena of the *ocular spectra* is full of discrepancies, and inadequate. And in that work and previous lectures I ventured to substitute my hypothesis of the Libration of Sensation, by which title I seek to express that tendency of the nervous system to oscillate from one extreme to an opposite condition, in the ratio in which the initial sensation was a departure from the nervous system's normal state. This law of *libration* or reaction might be shown to hold throughout the whole human constitution. A point of contact is thus established between the organisations of the macrocosm and microcosm. They are

[illegible] by the great law of compensation, by the law of the equitable distribution of force, which may be thus stated, viz., that whatever aberration takes place in excess of a *mean* state must be rectified by an equal [illegible] and opposite one in defect, and *vice versâ*, or well-being would be imperiled.

The fact that the sentient eye is the only "colour-box," and [illegible] ternal that there are but mechanical vibrations of different [illegible] ities, is not sufficiently present to men's minds to prevent [illegible] reasoning as if colour were a property of the vibrations [illegible]. This has been the case with respect to the explanation of [illegible]; the phenomena have been regarded as external effects instead of internal, and due to the reactions of the nervous system [illegible] are sequent sensations which may be perceived, [illegible] be closed against all external vibratory action. An initial sensation of a black spot in a white field is succeeded by one of a white spot in a black field. A sensation of a dark colour in a white field, by its light complementary sensation in a dark field, and [illegible]

We find, then, that the changes in the sense of colour which are produced by the cooling of beads, and which were alluded to by [illegible] correspondent in a recent number of KNOWLEDGE, also occur in the retina by the reactions which take place after an initial sensation. The complementary *spectra* are entirely subjective phenomena. After a very strong initial sensation of light, the sequent spectra endure for a sufficient length of time to enable anyone to experiment with them. For instance, after being dazed by the sun, any [illegible] spectrum, say dark green in a light field, will appear light [illegible] in a dark field, and become dark green again in a light field,- [illegible], then, are instances of the vibratory reactions within the [illegible] system producing different sensations of colour.

W. CAVE THOMAS.

HERNIA AND TRICYCLING.

516.—Dr. B. W. Richardson is altogether mistaken about this. I am 68 years of age, and have had hernia on both sides for 30 years. When 64 I commenced to ride a tricycle, riding daily three miles to [illegible] and three miles back, without the slightest inconvenience. I ought to say that I wear a Cole's double truss. This time of the year I enjoy three or four games of bowls every fine evening with [illegible] impunity.

E. K.

SINGULAR RAINBOW.

517.—I do not know whether I am contributing anything to KNOWLEDGE, but what I have to relate is quite new to me. A thunder-shower was approaching us the other evening. A most [illegible] and perfect rainbow was formed with a secondary bow, [illegible] very bright, but in addition, between the two was a third, in the shape of an ellipse, with the colours in the same order as those of the primary, and touching this near the ground. It was not sufficiently perfect for me to see whether it touched the secondary bow, but I think that if it had been perfect it would have done so.

J. F. ROUNTHWAITE.

HAIR TURNING GREY.

518.—My grandfather was surgeon of H.M.S. *Ardent* at the battle of Copenhagen. One of his assistants (a young man who had only just joined the service when the fleet sailed for the Baltic) was so overpowered with fear that he cowered down [illegible] during the whole of the engagement, and his hair, which was [illegible], became white. I have frequently heard my father, himself a naval surgeon, refer to this case, and I believe it to be strictly true.

J. THOMSON.

28 July, 1882.

EFFECTS OF LIGHTNING.

519.—In a thunder-storm which I witnessed near Berryville, Virginia, July, 1879, a wooden house with iron stove and pipe was struck and a woman killed. On examining the structure I found three places where the wooden boards of the walls were smashed outwards just at the level of the floor. Rough, jagged holes had been pierced, the current, which entered by the stove-pipe, having divided, and left the house on three sides. One of the tracks could be traced to a well about six yards distant, down which the discharge passed.

G. R. WYNNE.

A POWERFUL electric light on the steamer *Rosebud* created an immense sensation among the Indians at Fort Berthold, in Dakota. The light was turned upon a group on the shore, when they were paralysed for a moment, and then they set up a dismal chant, lay down and rolled, and were with difficulty pacified. They called it the white man's big moon medicine.

Answers to Correspondents.

**** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded, nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

ALLEYNE REYNOLDS. Our paradox corner is not for paradoxes of that sort. The one you quote naturally arises from the initial $x = x + 1$. Whence, you say, x = infinity; but, however large x may be, $x + 1 - x$ is always unity. Squaring both sides leads to $x^2 = x^2 + 2x + 1$; whence $x = -\frac{1}{2}$; but were x infinite, you could no more cancel the two terms x^2 here than the two x's in the original equation.—PAGET HIGGS. Quaternions would scarcely suit the majority of our readers.—HY. BOWMAN. Fear space will not permit. The influence of moon on weather is a very prolific subject. I can, from my own experience, affirm that no two believers have identical views.—H. NELSON. Only experienced engravers could say whether a spectacle or an eyeglass would best suit a "wood engraver, who is frequently prevented from working by the lines on the block becoming misty and indistinct." Bicycling is not supposed to have any special influence on the eyes.—F. P. Mr. Allen, in using the word "wish," neither means "an intelligent desire" nor only that a special feature *is* presented. He means that the colours of petals differ in different species according to the kind of insects which it is good for each plant to attract. He supposes his readers not wholly wanting in imagination. When a writer on the ivy speaks of it as clinging, say, to an oak, does he mean that the plant is capable of an intelligent clasp?—E. C. H. You are right. I had not noticed the date. I was so startled by Edward being called the twenty-fifth king that I quite overlooked the wrong date. Those cigars must have left their effect on the good Abbé, even to this very day. G. R. SMITH, L. Colmbly, E. Underwood, J. M. Hargreave, K. Smiles, R. F. Grierson, and others. We cannot undertake to solve problems. They come in in too great numbers.—FUSEE. I regret to hear you are among surroundings so unfavourable to chess. The position of a chess-player who can get no one to play with him at any game but draughts is truly lamentable. I wish I knew of any book on Draughts like Staunton on Chess—not for my own sake (for draughts seems to me a very monotonous amusement) but that I might tell you.—M. B. A. Neither can science understand the attraction of gravity.—W. B. W. You jump rather hastily at our expression "angry with the drunkards," asking if anger is the best spirit in which to try to repress crime, and speaking of revenge, &c. I used the word rather as implying strong objection than any feeling of personal animosity. Are you quite consistent? You are going to be a total abstainer, though not one of those who are tempted to drink; yet you will not join the Blue Ribbon Army. How, then, is your abstinence going to do any good? Now if wearing a blue ribbon meant—let us say—that the wearer was a reformed drunkard, there might be some pluck and credit in donning the symbol.—E. H. STEVENS. A cyclone is understood in meteorological phrase to mean, not a storm, but a region of low pressure or barometrical depression; an anti-cyclone to mean a region of high pressure. The terms are ill-chosen.—J. DEAS. Letter marked for insertion.—G. H. T. The inner satellite of Mars goes round the planet in less time than the planet takes to revolve on its axis, because the satellite is within the distance at which the period of revolution would be equal to that of the planet's rotation. This, however, is rather *how* than *why*. I cannot say why some comets revolve round the sun in different directions from the planets. If they all went the same way as the planets I could not tell you why that was, either. The moon can only cause the earth to rotate more slowly by exerting an action, the reaction corresponding to which increases the moon's distance.—W. ARNISON SLATER. I am interested to learn from the Paris *Figaro* that "Un Astronome Anglais, M. Proctor, pense qu'ils" (c'est à dire, les canaux supposés de Mars), "sont dus à l'industrie des habitants." It is a shame, I think, that M. Proctor never told *me* he thought so.—J. F. SIMPSON. Many thanks. Your communication unfortunately arrived when we were very much in arrears with our correspondence. Fear we can hardly find room for the notice you suggest; but if you could draw up a short one, would try to insert.—PARALLAX. These angles are the colatitudes of Greenwich and the Cape, namely, 39° 0′ and 56° 5′ respectively.—CHARON. Do not know how assistants are appointed to Observatories and Nautical Almanac Office.—H. W. FATCUS. It was the conception that in or near the place where the disturbance occurs there is an explosive mixture of oxygen and hydrogen, in sufficient quantities, to which I referred. You seemed to forget that observers have repeatedly been before, during and after thunderstorms, in the very region where this peculiar constitution of the atmosphere should have existed, if you are right.—Canadensis. Your suggestion is excellent. As to the P.D. theory, it really seemed too bad to keep all J. M.'s effusions for my own particular edification.—J. M. G. The subjects of your first three queries will be very suitable for future *articles*, scarcely for replies here. (4) There are not half-a-dozen stars whose distance can be regarded as determined. I place no reliance myself on any parallax but one—that of Alpha Centauri. (5) Let earth's mass be $81m$, moon's mass m, distance of earth's centre from moon's d; let x be distance from moon where attractions neutralised. Then by the known law of gravity $m \div x^2 = 81m \div (d-x)^2$; whence $x : d-x :: 1 : 9$; or $x : d :: 1 : 10$; thus the body's distance from the moon must be one-tenth the earth's.—Arthur Black. You have rather misapprehended my reply to "Gradatim," and the nature of the question he asked (naturally enough, as my answer was meant for him only). "Gradatim's" original query referred to a passage in Clerk Maxwell's little book on matter and motion, on referring to which you will find that the point you mention is fully considered. I wrote knowing "Gradatim" knew this. All these "answers" are to be read as replies to individual querists, not as independent statements.—Wm. J. Logeman (?). (1) I cannot remember receiving the letter you refer to. The subject, as you describe it, would not have suited these pages; but you may be assured your kind offer would not have passed wholly unnoticed. (2) Our electrical contributor added the remark that accidents of that kind (from lightning) are of great importance—I suppose in connection with the subject of risks from electric lighting. (3) Thanks for note that Evora (town in Portugal) is pronounced Ayvŏrah—accent on first syllable very strong, so that the two next are very short. (4) We by no means peevishly limit Knowledge to the abstract sciences. Cricket is a fit subject for our pages in the same sense that it is a fit subject for literature. You say, "If cricket is a fit subject for Knowledge, could you not find place for an occasional paper on 'Philology, the science of languages?'" Why, certainly; we could even do that if cricket were an unfit subject (also for an occasional paper on Logic).—Boyd Moss, F.R.C.S. It is only vivisection so intended and so regulated that has ever found approval here. —Charles Lassalle. No, I do not "suppose you require any puffings of your works"; because none of them have been sent to the office of Knowledge for review, far less for "puffings." Articles which, as I judge, have already been sent to other quarters, have reached me, with certificates, laudatory comments, and so forth. Should I have inserted the articles, or the certificates, or both?—W. S. Montague. I would use Todhunter, I think, for study; but read Williamson's, as treating the same subject from a different standpoint.—Hon. Sec. Have inserted your query, not feeling competent to express an opinion.—S. W. Desires to learn how to fumigate mahogany or oak wood, so as to give a deep rich colour and tone to new wood.—John J. Noarin, Jun. The energy is expended in both ways. First, on the brake as it checks and finally stops the turning motion of the wheels; then on the rails as they check and finally stop the advancing motion of the unturning wheels.—Zypero. Scarcely sufficient evidence given to show that that is the sole and true cause of Fairy Rings.—W. H. Stone. Alas, how can we find room?—T. W. W. Would much rather say "T. W. W. Yes." Would it be long?—C. O. The subject of "mnemotechnic formulæ," is, I agree with you, well suited to Knowledge.—C. J. B. In both cases the denser body falls fastest; because in each case there is a certain amount of resistance to overcome in falling: the heavier body, having the greater momentum, does the work soonest. Only in a vacuum does a light body of the same shape and size fall in same time through a given distance from rest as a heavier body. Blind-worm. (1) Astronomy knows no Vulcan. (2) I do not insist on the sun being inhabited when cool enough. Without a special warmer and light-giver he might not be a very comfortable world. Perhaps there might be inherent warmth enough for all practical purposes, and a proper amount of light might shine from his interior, through suitable apertures on large masses of floating cloud. I do not know how this will be arranged.—J. C. Lloyd. It is not certainly known at what time the Mammoth lived. Analysis of water, if we have space, later. Can scarcely find time for discussing specimens of flowers sent for identification.

BOTANICAL.

H. H. H. (Liverpool). I do not know how to make skeleton leaves, but I believe you will find a recipe in the book called "Enquire Within." Corcagiensis (Cork). *Soldinella alpina* is a plant of the primrose family, closely allied to *Dodecatheon*, the so-called American primrose. It is not related to the Edelweiss. The botanical name of the Papaw tree is *Carica papaya*. I have often heard that its leaves have the power of making tough beefsteak tender, but I never experimented upon it, though it grew in my garden in Jamaica. This is the first time, however, that I have ever heard of its use in preventing meat from decomposing, and I suspect that your informant was mistaken. The leaves, pressed against the head, make an excellent cold compress for the headache. —High School (Nottingham). I don't quite understand the nature of your objection to the phrase "double calyx." I see it is used by Mr. Bentham, and, I think, by all other botanists. The calyx of potentilla is double, because it consist of five sepals, alternating with five external bracts. Of course, if you choose, you can say the bracts are not part of the calyx; and if so minded, you may call them an involucel. But I don't see that it matters as far as the facts are concerned; everybody would understand at once what one means. On the whole, I prefer the old statement that language is meant to express our thoughts, to Talleyrand's amended version.—G. O. Dephaga. To preserve plants, first, if possible, get a perfect specimen, *i.e.*, one with root, stem, leaves, flowers, and fruit together; but as this is sometimes practically inconvenient (for example, in an oak or even a cherry tree), get as near it as you can. Lay it flat between several sheets of coarse, unsized paper (*not* blotting-paper), taking care to place the parts as separate as possible. Press it with a big, heavy book. Change the paper once or twice, till the plant is dry. Thick-stemmed and thick-leaved specimens may be split with a knife. Very succulent plants may be dipped in boiling water; but the flowers must not be immersed. You had better try Bentham's 'British Flora," which will not only give you full instructions for preserving specimens, but will also enable you to identify all flowering plants, ferns, horsetails, or club-mosses, indigenous or naturalised, in the British Isles. But you must be prepared to take a little trouble.—A Reader (London-street, Edinburgh). Sporting in cultivated turnips may be due to any of three causes—first, to reversion; second, and most frequently, to changed conditions of soil, climate, manuring, &c. (for all plants sport most often under cultivation); and third, to hybridisation by insects with the other cultivated varieties of *Brassica campestris*, namely, swedes and rape-seed, or with closely-related wild species, such as charlock; but this last cause would, I think, operate less often. It is impossible to be sure in any case, except by isolating your causes. You may experiment for yourself, but where the conditions have occurred spontaneously you can only surmise.

CHEMICAL.

X. Y. Z. The papers, according to your description, are prepared correctly; but the indications afforded are uncertain, as other causes affect the paper. Thus, the rapidity of the action is modified by the humidity and temperature of the air; further, paper once coloured becomes again decolourised by exposure. Other gases also liberate the iodine, and thus colour the starch. Houzeau prefers litmus paper, slightly reddened, and impregnated with potassium iodide; this paper is rendered blue by ozone, the same colour not being produced by any gas except ammonia. F. T. Drake. It is not wise to inhale or administer laughing gas, except by and with the advice of a medical man or other person duly experienced in the use of the gas (such as a qualified dentist). The gas, when required for breathing purposes, should also be prepared and purified by a competent chemist.

Our Mathematical Column.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

No. VIII.

By Richard A. Proctor.

THE following examples may serve conveniently to illustrate the application of even the first principles of the differential calculus to problems which otherwise would present considerable difficulty:—

Problem I.—*The captain of a racing boat has a vacancy in his crew, and is desirous of so filling it as to counterpoise the boat as much as possible on the side of the new comer. The breadth of the thwart to be filled is 2ft.; assuming a man's weight to be proportional to the cube of the linear distance he occupies on the thwart, and that a man who would occupy but half the thwart weighs six stone, what would be the best weight for the new oarsman?*

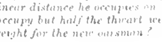


Fig. 3.

Let A C, Fig. 3, represent the width of the thwart, A M that of [illegible] r. Let A M = 2 x, so that the man's centre of gravity is [illegible] where G A = 1, A M = x.

[illegible] the man's weight is proportional to the cube of x, and may be represented by [illegible] will not trouble us.) And the [illegible] of the man's weight around the centre line of the boat's [illegible] is

$$= mx^3 \times G B$$

$$= mx^3 (1 - x) \quad \text{Since A B = 1 ft.}$$

[illegible] following first rule given in the last lesson but one.

$$\frac{dy}{dx} = 3\,mx(1-x) - mx^3.$$

[illegible] represents the rate at which y increases as we increase x. [illegible] as great as possible, there is no longer any increase, [illegible] we must equate the above expression to zero, giving

$$3\,mx\,(1-x) = mx^3,$$

or $$3\,(1-x) = 1$$

$$3\,x = 2$$

or $$2\,x = \frac{4}{3}$$

[illegible] must be the amount of thwart occupied by the oarsman if [illegible] is to most effective. Since a man occupying a width of [illegible] thwart would weigh 6 stone, our oarsman should weigh

$$6 \times \left(\frac{4}{3}\right)^3$$

$$= \frac{128}{9} \text{lbs.}$$

$$\text{i.e. } 14 \text{ st. } 3\frac{1}{9} \text{ lb}$$

P[illegible]M II.—*A person is in a boat B (Fig. 4) three miles from the [illegible] A, of a straight shore line, C D. He wishes to reach E, [illegible] 5 miles from A, as quickly as possible. He can walk 5 miles [illegible] 4 miles an hour. Where must he land?*

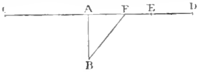


Fig. 4.

Suppose F is the point where he should land, and call A F, x. [illegible] B A is perpendicular to C D.

And $$B F = \sqrt{B A^2 + x^2} = \sqrt{9 + x^2}.$$

[illegible] time taken in traversing B F is $\frac{\sqrt{9+x^2}}{4}$.

Again $$F E = 5 - x,$$

[illegible] time taken in traversing F E is $\frac{5-x}{5}$.

[illegible] total time occupied in reaching E, we have

$$5 = \frac{\sqrt{9+x^2}}{4} + \frac{5-x}{5}.$$

[illegible] following the two rules, we get readily,

$$\frac{dy}{dx} = \frac{x}{4\sqrt{9+x^2}} - \frac{1}{5}.$$

[illegible] the rate at which the time increases as F is moved [illegible] A. One can see that when x is very small the value of [illegible] a negative increase is decrease. This shows [illegible] get to F more quickly by landing to the right of A [illegible] actually at A. And as long as $\frac{dy}{dx}$ continues negative [illegible] continues. But as x increases, we reach at last [illegible] which $\frac{dy}{dx}$ ceases to be negative and becomes positive, passing through the value *nought*. When x has that value, the shortening has reached its utmost; so that to obtain the maximum [illegible] we have only to solve the equation.

$$\frac{x}{4\sqrt{9+x^2}} - \frac{1}{5} = 0,$$

$$\text{or, } 5\,x = 4\sqrt{9+x^2},$$

$$\text{i.e., } 25\,x^2 = 16\,(9+x^2)$$

$$= 144 + 16\,x^2.$$

This gives $$9\,x^2 = 144$$

$$3\,x = 12$$

$$x = 4$$

So that our traveller must land four miles from A or one mile from F.

We see that whether for a maximum or minimum we must equate $\frac{dy}{dx}$ to zero. The question itself will show whether a maximum or minimum exists for the deduced value of x.

One more example will close the present lesson.

PROBLEM III.—*A sphere has a radius* r. ***What is the greatest right cone which can be inscribed in the sphere?***

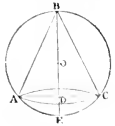


Fig. 5.

Let B D (Fig. 5), the height of the cone A B C, be x. Then D C, the radius of the base, is a mean proportional between B D and D E. That is $$D C = \sqrt{x\,(2\,r - x)}.$$

Hence the area of the base

$$= \pi\,x\,(2r - x),$$

and the content of the cone

$$= \pi\,x\,(2\,r - x) \times \frac{x}{3} = \frac{\pi\,x^2}{3}\,(2\,r - x).$$

(I assume a knowledge on the reader's part of the relations between the content and surface of cones, cylinders, spheres, and so on.)

Now put y for content of cone; that is, put

$$y = \frac{\pi\,x^2}{3}\,(2\,r - x),$$

and find the differential coefficient of y according to the first rule. We can write it down at once, thus,

$$\frac{dy}{dx} = \frac{2\,\pi x}{3}\,(2\,r - x) - \frac{\pi x^2}{3}$$

(the reader will at once see that the two portions of this value are obtained by Rule I., in last lesson but one.)

Now so long as by increasing x, y increases, we have not a maximum cone. Hence, since the differential coefficient expresses the rate of increase, we must have $\frac{dy}{dx} = 0$,

or $$\frac{2\,\pi x}{3}\,(2\,r - x) - \frac{\pi\,x^2}{3} = 0,$$

that is $$2\,x\,(2\,r - x) = x^2,$$

or $$4\,rx = 3\,x^2. \qquad \text{(i.)}$$

This gives $x = \frac{4\,r}{3}$, and, therefore, D must not be where it is shown in Fig. 5, but D E must be equal to twice O D. The reader will notice that (i.) is also satisfied if $x = 0$. We see that when $x = 0$, the volume of the cone is also nought. This is a minimum not a maximum value. It is clearly quite as necessary that the differential coefficient should vanish to give a minimum as to give a maximum. In all cases like the present, and indeed in nearly all the most useful simple applications of the calculus, the conditions of the problem itself show us when we have a maximum or a minimum. There *are* rules for analytically determining this; but I shall not trouble the reader with them. He sees in this case that the content of the cone starts from 0 when the height is 0, to 0 again when the height is $2\,r$; hence at some part of the passage from 0 to 0 the cone must have a maximum value; and the above process shows him (what he could not readily find by any other) that the cone has its maximum value when D E = 2 O D.

We regret that a very easy problem was given at p. 172 instead of this:—

To integrate $$d\theta = \left(\frac{4v^2 \times 3}{v^2 + 1}\right)^{\frac{1}{2}} dv$$

We regret that the omission escaped our notice in proof (or the index may have broken off in printing). The problem as actually given was correctly solved by J. R. C., An Engineer's Son, Kit, Menelaus, Arbuthnot, and others. X. Y. Z. solves correctly, another problem yet, having written $4v^3$ in numerator. The problem which should have been given (as above) is by no means so easy.

OUR WHIST COLUMN.—"Five of Clubs" considers that during the holiday season, Whist on alternate weeks, will satisfy our readers.

Our Chess Column.

GAMES BY CORRESPONDENCE.

IN the following game by correspondence tho notes were taken by both players independently of each other, as the game progressed. We give both sets of notes.

Two Knights' Defence.

	White. Chief Editor.	Black. Chess Editor.		White. Chief Editor.	Black. Chess Editor.
1.	P to K4	P to K4	36.	Kt takes R (*m*)	Kt takes Kt (13)
2.	Kt to KB3	Kt to QB3	37.	QR to KBsq (14)	Kt to R4
3.	B to B4	Kt to B3	38.	Kt to K4	Q to Q5
4.	Kt to Kt5	P to Q4	39.	Kt takes Kt	Kt takes Kt
5.	P takes P	Kt to QR4	40.	K to R2 (*n*)	K to R2
6.	B to Kt5 (ch)	P to B3	41.	R to Ksq	Q to B3
7.	P takes P	P takes P	42.	K to Kt sq	R takes P
8.	B to K2	P to KR3	43.	Q takes RP (ch)	K to R3
9.	Kt to KB3	P to K5	44.	Q to B2 (*o*)	Q to Q3
10.	Kt to K5	Q to B2 (1)	45.	R to K6ch (*p*) 15	Q takes R
11.	P to Q4 (*a*) (2)	B to Q3	46.	Q takes P (ch)	K to R2
12.	P to KB4	P takes P en pas	47.	R takes Kt	R takes R
13.	Kt tks P on B3	B to KKt5	48.	Q takes R	Q takes P
14.	P to KR3 (3)	B to Kt6 (ch) 4	49.	Q to B7 (ch)	K to Kt sq
15.	K to Bsq (*b*)	B to B4	50.	Q to Q8 (ch)	K to B2
16.	B to K3	Castles KR	51.	Q to Q7 (ch)	K to Kt sq
17.	Kt to QB3	QR to Ksq (*c*)	52.	Q to K8 (ch)	K to Kt2
18.	Q to Q2 (*d*)	Kt to Kt2	53.	Q to K5 (ch)	K to R2
19.	B to Q3	Kt to Q3 (5)	54.	P to KR5 (*q*)	Q to Kt8 (ch)
20.	B to KB4 (*e*) (6)	B takes QB (7)	55.	K to B2	Q to Q6 (*r*) (16)
21.	Q takes B	Kt to R4	56.	Q to K7 (ch)	K to Kt sq
22.	Q to KR2nd (*f*)	B takes B (ch)	57.	Q to K8 (ch)	K to R2
23.	P takes B	Q to Kt3 (8)	58.	Q to K5	Q to Qsq (*s*)
24.	P to KKt4 (*g*)	Kt to B3	59.	K to B3	K to R3
25.	Q to Q2	Kt to R2 (9)	60.	K to K4	Q to Q8 (*t*)
26.	P to KR4 (*h*)	P to KB4	61.	K to KB4	Q to Q7 (ch) (*u*)
27.	P to KKt5	P to B5	62.	K to KB5	Q to Q6 (ch)
28.	P takes P (*i*)	Kt to B4 (10)	63.	K to K6	Q to Kt6 (ch)
29.	P takes P	Kt to Kt6 (ch)	64.	K to KB6	Q to KKt sq (17)
30.	K to Kt sq (*j*)	R to B2 (11)	65.	Q to K3 (ch)	K to R2
31.	R to KR2	R takes P	66.	Q to K4 (ch)	K to Rsq
32.	R to KKt2	R to K6 (*k*)	67.	Q to K7	Q to Kt8
33.	Q to KB2	Kt to B3	68.	Q to K8 (ch)	K to R7
34.	Kt to KKt5	Q takes QP (12)	69.	Q to Kt6 (ch)	resigns.
35.	Kt to K6 (*l*)	Q to K4			

NOTES BY CHESS EDITOR.

(1) Q to B2 deserves a slight preference to Q to Q5, the usual continuation.

(2) 11. P to KB4 followed by 12. P to Q4 is given as the proper reply, or if Black replied with 11. P takes P *en pass.*, then 12. Kt takes P, B to Q3. 13. Castles; but the move in the text is by no means to be considered as bad.

(3) Bringing about a difficult game. White might have defended by Kt to Q2.

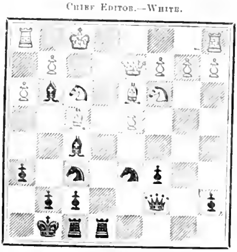
(4) 14. B takes Kt was stronger if White then retook with the B, B to Kt6 (ch), and Castles QR.

(5) 19. B takes B would have improved Black's attack, followed up by Kt to Q3 should White retake with Queen.

(6) This reply somewhat frustrates Black's intentions; the position is very interesting. We give a diagram of the

Position after White's 20th Move.

Chief Editor.—White.



Chess Editor.—Black.

(7) The position is now pregnant with interesting combinations Black might have followed a more advantageous line of play, which ought to have given him a winning superiority; but we can do no more than give some of the leading lines of play, as, after hours of labour, we found the variations too many for us to survey in our limited space :—

20.	B takes B (ch)			
21.	P takes B / Kt to R4			
22.	B takes Kt / Q takes B			
23.	Kt to K4 / Q to Kt sq (Threatening P to B4)		or Kt to K2 / R to B3	
24.	K to Kt sq / B to B4	or R to Kt sq / P to KB4	K to Kt sq / KR to K sq	or Kt to K5 / P to B3
25.	Q to QB2 / B to K6 (ch)	Kt to B3 / B to K6	Kt takes B / Kt takes Kt	Kt to QB4 / Q to K2
26.	Kt to B2 / Kt to Kt6	Q to QB2 / Kt to Kt (ch)	R to R2 / R to K7	R to B sq / B to R4
27.	R to R2 / B takes Kt (ch) (Winning the Queen.)	K to B2 / B to K6 (ch) and wins.	Q to B sq / KR to K6 (threatening R takes Kt and Q takes P ch.)	R to B2 / R takes Kt and wins.

but even though White had a more satisfactory reply than given in our analysis. Black ought to have obtained sufficient superiority to win.

(8) With the intention of taking KtP if the Queen took the Knight, but P to B4, with the intention of advancing it to B5, would have been better.

(9) Preparing for an advance of Pawns, with a preconceived idea.

(10) Having on his 20th move missed his catch, Black aims at obtaining an attack at some considerable risk to himself.

(11) Bringing the Rook to bear on the important Knight's file.

(12) Again the position is full of interest, and somewhat in Black's favour, 30. Q to B2, would have been a good move, as it threatens Kt to Kt5, i.e.,

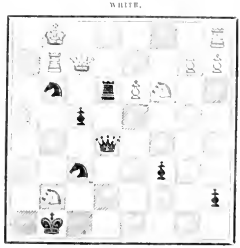
30.	— / Q to B2	31.	Kt to R3 / Kt B3 to R4	32.	R to Ksq / R takes R (ch)	33.	Q takes R / P to B6
34.	Q to K8 (ch) / K to R2	35.	Kt to Kt5 (ch) / R takes Kt	36.	P takes R / P takes R		

with some advantage. The move in the text also gave Black some considerable chance, as will be seen presently.

(13) Black gave up the exchange with the intention of now playing 36. Kt to Kt5, and if the White Queen moved to Q2, Black would win by Q to Q5, as he threatened a double discovered check with R to K8; but in reply to 36. Kt to Kt5, White had an ingenious defence in 37. P to Q4, if now Q takes P. 38. Kt to B5 wins for White; but taking the same line of play, we find that Black would, if not actually win, at least have the option of a draw by best play on White's side. We give a diagram of this interesting position, which will well repay the trouble of study.

Position after White's 36th Move.

White.



Black.

Instead of 36 K takes Kt. Black ought to have proceeded as follows:—

36.	Kt to Kt5 P to Q4			
37	Q to B3 Q to Q2	or Kt to R5 (best)		
38	Q takes RP R to R2 (best)	Q takes QP R to Qsq	if Kt takes Kt	if Q takes RP Kt takes Kt
39	Kt to K7 (ch) Q takes Kt	R to K8 (ch) R takes R	P takes Kt wins	Kt takes Q Kt to B5 (ch)
40	R to Kt6 (ch) K to Bsq (best)	Kt takes Q Kt takes Kt	if R takes Kt (B7)	and White wins.
41	Kt takes R (ch) K to Ksq	Kt to Kt5 (ch) K to Rsq	Kt takes Kt R to K4	
42	R to K6 (ch) and wins.	P to B6 and wins.	Q to B3 with a fair game.	

(14) A good move, which materially affects Black's position.

(15) An ingenious device by which White simplifies matters.

(16) The ending is also of some interest. White tries hard to win; the move in text bids fair to draw. Q to B7 (ch) K to K3 would not have been good, as Black cannot allow the White King to cross over to the Queen side.

(17) Black held out as long as possible, but White played with very good judgment in bringing his King forward, and now he wins by force.

NOTES BY CHIEF EDITOR.

(a) P to Q4. "Gossip" corrects Wormald for giving this move instead of P to KB4, but the reply given by "Gossip" 12. $\frac{\text{BQ3}}{\text{PKB4}}$ Castles applies equally to both lines of play. If I had referred, however, to Cook's synopsis (3rd edition), I should probably have played 11. P to KB4, as he quotes Mr. Wayte's remark on the position attained in the above game after Black's thirteenth move, that Black has the advantage. Nevertheless the advantage is, I think, more apparent than real.

(b) 15 K to Bsq. The only move, of course. After this White will have a cramped position for a long time; yet he seems to have ample resources for defence. Black can hardly pursue his attack effectively without bringing round his Queen's Knight, and to do this he must cross the diagonal along which Black's Queen supports the advanced Bishop. Then will be the moment for White to free himself.

(c) 17 QR to Ksq. Showing how the attack is to be pushed. If merely aiming at the general development of his forces Black would probably have played his KR to Ksq, but to push the attack on White King, the command of the KB file is important.

(d) 18 Q to Q2 Threatening a counter-attack, should a suitable moment come B takes RP, Q takes RP. Black will have to guard against any developments by which, after this, Q to KKt5 (ch) would win back the piece. Herein lies an element of safety for White.

(e) 20. B to KB4. This removes the obnoxious ecclesiastic from his threatening position.

(f) 22. Q to QB2. If Q to KR4, $\frac{\text{P takes B}}{\text{B takes B(ch)}}$ Kt to KB1, with fatal effect.

(g) 23 P to KKt4. At once protecting the QKtP and driving Knight back.

(h) 26 P to KR4. It is evident Black means to bring his KR into effective action, but by advance of KKtP his purpose may be foiled. For this advance, then, I prepare.

(i) 28 P takes P. Black is playing a bold game. This Pawn is clearly advanced to support his QKt at KKt 6. Yet, I think, I can safely take the Pawn he offers, for he will have to provide for his King's Rook and then I can provide for mine.

(j) 30. K to Ktsq. The only move for safety.

(k) 32. R to K6. Defending his Pawn attackingly.

(l) 35. Kt to K6. Attacking his Queen defensively.

(m) 36. Kt takes R. If this (followed by P to Q4 should he reply by Kt to Kt5) is not a sufficient defence, there is none on the board. So I need waste little time in analysing the defence. It is a case of *must*.

(n) 40. K to R2. Threatening the KBP, which Black's reply effectually guards.

(o) 44 Q to B2. The situation abounds with dangers, and Her Majesty is wanted at home.

(p) 45 R to K6(ch.) Here is a way of escape from my uncomfortable position, though at the sacrifice of the exchange (for my QR pawn will be captured). I shall remain with one pawn ahead and a fair chance of winning, whereas at present there is a risk of mate in my hampered corner, and it is almost certain that if mate is avoided (as with care it may be) there will be a draw by "perpetual move." If I move R to R2 the reply, Q to KKt3 compels Rook to return. If I move K to R2, Q to KB3 compels King to return. If he play R to Q8, and afterwards Q to Q5, my rooks and Queen being where they are, how can I escape either mate or loss of my Queen? If the chance of escape were likely to remain open for another move I would push my QR Pawn (to save it after exchanges). But in these cases "if you will not when you may" (the proverb is something musty), so I take at once the chance for safety.

(q) 54. P to KR5. This, of course, is what I have been playing for the last five moves.

(r) 55. Q to Q6. If Black keeps to this sort of play, the game is, I fear, drawn. I can get my Queen to KB6 with a check, and then advance KRP; but there will be no escape from perpetual check.

(s) 58. Q to Qsq. Still I see no way to win.

(t) 60. Q to Q8. Of what wickedness is Mephisto capable! I could now play Q to KR8 (ch), and then advance KRP, both pawns being still guarded by Queen, *only* to this he would respond Q to K7 (ch), *winning at once!* Note, however, that apart from this, the play of Q to KR8 would be bad, for in that position she can never protect King from repeated checks, and the game would be drawn. It is drawn, I believe, any way.

(u) 61. Q to Q7 (ch). Demoralised, I imagine, by the failure of his evil design at move 60, Mephisto gives me a chance. I confidently cross my Queen's guard of KRP. He dare not take it, and once round that corner I can win.

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CONTENTS OF No. 43.

Science and Art Gossip.

Southampton, *Aug.* 22, 1882.

If we may judge from some of our daily and weekly contemporaries, the proper thing at this juncture would be to occupy five or six columns of Knowledge with matter more or less carefully compiled from a Southampton guide-book. As, however, we do not see in what way this would be useful to those of our readers who are not visiting Southampton, while those who are will probably provide themselves with one or other of the various guide-books sold here, we will not inflict on our readers dissertations on Cerdic the Saxon, the Danish irruptions into Hampshire, Bevis of Hamptoune, and other subjects not strictly pertinent to science or art, or even to the British Association, except as affording matter for gossip during the excursions with which the committees propose to lighten the work of science. As to the Association itself, it is known to our readers that Dr. Siemens will preside, as successor to Sir John Lubbock, that Professors Thomson, Moseley, and others will deliver lectures, and that there will be the customary sectional gatherings. Whatever of interest may transpire on these occasions we shall describe, without technicalities, and as clearly and succinctly as possible, to the readers of Knowledge, noting that, as on former occasions, the bulk of the yearly volumes issued by the Association has not always afforded an exact measure of the matters of real novelty and interest brought before the members and associates, so it may be that we shall not find it necessary to describe, even in abstract, every single communication which may on this occasion be brought under the notice of the Association. In thus endeavouring to separate the wheat from such chaff as may possibly come under the action of our winnowing fan, we believe we shall be rendering as useful a service to our readers as in substituting, as far as possible, the words of ordinary discourse for the technicalities of scientific verbiage.

Several correspondents ask that there should be more astronomy, and especially that the papers should be resumed and extended in which monthly notice was given of celestial phenomena. When these were in progress, several complained that there was too much astronomy, and the editor (himself naturally preferring to have as much astronomy as readers would stand) yielded to their wishes. He proposes, however, after British Association matters have been disposed of, to resume and extend (but with care to attain compactness) the astronomical notes, which seem to have proved of real use to amateurs. Among the plans which he intends to carry out, is the monthly issue of a map of some constellation favourably placed for observation, with the places shown of all double stars of interest in Mr. Webb's "Celestial Objects for Common Telescopes," accompanied by drawings of ten or twelve of those objects. He trusts thus to form a collection which will prove of interest and value to amateur telescopists. A series of views of the northern heavens as seen from southern latitudes, which will be in reality views (for the same hours) of the southern heavens as seen from northern latitudes (a problem which we present for the amusement and study of the flat-earth men) will also appear monthly in Knowledge. Our geological contributor has not hitherto been able to fulfil his promises, but we trust he will shortly do so.

A Man of Great Brain.—The heaviest brain ever weighed in the United States was taken from the skull of James H. Madden, who died in Leadville on July 6. The doctor who attended him during his last sickness had observed the immense frontal and lateral development of his head, and determined to weigh the brain, but his astonishment was great when it brought down the scales at sixty-two and a quarter ounces. Cuvier's brain weighed sixty-four and a half ounces—considerably surpassing all other records—but the brains of Napoleon, Agassiz, and Webster, though phenomenally heavy, were much lighter than Madden's. It is an interesting circumstance that Madden was not a naturalist, a soldier, or a statesman, but a gambler.

Measurements of the winter movement of a large glacier in North Greenland (the Fjord of Jacobshavn), have been recently made by Herr Hammer, and the summer observations of Herr Helland on the same glacier in 1875 can be compared with them. The velocity is much the same, apparently, in summer and in winter; about fifty feet in twenty-four hours may be taken to represent the rate in the middle of the glacier, where it is greatest.

Upheaving of Land.—The Finnish newspapers record a striking instance of the extent to which the land on the shores of the Gulf of Bothnia is being gradually upheaved. It appears that on June 25, 1755, a land-surveyor named Erik Klingius, residing in the parish of Bergo, between the town of Nikolaistadt and Kasko, made an excavation in the smooth rock at an elevation of two inches above the level of the sea. On being lately measured, the present height was found, after the lapse of 127 years, to be six feet five inches above the sea-level.

Water from Wood.—By thrusting the ends of green scrub wood—"mallee scrub"—in the fire, and catching the sap driven out at the other end in a bark trough, an Australian supplied himself with water and saved his life while crossing in a waterless region. He says that a dozen mallee sticks, 4 ft. long and 2 in. or 3 in. in diameter, would give a pint of water in an hour, and suggests that the same device may possibly be found of vital importance to other bush-rangers and travellers in arid regions.

The National Gallery.—The Bill which Earl Granville has introduced with regard to the National Gallery proposes to empower any two or more of the Trustees, together with the Director, present at any meeting specially assembled for the purpose, to order that any pictures or other works of art under their control, which can, in their opinion, be spared from the national collection, be lent to any public gallery. Such a loan would be made for such time, and subject to such conditions, as the meeting might determine. A condition of a loan would be that all profits derived from any exhibition at the gallery to which the loan is made shall be devoted altogether to the promotion of science and art. Pictures which have been acquired under any gift or bequest would not be lent until the expiration of fifteen years from the Gallery's possessing them. And this period is extended to twenty-five years where there is a condition of the gift that the pictures given shall be kept together, or one that is inconsistent with their being lent. The expression "public gallery" includes those in the United Kingdom which are under the control of the Government, or of any municipal authority, or of any society or body approved by any two or more of the Trustees of the National Gallery and the Director.

Malaria in New England.—A short time ago the key to the mysterious extension of malarial diseases in New England was supposed to have been found in the damming of the streams for manufacturing purposes. Now the Boston *Advertiser* says that intelligent people living in the districts invaded say that the appearance of malaria in New England dates from the introduction of the cultivation of tobacco on a large scale upon the intervales of the Connecticut, and that its spread has kept even pace with the extended growing of this crop. The most plausible theory of the introduction and propagation of the aerial poison is this: To keep up the productiveness of the soil, fertilisers are freely used. The manure is brought from New York city, mostly in scows, which are unloaded on the banks of the river where the cargo is to be used. All the autumn and winter these heaps of putrid matter are fermenting and breeding disease. The air that comes in contact with these piles of filth is contaminated, and rendered as unfit for human lungs to inhale, as it is offensive to the senses.

A Venomous Lizard.—Stories about venomous lizards of different species are abundant in India and other tropical countries, but on investigation have always been found to be destitute of foundation. There is, however, one lizard of which the bite is certainly highly dangerous, though probably not fatal, to man. This is the Heloderm (*heloderma horrida*) of Mexico and Lower California, commonly known to the natives of those countries as the "scorpione" or "scorpion." An example of this lizard has lately been presented to the Zoological Society's collection by Sir John Lubbock, and may now be seen in the reptile-house. The deadly effect of the bite of this lizard upon small mammals has been proved by actual experiment, and Mr. J. Stein, a traveller in Mexico, who was bitten in the finger by one, suffered from symptoms similar to those produced by a snake-bite. The specimen in the Zoological Society's collection is about 15 in. long, and was forwarded to Sir John Lubbock by Mr. Treadwell, of the Central Arizona Mining Company. It is believed to be the first that has reached Europe alive. An article by Dr. Andrew Wilson on this interesting animal will appear in an early number.

The National Legislature of the United States pursues its intelligent and intellectual course with respect to foreign literature. "Perhaps," says the *American Naturalist*, "the secretary of the treasury desires to aid the friends of repeal by a *reductio ad absurdum* of some of the provisions of our tariff law. By a ruling of this department made some time last month, all books coming through the foreign mail for private persons are charged a duty of 25 p.c. if of the value of 1 dol. and over. To collect this amount the book must be sent from the Post-office to the Custom-house, then from the Custom house to the appraiser's store, where a valuation is put on it. It is then returned to the Custom-house, from which a notice is issued to the addressee. All this requires the filling of blanks and the obtaining of the signatures of eleven or twelve officials, by which the government is richer frequently by 25 or 50 cents. A more disreputable law it would be difficult to imagine. Only the poor student is taxed in his efforts to elevate himself above the general dead level. The aspirations of the seeker for knowledge have, it seems, to be paid for, although by following them the student usually resigns the opportunity of financial success in life. We know very well that it is not the producers of books in this country that desire protection. The sale of their wares abroad depends on their merits, and the production is not to be stimulated by a protective duty. It is the publisher who, like another noted character, sits

"Hard by the tree of knowledge,"

to whom we are indebted for this beautiful piece of legislation. We are not opposed to a protective tariff under certain circumstances; but we are opposed to one on the intellectual development of our people. It is worse than blood-money, it is soul-money. It is a discrimination against the cultivators of thought and mind, and intelligent members of our National Legislature must surely, ere long, see it in this light."

CLOUD IN THE AIR.

By the Editor.

(*Continued from page 179.*)

ONE of the most interesting consequences of the real form of the cloud layers above the horizon of a place is the greater cloudiness of the sky near the horizon, even when clouds are no denser in the air above those spots which lie towards the horizon than they are overhead. I have often been amused to hear the passengers on an ocean steamship speak of the cloudy region towards which the ship is travelling, as if they would presently lose the pleasant sunlight, when, in reality, a glance back along the ship's course, or on either side, showing just the same cloud-wrapt sky all round, should have shown that the clear sky overhead was an effect of the observer's position, not due to any real difference in the state of the air overhead.

It may be well first to notice that even when there are no clouds at all, and when the air overhead seems perfectly clear, the sky near the horizon may seem involved in thick mist, though the air *there* be in reality as clear as the air overhead. The deception is akin to that which Sir Edmund Beckett has noticed in that most interesting work of his, "A Book on Building"—*akin*, though not precisely the same. A "curious and common delusion," he says, "on the part of the dwellers in houses in low and obviously damp situation is, that by some peculiar idiosyncracy of the air, or providential interference, the fog never reaches them, but always stops at some convenient boundary which they point out to you. But if they will go and stand beyond that boundary, in a fog, they will discover the equally curious fact that their house is then just within the fog; the explanation of which is, that you can see a certain distance through an ordinary damp fog much as if there were none, but no further." Just so if you are near a particular part of the shore on what seems a perfectly clear day, you shall see the shore to a certain distance—perhaps ten or twelve miles or more—beyond which it is lost in haze; but when you have reached the spot which had seemed thus enwrapped in mist, you find the part where before the air had before seemed clear to be equally enshrouded; the reason being, as in the other case, that you can see through a great quantity of air laden with light haze, yet beyond a certain distance you cannot see; and by a delusion, common to all cases of vision through clouds, the haze, which is really very thin, and really lies along the whole space between the eye and a distant object or landscape, seems to be thick, close to, and around the object or landscape which it hides or nearly hides from view. Aiding this illusion, of course, if not playing the chief part in causing it, is the delusion we are now considering, as to the true shape of the atmospheric region above our natural horizon.

Let us, for instance, consider the question of the general haziness towards the horizon. Consider a layer of air one foot thick, throughout which a very thin haze is spread, so that to an eye looking squarely through the layer no perceptible effect of obstruction is perceived. Overhead, then, the sky is perfectly clear, so far as this particular layer is concerned. Let us consider what its obstructive effect will be close by the horizon, assuming that it lies at a height of (roughly) an eighth of a mile above the observer, who is supposed to have a sea horizon. Note that the lower it is, the greater will be the effect, or rather the difference of, effect we are considering:—Let C, Fig. 1, be the place of the observer, ADB the upper surface of the layer of

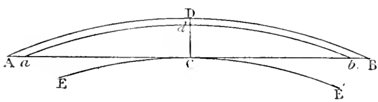


Fig. 1.

air we are dealing with, adb its under surface, and db one foot. What we have to determine is the breadth Aa or bB through which the line of sight towards the horizon passes. Proceeding as we did in last paper, we find (putting the diameter of the earth as 8,000 miles)

$$(Ac)^2 = DC.\ 8{,}000 = 1{,}000\ ;\ \text{and}\ (aC)^2 = dC\ .\ 8{,}000$$

$$\therefore (AC)^2 - (aC)^2 = (AC - aC)(AC + Ac) = Aa\ .\ aB = Dd.\ 8{,}000$$

Thus we have the proportion—

$$Aa : Dd :: 8000 : Ac$$
$$:: 8000 : \sqrt{1000}$$
$$:: 8000 : 32 :: 22.5 : 1 \text{ roughly.}$$

So that the line of sight passes through 22.5 feet of haze-laden air, or roughly $7\frac{1}{2}$ yards, in direction CA and CB instead of the one foot of such air through which it is directed in looking towards D.

But now note that in the case of such very thin haze as occupies the air on an ordinarily clear (or even a very clear) cloudless day, the most effective part of the haze lies much nearer the ground than the eighth of a mile; and that the nearer the ground is any layer we deal with as above, the greater is the disproportion between Aa, Bb, and Dd. Suppose, for instance, we had considered a layer also one foot thick, passing at a height of only 40 yards, or one 44th part of a mile overhead. Then we should have found $(AC)^2 = 8000 \div 44 = 182$; whence we shall have AC equal to between thirteen and fourteen miles. (Note, by-the-way, the striking circumstance that a layer of air 40 yards high reaches the horizon plane no nearer than some 13 or 14 miles away). This would give Aa a greater than Dd as 8000 is greater than about $13\frac{1}{2}$, or about 59 times. So that for this layer the line of sight passes through nearly 20 yards, instead of one foot, as it does overhead. For lower layers yet, and we must remember that the layers come right down even to the observer's place, the disproportion is greater yet. It follows necessarily that however lightly the air may be laden with haze, the observer looks through a great quantity of such haze, when it is directed towards the horizon. Only when the air is very pure indeed, then, are the heavenly bodies near the horizon seen under conditions approaching those under which they are seen when high overhead.

But the effects are still more curious when we consider cloud layers, for here we have often effects of foreshortening to consider, which alter a sky overhead, over which clouds are scattered with wide spaces between, into a sky entirely cloud covered, when we look towards or near the horizon.

Into these effects, and others akin to them, we must next inquire.

(*To be continued.*)

A GLASS OF WINE.

No. I.

By Dr. F. R. Eaton Lowe, M.A.

A GLASS of wine is not unfrequently regarded as a kind of passport to new friendships, and a tenacious cement to old ones. A parting "glass" is supposed to be the true expression of our regret on taking leave of a friend; while another glass is the inevitable exponent of our joy upon his return.

Something akin to this highly refined and pleasing custom obtains amongst uncivilised races. The simple African entertains his friends with his choicest palm wine, which has been stored up for festive occasions in calabashes; while the Tartar, actuated no doubt by the best intentions, well plies his company with the oldest arrack.

The virtues of a glass of wine have been so highly extolled in some quarters, that one would suppose it to be a panacea for half the ills that flesh is heir to; while, on the other hand, some writers, no doubt with equal sincerity, have ascribed to its daily use some of the most terrible evils that can afflict humanity.

The object of the present paper is not to attempt the settlement of contested points, or to enter upon the debatable ground opened up by the question in its physiological aspect; but simply to see what liquids and solids we have got in our glass of wine. When the physiological action of the separate constituents is understood, it will not be difficult to arrive at an approximate notion of the aggregate effect upon the human constitution. The most interesting ingredient in wine is, of course, the *alcohol*, or the intoxicating principle. Alcohol is one of the products of the fermentation of sugar; and this process of fermentation is one which has given rise to much difference of opinion amongst physicists, as it involves a phenomenon altogether out of the range of chemical decomposition. Fermentation has been known from the earliest ages; but it was not till yeast was examined by Fabroni, an Italian chemist who [illegible] towards the end of the last century, that some light began to dawn upon the subject. About 200 years ago, the famous Dutch microscopist, Leeuwenhoek, discovered that yeast consisted of a collection of minute cells or grains, as he called them, floating about in a thin liquid. No further investigations appear to have been made into the nature of this substance for another hundred years, when M. Appert, at the beginning of the present century, turned his attention to the subject of decay, and its prevention. He found that meat and other organic matter might be preserved from putrefaction for almost any length of time by cutting off all access of air. Yeast was one of the substances which came under his examination, and he found that air was essential to its formation, and that, if the wort of beer or the must of wine is boiled and kept in a closely stoppered bottle, no fermentation will ever be set up. This was a very important discovery, because it revealed to us the existence of minute germs or sporules in the atmosphere, which have the power of setting up those chemical changes in sugar which accompany the process of fermentation. Further experiments showed that if we filter the air in its passage into a bottle of fermentable matter by a plug of cotton wool, so as to prevent the entrance of the sporules, no fermentation will ensue, notwithstanding the fact that the air has free access through the plug. If the vitality of the sporules be destroyed by passing the air through a red hot platinum tube, all power of originating fermentation will, in like manner, be lost. It had before been noticed by Cagniard de la Tour that Leeuwenhoek's little grains grew from one another — that, when a cell became fully developed, it gave off from its side a minute bud or embryo cell, which, in its turn, enlarged, and ultimately sent forth another bud. This propagation by gemmation or budding is exactly analogous to the mode of growth in cellular plants, as mildew and other fungi. Yeast is, therefore, neither more nor less than a plant of a low order, and has received the name of *torula* (*Mycoderma cerevisiæ*). Fabroni soon afterwards examined these yeast cells chemically, and found that they consisted of a kind of bag, composed of cellulose, or woody fibre, containing a liquid whose composition was proteinaceous or nitrogenous. As the cells which compose the flesh of animals contain an albuminous liquid of similar composition, Fabroni called yeast a vegeto-animal. So far the yeast plant had come within the range of experimental demonstration; but when chemists began to theorise upon fermentation and the *modus operandum*, they entered the arena of speculative uncertainty, within which they are still groping. That yeast is the agent which causes the decomposition of sugar into alcohol and carbonic acid is indisputable, and that it appropriates some of this sugar for the purposes of its own nutrition is equally certain, but in what way its power is exerted is a question upon which eminent [illegible] are still at issue. M. Thenard and M. Pasteur [illegible] that the torula attacks the sugar, and by assimilating a portion for its own growth, causes the decomposition of the remainder. Liebig, however, denies this, and ascribes the decomposition to the action of the vital forces [illegible] within the plant itself. The doctrine of spontaneous generation, which some have held in reference to the yeast germs, is altogether inadmissible in the [illegible] of modern science. The protoplasm, or liquid matter of the yeast [illegible] contains ammoniacal salt and alkaline phosphates, so that the plant lives not only at the expense of the sugar but of the gluten which is associated with it in the must of wine and the wort of beer. The cells are exceedingly minute, the largest being only the two-thousandth of an inch in diameter, while the smallest are [illegible] than the seven-thousandth of an inch in diameter.

Now let us see what takes place when sugar undergoes fermentation. When glucose or grape sugar is exposed to the air at a temperature of 25° C, or 30° C, the sporules of the torula find in it the conditions of their existence, and chemical changes are at once set up. There is an appearance of frothing from the escape of gas through the syrupy mass; and when the action is complete, all sweetness will have vanished, and a spirituous taste become apparent. In fact, alcohol has been produced, and carbonic acid gas given off.

The formula for glucose is $C_6H_{12}O_6$ which in plain language means, that it is composed of 6 equivalents of carbon, 12 of hydrogen, and 6 of oxygen. This may be shown to be equal to alcohol plus carbonic acid by the following equation: —

$$C_6H_{12}O_6 = 2\ (C_2H_6O) + 2\ (CO_2)$$

The formula for alcohol being C_2H_6O, and that of carbonic acid being CO_2 the equation represents that from one equivalent of grape sugar we obtain 2 equivalents of alcohol and 2 of carbonic acid. Lavoiseur was the first to examine quantitatively the products of the decomposition, and came to the conclusion that the weight of the carbonic acid and alcohol together was exactly equal to the weight of the sugar employed. For many years this was accepted as true; but subsequent experiments proved that this was only true of about 94 per cent. of the sugar, and that the remaining 6 per cent. was split up into other compounds, as glycerine 3·5 per cent., succinic acid 0·6 per cent., cellulose and fatty matter, forming the sac or bladder of the yeast-cells, 1·7 per cent. Fermentation is, therefore, a much more complicated affair than was at one time supposed; in fact, a fractional part of the percentage is not yet satisfactorily accounted for.

There are other kinds of fermentation besides the alcoholic; thus, we have the acetous and the mucous fermentations, which are likewise due to vegetable sporules, of different species; while the butyric fermentation is caused by the ova of an animal, which can exist only in an atmosphere of hydrogen. The alcohol we are now dealing with is called *ethyl* alcohol, to distinguish it from other alcohols obtained from other sources. Thus, an alcohol can be obtained by the dry distillation of wood, which is called *methyl* alcohol, methylated spirit, or wood spirit, which is commonly used in the arts, as a cheap substitute for spirits of wine or ethyl alcohol. Again, the potato yields an alcohol called *amyl* alcohol, potato spirit, or fusel oil. All these varieties contain the same constituents, but in different proportions, and are therefore *isomeric*. They differ in specific gravity, solubility, volatility, and in their action upon the human system. They boil at different temperatures. Rectified ethyl alcohol boils at 172° Fah. (77 C). Methyl alcohol boils at a still lower temperature —140 F. (60 C) and when placed in an exhausted tube, as the "pulse" glass, boils with the heat of the hand. Amyl alcohol is very heavy, and does not boil below 270 F., or 58 above the boiling point of water. The heaviest of these alcohols is methyl alcohol, or wood spirit. Water being taken as 1000, the specific gravity of this spirit is 814, while that of ethyl alcohol is only 792. Fusel oil is nearly as heavy as wood spirit, having a density of 811. As our glass of wine contains, or ought to contain, only ethylic alcohol, we shall leave the other varieties out of consideration. We have seen that the composition of common alcohol is C_2H_6O. This is regarded as a radical C_2H_5 combined with the elements of water, HO, one equivalent of H in H_2O being replaced. To this radical the name of ethyl is given, hence the term ethyl alcohol in the same way. Methylated spirit is supposed to consist of a radical methyl combined with the elements of water.

Now the formula for water is H_2O, so that the radical ethyl has replaced one of the equivalents of hydrogen: hence we may call alcohol a hydrated oxide of ethyl. We have said that the alcohol of wine is derived from the grape sugar. The more sugar there is in the fruit, the richer in alcohol will be the wine produced. Thus the luscious grapes of Spain and Portugal produce the strongest wines; while the more acid fruit of France and Germany produce wines proportionately poorer in alcohol. British wines again are still weaker, and require not only the addition of sugar to disguise the acidity, but also of alcohol to prevent acetous fermentation.

The vine is cultivated in warm latitudes all over the world. On the equator itself in South America it is grown for the purpose of making wine; and in Hindostan it is met with at an elevation of 8000 ft. Marsala or Sicilian sherry is made from grapes grown upon the sides of Mount Etna at an elevation of 5000 ft.

Having settled that our glass of wine contains alcohol, it becomes an important matter to determine how much of that body we are consuming. Port and brown sherry contain naturally about 22 per cent. of alcohol by *volume*. The distinction between volume and weight must be borne in mind; otherwise we shall be supposed to be at issue with authorities who place the percentage at a much lower figure. The proportion of alcohol in natural port and brown sherry by *weight* is about 15 per cent. Natural port and sherry, however, are hardly procurable in this country. The wine shipped to this country is almost invariably fortified by the addition of brandy, for the purpose of arresting fermentation before all the sugar has been converted into alcohol. To such an extent is this practice carried, that the percentage of alcohol is often brought up to 32 by volume. An ordinary wine-glass contains about two fluid ounces: taking our port, then, to contain 26 per cent. of alcohol by volume—a very fair average—we shall have $5\frac{1}{5}$ fluid ounces, or about $2\frac{1}{2}$ wine glasses of pure alcohol to the pint of 20 ounces. Supposing our wine-glass to hold the tenth part of a pint, then our glass of port or sherry will contain abouth one-fourth of its bulk of alcohol. Madeira comes next in strength, and contains from 18 to 20 per cent. of alcohol. The light wines of France and Germany average 10 per cent., while champagne has 12 to 14 per cent. of alcohol. Instruments for determining the amount of alcohol in spirituous liquors is called an "Alcoholometer." It is simply a hydrometer which sinks more or less in a liquid according to its specific gravity. The greater the proportion of alcohol, the lighter is the liquid in relation to water; and the deeper will the instrument sink in it. These instruments, therefore, determine the alcoholic strength by weight, and not by volume.

ENGLISH SEASIDE HEALTH-RESORTS.

By ALFRED HAVILAND, M.R.C.S., F.R.M.C.S. Lond.

CLASSIFICATION (*Continued from page* 177).

LAND and Sea Winds. A very natural question arises in the minds of many health-seekers as they stand by the sea, and look towards the horizon it forms. It is, "What is the land opposite, that is separated from us by the arc of the vast expanse of waters before us, as they curve around the earth, and clothe it in obedience to the grand law of gravitation?" Outliers, as the British isles are of the great Europ Asian continent, and lying, as they do, in the North Atlantic ocean, the answer will, of course, depend upon the position of the standpoint whence the speculative survey is made. The question is no idle one, for it involves another of greater importance—viz., do the winds, which blow towards us, come to us after having travelled over thousands of miles of deep sea, or have they lingered in their course over the vast continent from which we are detached, and reached the shore on which we stand, after traversing the narrow and shallow channels which embrace us on two of the three sides of England.

The climate chart at page 163, and the "weather charts" that are now published weekly in KNOWLEDGE, will help us to understand the relation that our eastern and southern coast-lines bear to the lands which flank us on those sides. We must, therefore, refer our readers to them, whilst we briefly dwell upon this, the first division of our subject.

We will take the *east coast* first, from the south bank of the Tweed to the North Foreland, and, for simplicity sake, will only use the ordinary eight points of the compass—N., NE., E., SE., S., SW., W., and NW.

North.—From Berwick to Lowestoft (16); on facing this point we have the sea, uninterrupted by land, stretching to its North Polar ice-boundary; the wind, therefore, in passing from the arctic regions would cross the path of the gulf stream as it flows from the north-western side of the Shetland to wash the north west coast of Norway, and within these gulf stream longitudes would traverse the 60° N. Lat., where it would meet with a mean air-temperature even in the coldest month of the year, January of 33° 60 Fahr., or an amount of heat 37° 04 greater than that of the mean of all other longitudes in the same parallel. Thus we see how the influence of this wonderful stream is brought to our eastern coast over our North Sea, by even the north wind. The mean January temperature within gulf stream longitudes at 60° N. Lat., being 33° 60 F., as compared with −3° 44 within all other longitudes.

On the other hand, we find that at the same point in the gulf stream in July, the mean air temperature, according to Ferrel's researches, would be 57° 40, as compared with 56° 94 within all other longitudes, or only a difference of 0° 46 Fahr.

If we take a good representative meteorological station in the North Sea, such as Scarborough, we shall find that the *North* wind is the prevailing *sea wind* throughout the year. Thus, from the observations kindly furnished us by Mr. W. C. Hughes, F.M.S., we find that, during the five years 1877-81, the number of days it blew amounted to 35·19 per cent. of the aggregate during which these winds prevailed. Thus, within the interlatitudinal zone 11, in which this health-resort lies, the sea winds are as follows, with the percentage of their prevalence:—N., 35·19; E., 24·73; N.W., 15·93; S.E., 12·11; N.E., 12·00. The *North* wind at this station is least prevalent in *winter* (Dec., Jan., Feb.), 14·1 per cent., and most so in the *spring* (March, April, May), 30·6 per cent., culminating in May; in *summer* (June, July, Aug.), 29·1 per cent., and in *autumn* (Sept., Oct., Nov.), 26·3 per cent.: so that in the North Sea it may be said to be rather equably distributed throughout the seasons and the year generally. It may be added that the above winds are the *sea* winds along this line of coast between the two points indicated.

North-East.—Norway and Sweden are the countries which oppose an observer on this coast looking in this direction, and over these countries *some* of our north-east winds have travelled before crossing the North Sea to reach our shores. We say *some*, because it is now well established that these and other winds in different parts of their circuits appear to have very different directions. From observations extending over ten years at the following stations on the Norwegian and Swedish coasts, it appears that the mean air temperature in January at the point of departure of these winds is 33° 5, or 3° 5 less than the isotherm of our west coast (37°) during the same month. Thus Christiansund, 63° 7′ Lat. N. has a mean monthly air temperature of 31° 3 Fahr. ; Bergen, 60° 24′ Lat. N. 33° 3 ; Skudenses, 59° 9′ Lat. N. 34° 7 ; and Mandal, 58° 2′ Lat. N., 31° 8. In passing it may be noted that Mandal, although the most southern of these stations, has a mean January temperature 1° 5 colder than the most northern, Christiansund, which being on the north western coast of Sweden, has the immediate benefit of the gulf stream. These stations in summer (July) have a mean temperature of 55° 4, or 5° 1 lower than the mean of the four isothermals, 59°, 60°, 61°, and 62°, between Berwick and Cromer ; hence the cooling and refreshing influence of this sea wind in the height of summer on our east coast. It must now be observed that, at a time when the gulf stream influence is *nil*, and the sun-heat all powerful on the land, the most southern station, Mandal, has a mean air temperature of 58° 9, whilst that of the most northern, Christiansund, is only 51° 1, or a difference of 4° 5. This north east wind has a large marine element in it.

On the east coast it is the least prevalent of the sea winds ; it begins to become more frequent in March, and generally reaches its maximum in April and May. Compared with the other sea winds we have seen that the percentage of its prevalence is 12·00 throughout the year. During the months of its greatest prevalence, the Norwegian and Swedish stations have a mean air temperature of 40° 5 in April, and in May 46° 6, while the mean of the isotherms between Berwick and Cromer are 46° 8 in April and 52° 0 in May, the temperature of the sea for these months being about 42° 7 and 46° 3 respectively. Thus it is that the days on which this wind blows, a depression in the air temperature is experienced. It is the wind that brings what are called "black frosts" as distinguished from the "white," or hoar frosts, which are eminently local in their character, and the result of unchecked heat radiation under a serene sky. The north east wind before it reaches our shores has to travel over six or seven hundred miles of sea.

The western part of Europe must now engage our attention, as over it blows the wind which of all others exercises the most important effects upon our country. The observer as he travels from north to south along our east coast will have opposite to him, within the interlatitudinal zone I., Denmark, with its two stations, Tarm and Copenhagen ; within zones II. and III., the coast of Germany which unites Denmark with the Netherlands ; within zone IV. the Netherlands ; and zone V. Belgium. This coast line is the western boundary of the great central plain of Europe, which is walled in on the east by the Ural mountains, stretching from the north to the south of Europe. A wind that has traversed such a plain before reaching our shores must have had its marine character entirely altered, and it is a most important question whether, and under what circumstances, its short sea passage enables it to recover its title to be called a sea wind. This we shall reserve for our next paper.

Next to California, Australia is the most productive of gold-bearing countries. The gold-bearing territory of Victoria alone is [illegible] 2-[illegible] of New South Wales, 13,650 [illegible] of Queensland, 13,600 [illegible] in the Rocky Mountain [illegible] both in quartz rock and placers; but, like those of California, those of Australia are becoming every year less productive.

ELECTRIC LIGHTING AND ITS RISKS.

THE rapid development of electric lighting which we have witnessed during the past year or two has, as might have been anticipated, been accompanied by more or less important misadventures. Roughly speaking, these may be divided into two classes—first, accidents to the body ; second, accidents to property. A few efforts have been made to formulate and help guard against the recurrence of these accidents, the causes for which are, in the great majority of cases, easily discernible by practical electricians. There is, however, hardly a subject so important and so frequently ignored by amateurs and unpractical men generally as the necessary methods for confining the electric current to the channel through which its course is intended to lie. Its importance is comparable to the necessity of making strong boilers to confine steam, or of thoroughly washing the glass and other apparatus in the hands of the amateur or professional chemist.

If the electricity is properly confined or insulated, the chances of danger to the body are reduced to a minimum. These dangers arise only from currents of high intensity such as are used for arc lights ; and the wires transmitting such electricity should not only be carefully insulated, but should be fixed in such a way as to prevent the comparatively soft insulating being rubbed away by friction against the corners of houses, tunnels, chimney-stacks, &c. It would be well if some competent authority were employed by Government to fix a legal minimum amount of insulation, and to stipulate with the various companies that frequent, careful, and trustworthy tests should be taken. Were this done, we should hear nothing of such accidents as that which occurred at Hatfield, and which we cannot stigmatise in milder terms than by calling it barbarous. Should such an authority be appointed, one of its most important duties will be to see that the earth is rarely, if ever, used as a return wire. The dangers to property are of a very different kind. They result from the volume or quantity of the current. When this gets to be more than the conductor can sustain, it becomes hot, and may eventually set fire to the building. This we know to have frequently happened, and as it is not always possible to guard against a current getting too large for the conductor, an automatic device should be invariably inserted by which the circuit is broken and the current no longer allowed to flow. In certain places great stress is laid on a regulation that the conductors should be at a considerable distance from each other, but where proper means are taken to ensure thorough insulation, this becomes unnecessary. Whether anyone is ever appointed for this particular work or not, it is certainly to be hoped that we shall soon have something more definite than the generalisation to which we were indulged in the report we published a week or two ago. The gross ignorance displayed by very many electric light engineers (!) demands this, and the sooner something is done, the better will it be for the vendor as well as for the buyer.

LEARNING TO SWIM.

By Natator.

(Continued from page 180.)

HAVING acquired the art of balancing easily in the water, body aslant, back uppermost, you are practically master of the situation ; for, while the balancing comes easier at every trial, many ways of making progress come naturally to you. For instance, if you put the palms of the hands together, and so thrust them forward, then separating them and forming each hand into a cup-shaped paddle, in the way already described, you carry them with a wide sweep backward, so that the hand-paddles drive back as much water as possible, you are, of course, carried forward; and you can repeat this action as often as you like, without using the legs at all. Or again, if you let your arms and hands simply wave about in front of you, keeping your balance, you can use your legs and feet in a rough-and-ready way to propel you, drawing the feet up under you aslant to the water, and kicking them back square to the water. Or you can progress more systematically by the process called "swimming like a dog," in which each hand is alternately slid forward, points of the fingers first, as far as it will go, and then drawn strongly back, held downward from the wrist in the cup-paddle form, while the legs also move alternately to give a kind of slow, backward kick, like that already described. In these and many other ways you can now get about in the water, not very quickly, but probably as fast as you want to go, and quite safely,—though, of course, it is well not to go out of your depth.

Still, this is not to be called swimming. If you want to swim well, you must learn from the beginning a good style,—which really means the sound, scientific application of the methods of progression possible in the water. That you may the better do this, do not be in a hurry: but first practise several things which will increase your confidence in the water, and enable you, when you do begin to learn the true swimming strokes—the breast stroke and the side stroke—to give your whole attention to style.

First, then, learn how to float on the back.

This is easier by far than learning to balance with the back uppermost (and the mouth out of water—a desirable state of things for those who prefer to breathe). But it is not right to learn *first* to float on the back, just because it is so easy that the learner is apt to stop there, and make no further progress. Besides, in turning from back floating to front floating, it is just as well to be able comfortably to balance in the latter position, and not be obliged ignominiously to splutter and struggle into a standing position.

Standing up to the breast in the water, *your back towards the shore*, hold the arms out on either side, or inclined rather upwards and backwards, lean gently backwards—further and further, until the arms and the back of the head enter the water: you leave the ground, and at the first few trials you feel as if your head and shoulders *must* dip under. But they *cannot* do it, even if you try. The odd thing is that when you lean forward from a standing position in the water, you feel as if you could readily balance yourself, yet as soon as the feet leave the ground the beginner invariably goes head under, but when you lean backwards with the arms outstretched, you feel as if you were surely going under, yet as soon as the feet leave the ground you find yourself lying as comfortably on the water as if you were on a feather bed. There is scarcely any tendency to roll sideways, and what there is is very easily controlled by the hands in the water. But so little is there that after the first few trials you can put your arms or hands under the back of the head and float on your back as if you were going to sleep in that position on the greensward.

To progress in any required direction, when floating on the back, is exceedingly easy. You can hold the arms easily alongside and work the hands from the wrist, "cupping" them for greater driving action, if necessary, or you can use the arms more freely, taking advantage of their full sweep. The legs can be used by gentle kicking, slanting the feet as you draw them up for the kick, and squaring them against the water as you give it. But you can now try a method of propulsion with the legs, which will prove much better, and give you an insight into the true principle of leg propulsion in swimming. Floating on the back, gently draw up both legs, and kick them out simultaneously as far apart as you conveniently can; there then lies between them a triangular space of water. Bring them now, still extended, close together, forcing out, of course, towards the feet, the water which had lain between them (the action is like closing the blades of a pair of scissors). This action, you will find, produces a strong propulsive effect,—the forcing of the water backwards urges, in fact, the body forwards.

While learning these preliminary exercises in order to acquire a good swimming style, both for breast-stroke and side-stroke, learn to roll over easily from the back to either side, and from the side to the front, until you feel as little care about any of these movements as you would about the corresponding movements in bed. To make them more difficult, change your floating positions from back to front either way *after* expelling the air from the lungs, being careful, however, to do this at first only in shallow water; for though, after a little time, no difficulty whatever is found in bringing the mouth above water when the lungs are exhausted, it is, at first, rather discomfiting to find how very little floating power remains after the air has been expelled. I have seen a learner very much confused by the depressing effect of a hearty laugh in which he had indulged when floating. But of course, after a little experience, the learner finds out the advantage of keeping his floating apparatus, the lungs, well filled with air. It also does not take him long to learn that it is not quite the right time to replenish them when the mouth is under water.

(To be continued.)

BUTTERFLY PRINTING.

By E. N. Parker.

Before commencing a description of this (to my mind) most useful way of preserving butterflies and moths, I may perhaps be allowed to mention that "Butterfly Printing" is not an exact term for the method, which should be more properly described as "Butterfly Gumming," or by some longer collection of words, which I will leave to your readers to put together for themselves.

The best time for the work will be found to be during the long winter evenings at home, after the collecting season is over; but I think this description is timely now, as a number of specimens of the common sorts can be captured, and used for practice and gaining experience in the method about to be described, without which the collector would, no doubt, hesitate some time (and with reason) before using his perhaps solitary specimen of some rare species, taken after the expenditure of a large amount of time, trouble, and, possibly, money.

The materials are few and simple, and all that will be found absolutely necessary are two common penny paint-brushes of camel-hair (so-called) one large and one small, an ounce of gum arabic, and a quire of thick cream-laid note-paper, a pair of tweezers, which should be pointed bluntly and slightly bent, so that the points meet when squeezed without the rest of the instrument touching (or a pair of tweezers taken from the microscope box, slightly bent in the same way, will answer as well): a tumbler or wineglass broken across the stem, and a few sheets of thick blotting paper torn into strips of about 6 in. long by 2 in. broad.

Our butterfly caught, killed in the usual manner, impaled and brought home, all the material being made ready, and the gum dissolved in cold water and strained through a piece of muslin, the operator must take it (holding tightly) by the pin, in the left hand, and with a sharp knife or pair of scissors cut off the four wings as closely as possible to the body, letting them drop on a clean sheet of ordinary paper.

The next step is to take the tweezers and arrange the wings with the underside uppermost, and place the tumbler over them to prevent a breath of air moving them.

Then take a half sheet of note-paper and fold it across the middle, and having opened it again, smear it over about half the surface towards the middle of the paper with the gum; hold it by the edge with the left hand, fingers lengthwise, and with the second finger of the right hand distribute the gum over the paper, pushing it from left to right, and then turning the paper round and doing the same, until on holding it up and looking at it sideways in the light no lines can be seen. Place the paper breadthwise before you; and with the tweezers arrange the wings on the nearest half of the gummed paper, placing first the upper wings and then the lower wings as they would appear when the insect is "set" in the usual manner, leaving, however, room for the body, which must be carefully preserved and ticketed in a manner which will show what wings it belongs to.

Having arranged the wings, which, once placed, must not be again moved under pain of the specimen being spoilt, fold over the paper, let it stick together, and rub hard on the outsides, top and bottom, where the wings are placed, with a pocket-handkerchief over the finger. Open the paper, remove the wings, which may be done by blowing or lifting them gently and carefully with the tweezers from the end nearest the body, and all the scales will be found to have stuck to the paper in order as on the butterfly itself, there being an upper and under view.

After this, the paper must be washed over with clean water, to remove the gum (being careful to go close up to, but not over, the scales), using the blotting paper to absorb it, and, when the surface is quite clean, placed in a heavy book to press and dry.

When thoroughly dry (in about half an-hour) commence to paint in, with ordinary water colours, the body, between the wings, to do which well, and get a good copy, will require some practice.

When this is finished, the paper may be cut in two and stuck into a scrap album with thick cardboard leaves; the species, upper or under wing, being written in one corner, and the place and date of capture in the other, or as the collector's fancy may dictate.

The great utility of this system appears to me to be that specimens are free from any chance of being destroyed by moths or dust when by accident the necessary supply of camphor is forgotten to be renewed, and a much more portable collection is obtained, which can be laid on the drawing-room table, carried about, or even dropped, without danger to the specimens.

I have transferred to paper in this manner a number of West Indian butterflies caught more than fifty years ago, and given to me in various stages of decay and destruction.

One fact has been revealed to me by this process which I did not know before, and that is that most butterflies and moths have two sets of scales and fringe round the borders of the wings. This is proved by the fringe being perfect on both the upper and under view, and by the fact that I have once or twice been able, with great care, to take two impressions from the same wings.

In every case but one, I have found the above described method to be successful, and that one failure is in the blue butterflies, of which the under sides of the scales (which appear uppermost on the print), are of a whitey-blue colour, and not the bright tint which we see so often flitting about our fields.

I trust that I have made the above fairly plain, though not so short as I or you might have wished; but if any of your readers find a difficulty in carrying out the directions, I shall be pleased to answer any questions they may like to put. The key to the whole thing is the consistence of the gum and delicacy of touch.

HAS THE MOON AN ATMOSPHERE?

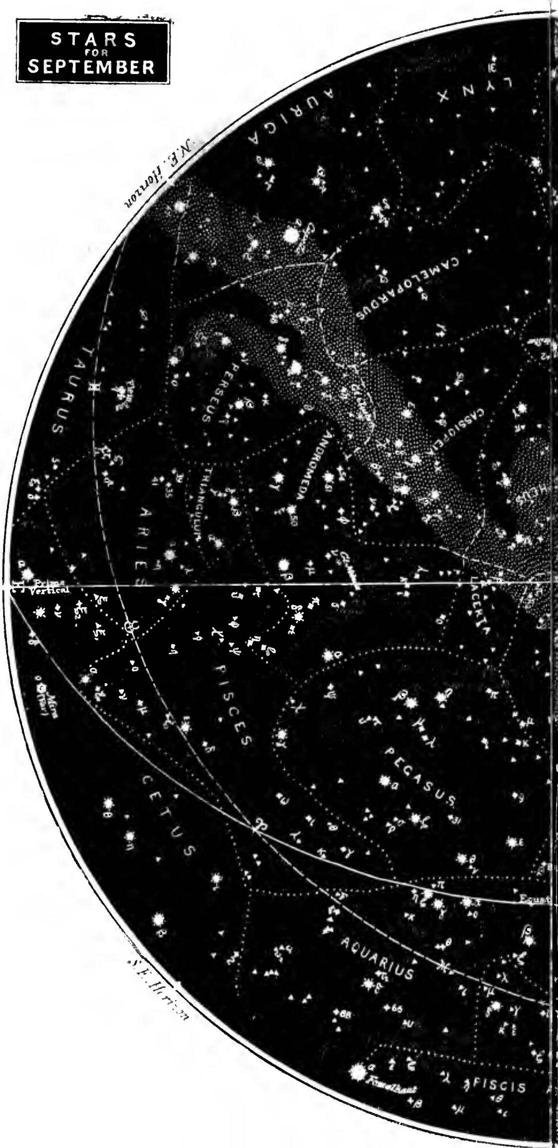
By Mr. Ranyard.

No lunar clouds are ever seen floating over the sharply-defined objects of the lunar landscape. As the sun rises upon the moon, the transition from darkness to light is quite sudden. No zone of twilight stretching beyond the sun-illuminated region can be detected, and as the moon passes over bright stars, there is no gradual diminution of their light as they approach the lunar limb, but they disappear suddenly, as if snuffed out, at the instant that the lunar limb covers them. It is quite certain, therefore, that the moon has not a vapour-laden atmosphere which is as dense, or nearly as dense, as the atmosphere which envelopes the earth. There is no evidence tending to show that rays of light are bent as they graze the lunar limb. Rays grazing the earth's surface in a similar manner would be turned through an angle of more than a degree from their original course by refraction in the earth's atmosphere, for it is known that stars, when seen upon the horizon, are raised more than half a-degree above their true places by the bending which rays of light undergo before they reach the observer. If there were any such refraction of light by a lunar atmosphere, the sun would never be entirely hidden by the dark body of the moon during an eclipse. During the recent total eclipse, as seen from Sohag, the moon's diameter was about half-a-minute of arc greater than the sun's diameter, and at the time of central eclipse, when the centre of the moon's disc coincided with the centre of the sun's disc, the sun's limb would have remained visible if there had been a lunar atmosphere giving a refraction equal to 1-240th part of the refraction which would have been caused by the earth's atmosphere. But not only was the sun's limb hidden at the time of central eclipse, but it remained hidden for more than a minute—in fact, the observed duration of totality agreed within a few seconds with the duration calculated on the supposition that there is no bending of light by a lunar atmosphere.

There is always some discordance amongst observers as to the actual duration of totality, for the disappearance of the sun's light is not an absolutely instantaneous phenomenon, so that occasionally trained observers standing beside one another differ as much as three or four seconds in their estimates of the time of the commencement of the total phase. There is also some uncertainty as to the real diameters of the sun and moon. But after making allowance for these uncertainties, we may safely assert that the observed duration of total eclipses agrees with the calculated duration sufficiently closely to enable us to be sure that there is not an atmosphere about the moon capable of causing a refraction equal to one two thousandth part of the refraction which would be caused by the earth's atmosphere under similar circumstances.

But this does not prove that there is no lunar atmosphere, or even that there is not a lunar atmosphere equal

STARS FOR SEPTEMBER



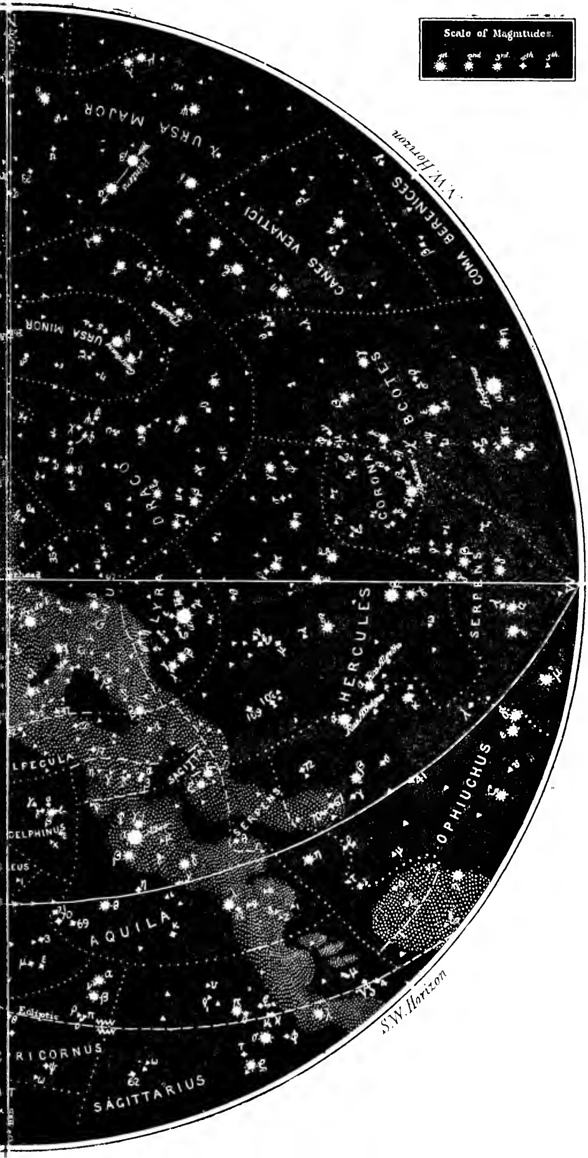
OUR STAR MAP.—The circular boundary of the map represents the horizon. The map shows also the position of the equator and of that portion of the Zodiac now most favourably situated for observation. The names of ninety-nine stars of the first three magnitudes are given below.

On Aug. 29, at 10·30 p.m.
On Sept. 2, at 10·15 p.m.
On Sept. 6, at 10· 0 p.m.
On Sept. 10, at 9·45 p.m.
On Sept. 14, at 9·30 p.m.
On Sept. 17, at 9·15 p.m.
On Sept. 21, at 9· 0 p.m.
On Sept. 25, at 8·45 p.m.
On Sept. 29, at 8·30 p.m.

ARABIC NAMES OF STARS.

The following table exhibits the names of all the stars of the first three magnitudes whose names are in common use:—

α Andromedæ ...	*Alpheratz*
β ——— ...	*Mirach, Mizar*
γ ——— ...	*Almach*
α Aquarii ...	*Sadalmelik*
β ——— ...	*Sadalsuud*
ζ ——— ...	[illegible]
α Aquilæ ...	*Altair*
β ——— ...	*Alshain*
γ ——— ...	*Tarazed*
α Arietis ...	*Hamal*
β ——— ...	*Sheratan*
γ ——— ...	*Mesartim*
α Aurigæ ...	*Capella*
β ——— ...	*Menkalinan*
α Boötis ...	*Arcturus*
β ——— ...	*Nekkar*
ε ——— ...	*Izar, Mizar, Mirach*
η ——— ...	*Muphrid*
α Canum Venaticorum ...	*Cor Caroli*
α Canis Majoris ...	*Sirius*
β ——— ...	*Mirzam*
ε ——— ...	*Adara*
α Canis Minoris ...	*Procyon*
β ——— ...	*Gomeisa*
α Capricorni ...	*Secunda Giedi*
δ ——— ...	*Deneb Algedi*

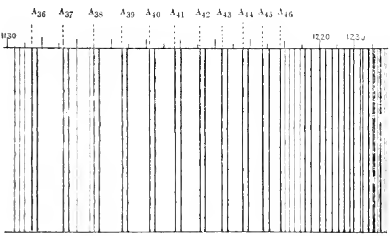


α	Cassiopeiæ	*Schedar*
β	———	*Chaph*
α	Cephei	*Alderamin*
β	———	*Alphirk*
γ	———	*Errai*
α	Ceti	*Menkar*
β	———	*Diphda*
ζ	———	*Baten Kaitos*
ο	———	*Mira*
α	Columbæ	*Phact*
α	Coronæ Borealis	*Alphecca*
α	Corvi	*Alchiba*
δ	———	*Algores*
α	Crateris	*Alkes*
α	Cygni	*Arided, Deneb Adige*
β	———	*Albireo*
α	Draconis	*Thuban*
β	———	*Alwaid*
γ	———	*Etanin*
β	Eridani	*Cursa*
γ	———	*Zaurac*
α	Geminorum	*Castor*
β	———	*Pollux*
γ	———	*Alhena*
δ	———	*Wasat*
ε	———	*Mebsuta*
α	Herculis	*Ras Algethi*
β	———	*Korneforos*
α	Hydræ	*Alphard, Cor Hydræ*
α	Leonis	*Regulus, Cor Leonis*
β	———	*Deneb Aleet, Denebola, Deneb*
γ	———	*Algeiba*
δ	———	*Zosma*
α	Leporis	*Arneb*
α	Libræ	*Zuben el Genubi*
β	———	*Zuben el Chamali*
γ	———	*Zuben Hakrabi*
α	Lyræ	*Vega*
β	———	*Sheliak*
γ	———	*Sulaphat*
α	Ophiuchi	*Ras Alhague*
β	———	*Cebalrai*
α	Orionis	*Betelgeux*
β	———	*Rigel*
γ	———	*Bellatrix*
δ	———	*Mintaka*
ε	———	*Alnilam*
α	Pegasi	*Markab*
β	———	*Scheat*
γ	———	*Algenib*
ε	———	*Enif*
ζ	———	*Homan*
α	Persei	*Mirfak*
β	———	*Algol*
α	Piscis Australis	*Fomalhaut*
ε	Sagittarii	*Kaus Australis*
α	Scorpionis	*Antares, Cor Scorpionis*
α	Serpentis	*Unukalhay*
α	Tauri	*Aldebaran*
β	———	*Nath*
η	———	*Alcyone* (Pleiad)
α	Ursæ Majoris	*Dubhe*
β	———	*Merak*
γ	———	*Phecda*
ε	———	*Alioth*
ζ	———	*Mizar*
η	———	*Alkaid, Benetnasch*
ι	———	*Talitha*
α	Ursæ Minoris	*Polaris*
β	———	*Kochab*
α	Virginis	*Spica Azimech, Spica*
β	———	*Zavijava*
ε	———	*Vindemiatrix*

to one five-hundredth part of the terrestrial atmosphere, for the mass of the moon is less that one-eightieth part of the earth's mass, so that the weight of a body at the moon's surface is less than one-fifth of the weight it would have upon the earth's surface. And an atmosphere like our own would, if removed to the moon (the temperature remaining the same), be more loosely packed, and would extend to a much greater height above the surface.

There is another method by which the existence of a lunar atmosphere may possibly be detected. Besides bending rays of light, the earth's atmosphere absorbs certain wave lengths more than others, so that in the spectrum of sunlight which has passed through the lower strata of the atmosphere for some distance, as at sunrise or sunset, there are certain lines which are not to be found in the spectrum of a high sun. M. Thollon, who was one of the observers of the total eclipse at Sohag, has spent many years in making a great map of the solar spectrum, in which he has laid down the position and relative intensities of the solar lines, and he has also mapped down the places of many hundreds of atmospheric lines which are proved not to belong to the true solar spectrum, because they grow more intense as the sun sinks towards the horizon, and vary with the amount of aqueous vapour present in the atmosphere.

The instrument with which M. Thollon has made his observations is a bisulphide of carbon spectroscope, giving a dispersion equivalent to thirty-one prisms of 60° of ordinarily dense flint glass, and giving a much brighter spectrum and far better definition than could be obtained with such a cumbersome train of prisms, if it were possible to mount them and keep them in adjustment. M. Thollon has in a very simple manner contrived to make the solar rays pass three times through a system of prisms and half-prisms, so that the eye-piece of the viewing telescope and the slit remain fixed, while by a motion of the prisms, different parts of the spectrum can be brought into view. M. Thollon has made with this instrument a map of the solar spectrum 49 feet long, showing more than 4,000 lines.



The wood-cut, copied from one of M. Thollon's drawings, represents the well-known B group, which lies towards the red end of the spectrum. It is a group which is modified in a most striking manner by atmospheric absorption.

During the total solar eclipse of July, 1878, Professor C. A. Young examined this region of the solar spectrum with the slit, of his spectroscope placed upon the image of the solar crescent, so that light from the sun's disc entered one half of the slit while the other half of the slit was upon the image of the dark moon. On looking into the eye-piece of his spectroscope a brilliant solar spectrum was seen in the half of the field corresponding to the half of the slit which was upon the sun's disc, while the other half of the field appeared quite black. The division between the two halves of the field was exceedingly sharp. There was no gradual dimming of the solar spectrum close to the moon's limb, and Professor Young was not able to recognise any of the well-marked terrestrial absorption lines, or any new lines in the solar spectrum, though he spent some time in carefully examining the region close to the moon's limb.

Professor Young's observation was made with a grating spectroscope of 17,300 lines to the inch, which in the spectrum observed gave a dispersion about equal to the dispersion of M. Thollon's liquid spectroscope; but the amount of light and the sharp definition obtainable with Professor Young's instrument was not equal to that given by M. Thollon's instrument.

It will be seen that the light which enters the slit close to the moon's limb must, if there be a lunar atmosphere, have passed through the densest portions of it; but although the air of Colorado, where the observation was made, was very dry (and the sun was at a considerable altitude, more than 41° above the horizon, so that there would be very little absorption taking place in the earth's atmosphere, and the lunar absorption lines, if any, ought by contrast to have been well shown), Professor Young was unable to detect any trace of absorption. I was observing near to him, and he kindly gave me an opportunity of looking through his instrument. I was much struck by the sudden transition from the ordinary solar spectrum to utter darkness, a transition totally unlike that which is observed when the slit lies across the nucleus of a sun spot. The edge of the spectrum was much more strikingly abrupt and sharply defined than the edge of the spectrum which corresponds to the sun's limb when the slit is placed radially on the uneclipsed sun so as to project beyond the solar disc, and the dark lines of the solar spectrum were sharply cut off, apparently without alteration. No evidence, therefore, was obtained by Professor Young tending to show that any absorption of recognisable amount takes place at the lunar limb. In our next article we will examine the evidence which was obtained by MM. Thollon and Trépied during the recent total eclipse which they observed in the dry air of Upper Egypt.

(To be continued.)

A Super-Sensitive Thermometer.—Since the days when Mr. Edison brought out his micro-tasimeter, which proved so sensitive to heat, until now, we have had no instrument devised for measuring extremely delicate changes of temperature. Such an apparatus has, however, been recently devised by M. Michelson, and brought, at least in its experimental form, before the French Physical Society. It is based on the principle of bi-metallic thermometers, but ebonite or hard caoutchouc is chosen instead of one metal. Hard rubber is ten times more dilatable than platinum under heat, and a spring composed of platinum on one side and ebonite on the other will curve under the least increase of temperature. At the extremity of the spring is fixed a small glass stem, forming an elbowed lever, which abuts against a light mirror suspended by a silk fibre. When the spring curves or straightens, the mirror is deflected, and a ray of light from a lamp reflected from its surface to a scale moves up or down the divisions of the scale. By giving to the spring and lever a relatively great length, this instrument can be made very sensitive, and the inventor hopes to be able to measure the thousandth of a degree Centigrade.—*Engineering.*

Reviews.

TWO ELEMENTARY BOTANY BOOKS.*

THERE is nothing harder on earth than to find fault, and especially to find fault with established authority. If possible, one would like to praise everybody, and above all to praise earnest men of science, whose title to speak about their own special subject is quite undoubted. But we cannot find it in our hearts not to utter a word of protest against Professor Bentley's little manual, which he has prepared "with the intention of supplying young boys and girls with a simple introduction to the study of plants." It is meant to be "quite intelligible to any boy or girl beyond the age of twelve years, who has even received but a moderately good education." And here is some of the fare provided for the phenomenal boys and girls beyond the age of twelve years:—

> Thus, if the blade is pinnately-veined the divisions are correspondingly placed, and the leaf is *pinnatifid*, *pinnatipartite*, or [illegible] according to their depth; or when palmately-veined and divided [illegible] the leaf is *palmatifid*, *palmatipartite*, or [illegible], in like manner. When the divisions are [illegible] divided in a similar manner to the blade itself the leaf is [illegible], &c., the application of which terms will be readily understood without further explanation.

Elsewhere, from a single page of this little primer, we extract the following choice expressions: "Coiled up in a circinate manner," "young flowers in a scorpioid cyme," "sori," "indusium," "sporangia," "a ring or annulus," "antheridium," "spirally waved filament termed a spermatozoid," and so forth: while the next page takes us into all the dry details of archegonia, embryo sacs, germ cells, and the rest of it, which, as Mr. Silas Wegg justly remarked, had much better be discussed "in the absence of Mrs. Boffin." Organography, morphology, alternation of generation: this is what the boys and girls above the age of twelve years have to study. And yet they have received but a moderately good education! Why, Macaulay's famous schoolboy was but an ignoramus by the side of these modern prodigies!

The anonymous author of "Plant Life," seems almost equally unable to think himself away from the technicalities wherein he was instructed, and to think himself into the position of the hapless children for whose instruction he [illegible] to write. It is true, he has been heavily weighted by the "requirements of the Education Department, as published in the Revised Code": and certainly the collective wisdom which prescribes an acquaintance with cells and vessels or the phenomena of germination deserves to be treated with deferential caution; but even that awful and impersonal entity, the Revised Code itself, could hardly desire that the babes and sucklings of the Board Schools should be crammed with such solid pudding as this:—

> [illegible] of which contains a curled- [illegible] free, find their way [illegible] the result being that growth [illegible] called the nucleus. It [illegible] away the upper [illegible] as the *calyptra*. [illegible] a variety of reproduction [illegible]

All this is very true and very beautiful, no doubt; but as we [illegible] wonder, somehow, whether it would not [illegible] a botany book for children in a simpler, pleasanter, and more natural way. Might not one begin with the pretty pink flower itself, the thing that little children know and love, instead of beginning with "the root or descending axis," and proceeding duly to the andræcium and the gynæcium, and all the other horrid structural details? Might not one explain first the use and meaning of flower and fruit, and then work back to leaf, and stem, and root, and cells, and vessels? Might not one do all this, with the accompaniment of some simple diagrams, and yet never once employ such charming words as lyrete, runcinate, palmate, digitate, and pedate? But, then, a botany book written upon those lines would perhaps be actually interesting, and what would the Revised Code say to that? No, collective wisdom is all for the best, no doubt; and the poor children must go on with these weak and beggarly elements to the very last. Yet, we venture to predict that all the good they will ever get from them will be a profound and deeply-rooted hatred of systematic botany.

* "M[illegible] Botany," by Professor [illegible] "[illegible] Botany," by the author of "[illegible]"

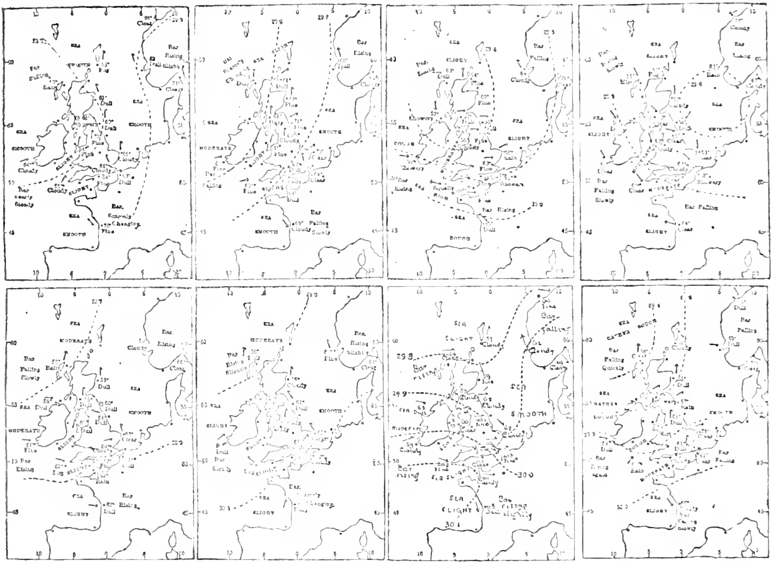
"The Botanical Atlas; a Guide to the Practical Study of Plants." By D. McAlpine, F.C.S. (Edinburgh: W. & A. K. Johnston, 1882. Part I.) This is a capital work of its sort, well designed and well printed, with most of its information brought thoroughly up to date. It consists of dissections and magnified views of illustrative plants, which will show practical students what they ought to see for themselves in the specimens they examine. Not only is the structure of each species well exhibited, but attention is called in passing to functional uses, while such points as the devices for favouring or ensuring cross-fertilisation in the sage and the wallflowers are admirably brought out in the drawings and enforced in the letter-press. Here and there we notice a little vagueness of detail in the essential organs of the flowers represented, and the descriptive literary matter requires more careful editing; but we hope to see these slight defects remedied in forthcoming parts, and we can cordially recommend the work to all amateurs or beginners who wish for a guide in the difficult matter of plant dissection. It is prettily coloured, too, which gives it the first introduction of a pleasing appearance, and it is commendably free from any unnecessary technicality of language.

Mrs. R. C. Barnard, of Bartlow, Leckhampton-hill, Cheltenham, sends us some excellent lithographed illustrations to "Houston's Practical Botany," which are to be had "only by application to the artist." They are well and faithfully drawn from nature, and the structural details have been carefully brought out. Above all, Mrs. Barnard has succeeded in catching what botanists call the "habit" of the different plants—that is to say, their distinctive individual appearance. There is nothing so difficult to do as this, for draughtsmen will often give every technical detail with perfect correctness, and yet the whole will be so unlike the real plant that nobody will recognise it for the same thing. It is like expression in portrait-painting—dependent upon such petty turns or twists of feature that only a true artist can ever catch it. For her present purpose, Mrs. Barnard may be considered as such.

According to Dr. Frankland's report upon the quality of the waters furnished to the metropolis during July, the Thames water distributed by the five companies drawing their supply from that source was of better average quality than in any previous month of the year, although all the samples, except that drawn from the mains of the Lambeth company, were slightly turbid from insufficient filtration. The Lea water, distributed by the New River and East London Companies, also showed considerable improvement in quality.

WEATHER CHARTS FOR WEEK ENDING SUNDAY, AUG. 20.

Sunday, Aug. 13th. Monday, Aug. 14th. Tuesday, Aug. 15th. Wednesday, Aug. 16th.



Thursday, Aug. 17th. Friday, Aug. 18th. Saturday, Aug. 19th. Sunday, Aug. 20th.

In the above charts the dotted lines are "isobars," or lines of equal barometrical pressure, the values which they indicate being given in figures at the end, thus—30·4. The shade temperature is given in figures for several places on the coast, and the weather is recorded in words. The arrows fly with the wind, the force of which is shown by the number of barbs and feathers, thus:— ⟶, light; ⟶, fresh or strong; ⟶, a gale; ⟶, a violent gale; ⊙ signifies calm. The state of the sea is noted in capital letters. The * denotes the various stations. The hour for which each chart is drawn is 6 p.m.

THE PUBLIC HEALTH.

The Registrar-General's returns for the past week show that in London 2,670 births and 1,528 deaths were registered. Allowing for increase of population, the births exceeded by 21, while the deaths were 48 below, the average number in the corresponding week of the last ten years. The annual death-rate from all causes, which had slowly increased in the four preceding weeks from 17·7 to 19·2 per 1,000, further rose last week to 20·5. During the first seven weeks of the current quarter the death-rate averaged only 18·6 per 1,000, against 21·5 and 23·6 in the corresponding periods of 1880 and 1881. The deaths attributed to diarrhœa (including dysentery), which had been 103, 118, and 147 in the three preceding weeks, further rose last week to 164, but were 83 below the corrected average weekly number. These 164 deaths from diarrhœa included 127 of infants under one year of age, and 29 of children aged between one and five years. The fatal cases of whooping-cough, which had been 63, 57, and 44 in the three preceding weeks, rose again to 52 last week, which were 11 above the corrected weekly average; 5 occurred in St. Pancras, 4 in St. George-in-the-East, 4 in Bermondsey and Rotherhithe, and 6 in Lambeth. The deaths referred to diseases of the respiratory organs, which had steadily increased in the four preceding weeks from 157 to 223, declined again to 197 last week, but exceeded the corrected weekly average by 30; 106 were attributed to bronchitis, and 45 to pneumonia. Twelve cases of suicide were registered, which exceeded the corrected average by 4.

BUTTERFLIES AND MOTHS.

By W. J. H. Clarke.

THE PROMINENT MOTHS.

Among the division of Lepidoptera known as the *Cuspilates*, we find a very interesting and peculiar class of moths styled "Prominents." They derive their name from a small projecting tuft of scales on the lower margin of the upper wings, which stands out very prominently when the insect is at rest.

In England, twelve species in all have, up to the present, been found, but many are of such extreme rarity that very few cabinets possess authentic British-caught specimens of all the varieties.

The first in order is the Plumed Prominent (*Ptilophora Plumigera*), a very handsome but rare insect. It has been found in Buckinghamshire in the month of October, but only on very few occasions. The fore wings are semi-transparent, of a raw sienna [illegible], with a bar of a paler hue beyond the centre. The caterpillar feeds on the maple, and is to be found in June and July.

The next species [illegible] is the Pale Prominent (*Ptilodontis [illegible]*), which is [illegible] more common than the last. This moth is of a pale brown colour, with three bands of a darker brown, and black dots and [illegible] scattered over the wings. The caterpillar feeds on the [illegible] sallow, and is of a green colour, covered with [illegible] raised [illegible] spots, arranged in six bands, with a yellow line down each side. It changes into a chrysalis in the beginning of October, and remains in that state during the winter. The perfect insect appears in June.

[illegible] Coxcomb Prominent (*Notodonta Camelina*) is [illegible] it is a very handsome insect, the fore wings being [illegible] brown, and the hind wings of a similar but paler colour. The caterpillar is very peculiar in form, and feeds on the oak, [illegible] maple, &c.; the body is green, with worts or raised spots on the back, tipped with pink, from which issue tufts of black hairs. On each side of the body is a white line, composed of spots joined together with stripes; the caterpillar is to be found during the present month and the beginning of next. The moth itself comes out during the summer months.

The Maple Prominent (*Notodonta Cucullina*) is a very rare insect, the caterpillar of which feeds on the maple. It has been caught at Halton, in Buckinghamshire, in the month of May. The caterpillar appears in July.

Next we come to the Scarce Prominent (*Notodonta Carmelita*). This moth is to be found on the wing in April, and should be sought for on the trunks of birch-trees and places adjacent. The fore wings are reddish grey, with the upper edge darker where there are two pale yellow spots, from which proceed lines and black dots transversely. The caterpillar is green, with a large number of raised yellow dots all over the surface, and a buff-coloured line down the side, and is to be found in the month of June on birch-trees.

Next in our list of Prominents comes the White Prominent (*[illegible]*), a very rare and beautiful moth. It appears on the wing in June, and is said to have been captured in Staffordshire. The wings of this moth are white, with black spots and other markings, the front margin of the fore wings being slightly arched. The hind wings are light, but without spots, and the [illegible] head and the rest of the body of the same colour. The caterpillar, like most of the Prominent larvæ, is green, with a yellow stripe down each side.

The remaining six species will be described in next paper, as space forbids [illegible] this.

Professor Tommasi has written a letter to the *Piccola*, describing a case of hydrophobia in which the powerful drug pilicarpina had been used without effect. The professor writes:—"The prodigious effects of this potent remedy soon showed themselves profuse sweats and enormous salivation; and yet the malady continued its fatal course as usual. I was one of those who had hoped in the good effects of pilocarpina in cases of hydrophobia, and now this hope has vanished, and it is necessary that the fact should be known."

Mountaineering as Exercise. Mountaineering is doubtless excellent exercise for the nervously strong and muscular, but it is unfortunate that it should be the pastime of the very class of persons least well fitted for its pursuit. Those who lead habitually [illegible], and, to a large extent sedentary lives, incur great peril of [illegible] and accident when they resort to this arduous and [illegible] exceptional form of exercise in their annual holiday. [illegible] steady of nerve and clear-headed, strong of wind and [illegible] the strain is too severe, and the overtaxed faculties of [illegible] may at any moment give way suddenly, when life [illegible]. Members of our own profession [illegible] in respect to the way they spend their [illegible]. We do not think that, as a class, they are [illegible] the climbing of mountains, but there are [illegible] unaccustomed labour of any kind, although [illegible] and perhaps with seeming ease [illegible] some reserve of force on hand is [illegible] reasonably be expected, and it [illegible] on the hazard. Mountaineering [illegible] requires long and continuous practice [illegible] reckoned as salutary [illegible]. It is too laborious, [illegible] exhausting to all [illegible] without more than [illegible] power, which may be misleading. [illegible] in training, or he should only [illegible] particular expenditure of [illegible] no extraordinary risk.—*The Lancet.*

Letters to the Editor.

[*The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.*]

All Editorial communications should be addressed to the Editor of KNOWLEDGE; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

*** *All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

MR. MATTHEW ARNOLD ON KNOWLEDGE.

[520]—I learn by your extract from the *Nineteenth Century*, on p. 193, that Mr. Matthew Arnold is still hammering away at his chronic craze, concerning the supernal importance of the study of ancient classical literature. It may appear presumptuous on my part to differ with the apostle of sweetness and light—nay, I am thoroughly sure that it *will* appear presumptuous to Mr. Arnold himself, affording as he does so admirable an illustration of the appositeness of the celebrated definition that "toleration is letting you believe as I believe, intoleration wishing me to believe as you believe." As one, however, who, perforce devoted some years of his life to classical study, and who has spent no inconsiderable part of the remainder of it in the acquisition of knowledge of the natural and physical sciences, I at least claim to speak with a certain amount of experience, experience which, in the case of scientific study, I venture to think Mr. Arnold is scarcely in a position to share. Now, if the end of life be to cultivate the æsthetic faculty in man, there exists, I venture to affirm, even in modern (to say nothing of mediæval) literature, the most ample materials for this purpose; accessible, moreover, to thousands to whom the pious Æneas represents nothing, and to whom the childish and indecent legends of the inhabitants of Olympus are (happily) a sealed book. The classics, in real truth, merely supply a system of mental gymnastics; suited well enough to a certain intellectual type, but failing conspicuously when applied to another. I really wonder how much there is in our extant classical literature which is read for its own sake? by which I mean for the sake of the information or instruction conveyed by it. It suits the purpose of Mr. Arnold to covertly sneer at and depreciate the value of the statement of such a fact as that "when a taper burns the wax is converted into carbonic acid and water;" but I confess that I find more that ministers to "the sense which we have in us for beauty" in Faraday's "Chemical History of a Candle," than I do in many parts of the works of Aristophanes: while I assuredly derive much more vivid impressions of what is most distinctively bestial in the human race from the perusal of Juvenal's Sixth Satire than I do from learning, through the imperishable researches of Darwin, that the ancestor of man was probably "a hairy quadruped, furnished with a tail and pointed ears, probably arboreal in his habits." I should be more urgent in insisting on the essential unsoundness of Mr. Matthew Arnold's advice "to choose to be educated in humane letters rather than in the natural sciences," were I not convinced that, in the present enlightened condition of public opinion, he has but small chance of being listened to. That the study of the Cosmos is destitute of those elements which minister to man's æsthetic faculties, or exercises a less refining influence on the human mind than the perusal of nasty fables, no one but a very fanatical enthusiast would, I think, now venture to assert. I confess that investigations into the physical structure of our visible Stellar Universe has exercised an indefinitely more elevating and purifying influence upon my own mind than even the perusal of the story of Leda and the Swan did.

A Fellow of the Royal Astronomical Society.

FAIRY RINGS.

[521]—It may be objected to the new phase of Mr. Williams's "hypothesis" that the Fairy Rings I referred to often occur on precipitously steep hill sides, where tethered animals are never found. Similar rings are often an intolerable nuisance on the well-kept lawns of mansions, opposite the drawing-room windows, in positions where hay-cocks and tethered animals are (not to put too fine a point upon it) extremely rare.

A Fairy Ring starts from a single fungus, or a small group of fungi; this little group exhausts the ground, and renders it unfit for the further growth of fungi. From this starting-point the underground spawn radiates, and in the second year the Fairy Ring appears; it is then about 6 in. or 9 in. in diameter. The fungi decay, and this decayed material suits the growth of grass; this luxurious grass (manured by the previous year's fungi) is usually termed the Fairy Ring. The third year the ring will be a foot or more in diameter, and so on to a hundred feet or more, the spawn always increasing from the centre outwards. Haycocks are never six inches or a hundred feet in diameter. If a small hole is dug just outside a Fairy Ring, the spawn of the fungi is invariably met with. When there is too much or too little rain, the fungi cannot come up, and this accounts for the curious absence of the Fairy Ring fungi in some seasons; the circle of spawn is, however, alive in the ground, and if the next year is suitable, the ring of fungi again appears, always just outside the luxuriant grass. In some places where Fairy Rings are common, two or more circles of underground spawn come in contact; at the point of contact the rings cannot go on, so semicircles or ogee-curves are the result. Tethered animals do not walk about in circles a foot in diameter, in semicircles, or ogee-curves.

Mr. Williams has confused several things together—the rank grass found about haycocks, manure-born fungi, and Fairy Rings. They are all quite distinct from each other. W. G. Smith.

MECHANICAL PARADOX.

[522]—Thanking you for replying to my last query, may I trouble you with the following?

In a book entitled "Remarkable Men" (published by The Society for Promoting Christian Knowledge) I find the following called "Ferguson's Mechanical Paradox," in which he (Ferguson) says: "Suppose you make one wheel as thick as other three, and cut teeth in them all, and then put the three thin wheels all loose upon one axis, and set the thick wheel to them so that its teeth lock into those of the three thin ones; now turn the thick wheel round, how must it turn the others?

'Turn the thick wheel which way you will, it shall turn one of the thin wheels *the same way*, the other *the contrary way*, and the third *no way at all*."

In the book above-mentioned, this mechanical paradox is fully illustrated, but not explained, and I have failed as yet to get an explanation of it. Cupidus Cognoscere.

ARE TOADS POISONOUS?

[523]—I have domesticated toads, frogs, lizards, slow-worms, snakes, and other reptiles, and have studied their habits. Some of my observations do not accord with the statements in the biological text-books, but on the question raised by Mr. Herbert Brown (No. 499) they are quite in harmony with the usual descriptions of the acrid secretions emitted from the pustules or warts on the skin of toads. I have seen several cases of dogs attacking toads, and in all the dog has suffered considerably in the manner described by Mr. Brown. On one occasion I dropped a toad much in the same manner as dogs do. His skin came in contact with an excoriation on my hand, and the result was like picking up something very hot indeed. They are quite innocent of any "sting" or poison-teeth.

W. Mattieu Williams.

SINGULAR COINCIDENCE.

[524]—A curious circumstance which happened to me in Switzerland in the year 1877 may perhaps be deserving of record. On August 4 I left my quarters at the Hotel Rigi Scheideck, where I had occupied No. 123, for the Hotel National, at Lucerne. Here I was struck by the fact that my room had the same number; but my surprise was greatly increased when on proceeding on August 6 to the hotel at Giessbach, I found myself again confronted by 123 on my door. The sequence, too, of the numbers was curious, and it so happened that the party consisted of three, though one of these occupied a separate room. T. W. Webb.

AN AUGUST METEOR.

[525] On the evening of the 10th inst., about 1.45, whilst in the act of viewing with admiration and delight the great cluster in Perseus, my attention was called to a magnificent meteor which burst into view in Perseus, about 3° south of the point I was engaged upon. It shot slowly across in the direction of Ursa Major, leaving a beautiful stream of light in its wake, and burst about half-way to that constellation. I fixed my glass (a 3 in., with a power of 80) on it, and perceived a long waving light of a greenish hue, slowly fading away. Against the dark background it seemed like an immense crack in the sky, and had a most remarkable appearance. It was clearly visible for 45 seconds.

Yours truly,

Dukinfield, *Aug.* 11, 1882. William H. Shirley.

TARNISHED DAGUERREOTYPES.

[526]—I have a tinted daguerreotype which is much tarnished, so that the figure can only be seen in a particular light, and then imperfectly, while the surroundings are bluish-green. I should feel much obliged if I could be informed how or where it can be restored. I am a subscriber to Knowledge, and read in an early number that it can be restored. I was referred to my chemist, who, brought up with photographers, never heard of restoring a tarnished daguerreotype. F.

DRAMA FOR AMATEURS.

[527]—Wanted, the names of two or three dramas subject to the following conditions:—(1.) Sufficiently elevated and improving in tone for representation by a Mutual Improvement Society at one of their meetings. (2.) One that we could curtail, if necessary. (3.) Containing a cast—say three ladies and three or more gentlemen. We should have three months for preparation, and possess a fair amount of amateur talent. Hon. Sec.

THOUGHT READING.

[528]—You may be interested to know that I have been successful in a feat of thought reading somewhat similar to, though less wonderful than, that performed by Cassneuve, described by your correspondent "Henry Milton." It was this:—

I wrote on a slip of paper the name of, say, a flower and an animal, folded it up, and gave it to a friend, requesting him to look me steadily in the face and mention the name of the first flower that came into his head. Having done this, I asked him to mention the name of the first animal that occurred to him. In both cases the answer was correct. I have tried the experiment several times since, and have been, generally speaking, successful; on the second guess, almost invariably so. The *modus operandi* was simply that my friend should look me straight in the face and mention the first which occurred to him of the kind I had told him to think of. I, on my part, simply concentrated my thoughts on the object to be guessed. James Deas.

BALL-BEARINGS TO BICYCLES.

[529]—In reply to your correspondent, Thos. B. Walker, I think he has fairly made out his case, but it will probably interest him to know that in many of the best makes of tricycles the manufacturers have reversed the method adopted in the construction of bicycles, and have put ball-bearings to the small steering-wheel, while using plain bearings to the large wheels. This is the case with the Burdess Sterling Tricyle, which I am at present testing, and of which I think favourably. There is great originality in the construction of this machine; the cranks are driven backwards to drive the machine forwards; this gives the rider great power, and steadies the machine in quick running and going down hill.

Your correspondent's well-reasoned remarks will, I have little doubt, be useful in directing the attention of manufacturers to the desirability of putting ball-bearings to the small or trailing wheels of bicycles. For my own part, if I were compelled to have a bicycle with only one set of ball-bearings I should prefer those bearings being applied to the hind wheel, because I have found that they generally run well where they have to run with a great velocity and under small weight, but more frequently get out of order when they have to bear any amount of weight while running, and when they do get out of order they are very difficult to set right without tools and appliances, which amateurs seldom possess.

John Browning.

Answers to Correspondents.

**** All communications for the Editor requiring early attention should reach the Office [illegible] the Saturday preceding the current issue of* KNOWLEDGE, *the [illegible] week.*

[illegible] 1. No questions asking for scientific information can [illegible] 2. Letters sent to the Editor for correspondents cannot [illegible] names and addresses of correspondents be given in answer [illegible] 3. Correspondents should write on one side only of the paper [illegible] on a separate leaf. 4. Each letter should have a title, and in [illegible] reference should be made to its number, the page on which it [illegible].

[illegible] If the sun's rays have been all these millions [illegible] years working their way round, and even now give [illegible] back, I fear I must ask you to wait till they do [illegible] before discussing your theory. Science finds [illegible] ample reason for being certain that the solar rays, [illegible] undulations, travel in constantly enlarging spheres [illegible] centre. There is absolutely nothing known in [illegible] that this action can ever reverse its course. [illegible] reason to correct the spelling, the printers would [illegible] if your letter had been marked for insertion; [illegible] except for Paradox Corner.—NAMUK. 1. Draw [illegible] of AC, a perpendicular, OD, which [illegible] to the circle, O being the centre. From O [illegible] OE equal to AC. Then EB, perp. to OD [illegible] required point D. 2. The highest point [illegible] as 45 degrees above the horizon. It [illegible] is on the horizon, and it is then about 41 [illegible] the sun the lower the rainbow, and t[illegible] are.—AMATEUR desires to know the name [illegible] of best book giving chemical tests for [illegible] Rodwell's Scientific Dictionary, price, [illegible] modern scientific terms.—J. H. GRANT. Y[illegible] Watt's parallel motion suggests that you are [illegible] than the one I am familiar with. W[illegible] sketch showing where C, C′, &c., of your [illegible] you must not expect to find any way [illegible] equation you have obtained shall be [illegible] of the first degree; all you can [illegible] expression for the deviation from the straight [illegible] maximum (that is, where it is greatest or least) and [illegible] with respect to a determine for what value. Of [illegible] deviation is least.—W. A. E. wants to know w[illegible] in yeast, when made into bread, is destroyed in the [illegible] alcohol is to be obtained from bread baked brown [illegible] of pure water; and if so, whether excluding the air w[illegible] preventive.—H. B. LINDSAY. 1. The *Edinburgh Review* is [illegible] Our English system of numeration reckons a billion [illegible] a trillion as (a million)³ and so on—a very sen[illegible]. Americans use the unwise and practically absurd [illegible] a thousand millions a billion, a thousand b[illegible] It would puzzle their arithmeticians to ex[illegible] tri-, and quadri-, &c., of these numbers are to be interpreted. 2. [illegible] commonly supposed a French league is three E[illegible] are, in fact, two French leagues neither of wh[illegible] in length, one of 2,000 *toises*, or 2·42 E[illegible] which was formerly the legal posting measure, [illegible] 25th part of a degree, or about 2·77 English miles. [illegible] by Flammarion in the passage [illegible] The [illegible] is the 2[illegible]th part of a degree, or [illegible] geographical miles.—F. CRAWSHAW. Letter for[illegible] English astronomers regard the day as [illegible] at Greenwich Aug. 3, 1 o'clock p.m., being A[illegible] Aug. 3, 1 o'clock a.m., being Aug. 3, 13 h. But [illegible] must always be a question at any [illegible] how the ordinary day that [illegible] for instance, at or near A[illegible] of Aug. 3, civil or mean [illegible] which is near its commence[illegible] If we pass eastward from Gr[illegible] to cease rotating for the [illegible] in the morning till, w[illegible] the morning hours of Aug. 3 are [illegible] If we go westward, we find the [illegible] when we arrive at 180° w[illegible] other way, it is mid[illegible] Aug. 3 are just about to begin. [illegible] difficulty. All we ca[illegible] the Greenwich da[illegible] Even at Paris, [illegible] the day differs from [illegible] from 11.50 in the evening of Aug. 3 at Gr[illegible] midnight [illegible] Aug. 3 at Greenwich, it is the beginning of Aug. 4 at Paris.—W. MEADOWCRAFT. When you have said that the apple is in the smaller box, and the smaller box in the larger, what more is there to say?—J. A. OLLARD. That seems about it. Besides, there is a certain degree of probability that what the mind regards as probable will really occur.—J. THOMSON. Do not know of Ling's book. No instrument has yet been invented for measuring brain movements. As trepanning would seem a necessary preliminary, I venture to predict that such an instrument, when invented, will not be widely popular.—A. McD. 1. Dr. Ball refers to appearances in the transit instruments, which inverts. 2. No: R.A. of a star is not the time when the star crosses the meridian of a place; but the interval in time between the passages of the meridian by (i.) the first point of Aries and (ii.) the star. 3. You are right in your correction of what Dr. Ball says as to zenith dist + colat. being equal to polar distance; it should be colat. ± zenith distance, according as star crosses meridian south or north of the zenith.—A. STRADLING. Most willingly; not undertaking, of course, to insert everything.—T. CHASE COX. Darwin attributes the colours of human races to the gradual influence of sexual selection. Slight differences at first between different races were gradually increased. When the change was in progress, there must have been, what is now not seen, a marked difference of colour between the two sexes. As to the lady and gentleman you mention, science may express an opinion when it has had evidence of their having existed.—E. SCOTT. Darwin touches, in his "Descent of Man," on the origin of the emotions, feelings, conscience, &c. It is not very wonderful that we have but very vague evidence on this point. You ask whether evolution recognises the human soul, and, if nothing can be destroyed, what becomes of it after the death of the body? I am not concerned to say what evolutionists believe about the soul, a future life, and so forth. These matters lie outside *our* field of inquiry; but as to your question, regarded scientifically, might it not be paralleled thus, Science recognises the human mind: nothing can be destroyed; what becomes of it after death? *or thus,* Science recognises human strength; nothing can be destroyed; what becomes of our strength after death? Science can only recognise the strength, the mind and its powers, the soul and its emotions, as functions of the body.—ESCRIMADOR. You must have been misinformed by the person who stated that a book giving the Latin roots (pure radicals) issued by the Clarendon Press, was suppressed lest the pupils should outlearn the teachers!—C. A. WILLIAMSON. The information was given in KNOWLEDGE for August 4, p. 170. Publishers, Messrs. Trübner & Co., price 15s.—J. RAWCLIFFE. Fear cannot find space for critique on Mr. Whewell's article in *Journal of Science*, October, 1880, on "Free Forces in Nature."—J. BEDFORD. You are known.—FACIEBAT. Before November we shall have some papers on meteors and shooting stars. Dropped K. because many misunderstood.—F. J. M. Fear must ask some reader with more leisure than we have to determine on what day the full moon fell in July, 1573.—W. W. FAWCETT. In what way do Dr. Hermann's assertions affect what I said? Have I ever asserted there were no cruel and wrong-headed vivisectionists?—Z. Y. X. Many thanks. We have sent on the electric boy to our electrical contributor for his opinion.—J. WILSON. We do not see the difficulty. It is certain that ever since sub-aerial denudation has been in progress, every formation must have been partially consumed to provide materials for the next; portions also would remain much as they were originally formed. Why should you go on to reason as if geologists asserted that the whole of each formation was consumed while the next was forming? In so doing you make the difficulty which troubles you.—H. MARRIOTT. On the hottest day you will often see *cirrus clouds,* which consist of ice crystals. Whatever theory we accept as to the formation of hailstones, we know that they are formed where the air is at a temperature below the freezing-point.—J. RALPH. You have taken Mr. Mattieu Williams somewhat too seriously; of course he does not really mean that drinking habits should be encouraged in order to get rid of the worse members of society. Besides, he speaks only of the coarser type of drunkards. We insert, however, as much of your letter as we can find space for.—A. H. SKELTON. I noticed the two misprints at p. 170, 1880 for 1800. There was only one wrong in proof, and I corrected that but somehow with the result that both were made wrong. It did, not, however, make the answer unintelligible; for I received a note from the querist thanking me for the reply, which he had manifestly read as corrected. So, as the answer had only been intended for him, I did not think it worth while to correct the mistake. There was a very annoying erratum in No. 41, first page. I had written that some regard "the results of sound reasoning as if they were fanciful hypothesis." For "hypothesis," I found "hypotheses," which I corrected. To my horror I found the sentence altered into the ungrammatical and unmeaning form in which it actually appeared, the results of sound reasoning being regarded as if *it* were *a* fanciful hypothesis. Hypothesis in the abstract, as distinguished from any particular hypothesis or hypotheses, was, of course, what I intended.—S. W. Flannel next to skin as best for bodily health,—therefore better for the mind,—*mens sana*, &c. For the other trouble there is nothing but resolute will; which of us has not been troubled that way? Still, busy work which has also interest for the mind will in the long run chase from us thoughts we have no wish to entertain.—J. E. Okill. Pardon me, it is *you* who have "missed the mark again:" preferring beer to water is not the same as craving strong drink. As the old song has it, when I am hot and tired

> I loves a glass of good beer,
> I'm partikler partial to beer.

Yet I assuredly have no craving for it, and for ten years have scarce tasted it. You think few, but, so far as I can judge, every reader of Knowledge reads these Answers.—John Rouse. Although the discoveries of asteroids have been rather common of late years, the subject is full of interest. I am planning a paper in which the ingenious ideas of my friend, Professor Kirkwood, of Bloomington, Indiana, will be considered. I look upon his discovery respecting the arrangement of asteroidal distances as full of interest.—J. V. E. There are so many articles waiting that I fear it would be unwise to invite you to send yours. It would, however, be returned. Not undertaking to return, &c., is not the same as undertaking not to return.—E. A. Francis. I venture to mention my "Half Hours with the Stars," published by D. Bogue, price 2s. 6d., as likely to help you. I have no pecuniary interest (never had in fact) in the sale of the book, or would scarcely mention it. Still, I think it would be of use to you.—M. M. W. We share your views; but the subject is outside the line we marked in our first number. It is better avoided.

ELECTRICAL.

James Nelson Fraser. You need not be afraid of asking questions, simple though they be, more particularly if they are such as it is difficult to find a direct answer to in the ordinary elementary text-book. Where specially made zinc is unobtainable, amalgamation should always be resorted to. It is a simple process, which you can carry out for a few pence. Get a little sulphuric acid (a pennyworth of oil of vitriol from the oil-shop will do) and mix with water, in the proportion of one of acid to about twelve or more of water. Place your zinc in this (to remove surface impurities), and leave it until it nearly stops fizzing. Then with the aid of a piece of wool, &c., the zinc being still wet, rub in a little mercury until you get a uniformly bright surface. If it isn't bright all over dip it in the water again, and then give it another rub. Don't be wasteful with the mercury. A globule about the size of a pea is amply sufficient for a good-sized plate.—S. Crosse. The half of the ring nearest the magnet assumes a polarity opposite to that of the inducing pole, while the remote half assumes the like polarity. The neutral line in this case is the diameter of the ring at right angles with the axis of the magnet. No change is produced by coil copper wire round the stationary iron ring.

Our Whist Column.

By "Five of Clubs."

The following game illustrates well the advantage of understanding partner's play, or of being assured that partner plays according to some definite plan in particular cases. The hand resembles one described by Drayton, and so closely, that it may be regarded as the same hand. (It was written from memory of that hand.)

THE HANDS.

A.
Clubs—Q, Kn, 9, 4.
Hearts—10, 7, 6.
Spades—9, 8, 2.
Diamonds—Q, 6, 2.

Y.
Clubs—10, 5.
Hearts—9, 5, 4, 2.
Spades—A, K, 4.
Diamonds—K, 10, 7, 4.

B
Y — Z (Dealer.)
Trump Card, Club King.
A

B.
Clubs—A, 8, 7, 2.
Hearts—A, Q, Kn, 8.
Spades—5, 3.
Diamonds—A, Kn, 9.

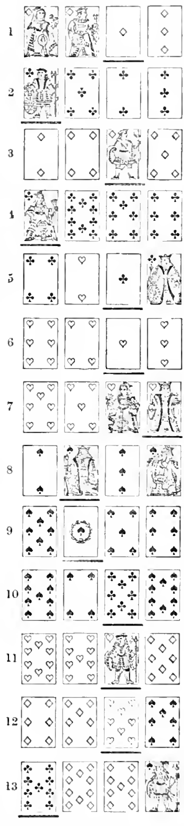
Z.
Clubs—K, 6, 3.
Hearts—K, 3.
Spades—Q, Kn, 10, 7, 6.
Diamonds—8, 5, 3.

Score :— { *A*, *B*, = 0 / *Y*, *Z*, = 0 }

THE PLAY.

Note.—The card underlined wins the trick, and card below leads next round.

A Y B Z



REMARKS, INFERENCES, &c.

1. *A* having only three-card suits, outside trumps, and not sufficient strength to justify a trump lead, leads the best card from a short suit. *B* holding the Knave knows that the lead is not from Q, Knave, ten, or from strength. He infers, therefore, that *A*, who is a steady player, has four trumps, but is not strong enough to lead trumps. He, therefore, having four trumps, leads one, through *Z*'s King.

2. *A* cannot as yet tell whether *B* has led from strength in trumps, or, recognising evidence of length in trumps in *A*'s hand, has simply led through the honour to help him. He therefore does not return a trump.

3 and 4. *B* again plays through the honour; and now *A*, seeing his partner must have four at least,

5. Returns a trump, which draws the King.

The rest of the hand plays itself. At 8 and 9, *Y* plays to clear his partner's suit, but the third round in spades is ruffed.

We cannot say we altogether approve *A*'s play. Having no means of knowing whether diamonds were his partner's suit or one of his opponent's, he should not, we think, have thrown away the Queen; had the suit been headed by the Knave, he could not have done better than to lead the best.

EASY END GAME (Page 174).

If *Z* wins the trick with his small trump, *YZ* lose. Winning with his Queen of trumps, *Z* leads the three. *Y* having the tenace over *A* wins two rounds of trumps, and leads his winning heart.

Correct solutions received from J. Hargreave, R. M. Grierson, F. Y. L., Two of Hearts, Geo. H. Bonner, Caudle, Green Baize, Sandy Man, and R. T. Prout.

Playing with a Bad Partner.—In the face of the immense variety of the style of play one may meet with, the only general advice one can give is, as soon as it becomes apparent that your partner does not understand your own system, observe his play carefully, and endeavour to discover what his peculiarities are; and if you find he has any fixed habits at all, you may in most cases adapt your play to them, and so turn them to your joint advantage. If he cannot, or will not, fall in with your system, you must adopt his, and so endeavour still, in defiance of him, to make some sort of a combination, and avoid the cross purposes which are so beneficial to the adversary. Pole.

A couple of notoriety-seekers were married in a balloon at Topeka, Kansas, recently, and afterwards took a little bridal trip into cloudland.

A man in Rome, Ga., who has been experimenting in extracting sugar from water-melons, finds that they contain seven per cent. of saccharine matter, or pure sugar, and estimates that an acre of good land would produce 34,500 pounds of melons, from which 2,415 pounds of sugar could be extracted, worth, at 10 cents, $241.50.

Our Chess Column.

By Mephisto.

MENTAL [illegible]OGRAPHY FOR AMATEURS.

A [illegible] R. G. and H. C. Brothers.

WE [illegible] the above designation the most appropriate one to [illegible] blindfold play. A game is not carried on without [illegible] by means of memory pure and simple that is, [illegible] of all moves made—but by means of devoting the [illegible] collection of the position as a whole. In blindfold [illegible] player is constantly engaged in taking a photograph of [illegible] without the help of the optic nerve, which usually [illegible] reflection of the board to the brain. It is, therefore, a [illegible], or photograph, which enables a player to play his [illegible] make his combinations, without sight of the board—i.e., [illegible].

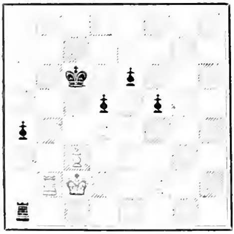
A[illegible] who wish to practice blindfold play, must bear the [illegible] in mind in their practice. A great help in that direction [illegible] obtained by putting up on a board easy positions, and [illegible] at them steadily for a time, try to recollect the position [illegible] of the board.

Messrs. H. C. and R. G. Brothers have sent us a game played [illegible] blindfolded, which extended to fifty-seven moves. It was [illegible] contested throughout. We give the end position:—

Position after Black's 43rd Move.

R. G. Brothers.

Black.



White.

H. C. Brothers.

The game was continued with —

44. P to Kt8	R to R7(ch)	51. R to R7(ch)	K to B3
45. R to Kt sq	R takes P	52. R to R3	K to B4
46. R to QR8	P to B5	53. K to Bsq	K to K5
47. R takes P	P to B6	54. K to Qsq	R to K7
48. R to B6(ch)	K to Q2	55. P to B4	P takes P
49. R to B7(ch)	K to Ksq	56. R to R3	R to K6
50. R to R6	K to B2	57. Resigns.	

Position after White's 20th Move.

Chief Editor—White.

Chief Editor—Black.

In reference to the above position, and our note (7) of the game, published last week, a correspondent writes that White need not have taken the B on his 22nd move, *i.e.*, 20. B takes B(ch), 21. $\frac{\text{P takes B}}{\text{Kt to R4}}$, but played 22. $\frac{\text{B takes RP}}{}$ (see note *d* of Chief Editor's notes). If, then, P takes B, 23. Q takes P, and it looks as though White gets back the piece. If 22. $\frac{}{\text{Kt to KB4}}$ 23. $\frac{\text{Q to Kt5}}{\text{Kt takes B}}$ 24. Q takes Kt.

The proposed move would not have been good. The following would have resulted:—

20. $\frac{}{\text{B tks B(ch)}}$	21. $\frac{\text{P takes B}}{\text{Kt to R4}}$	22. $\frac{\text{B takes RP}}{\text{Kt to KB4}}$	23. $\frac{\text{QtoKt5(}a\text{)}}{\text{B to B5}}$

and White will lose his Queen, whether he takes either Knight or plays Q to Kt4.

(*a*) If 23. B to Kt5, Black wins by 23. $\overline{\text{P to B3}}$.

A correspondent sends us the score of a game played, and asks for our opinion on the following point. In defending a salvio, his opponent played K to K2. Which is the best way of meeting the novelty?

The position is brought about as follows:—

1. $\frac{\text{P to K4}}{\text{P to K4}}$	2. $\frac{\text{P to KB4}}{\text{P takes P}}$	3. $\frac{\text{Kt to KB3}}{\text{P to KKt4}}$
4. $\frac{\text{B to B4}}{\text{P to Kt5}}$	5. $\frac{\text{Kt to K5}}{\text{Q to R5(ch)}}$	6. $\frac{\text{K to K2}}{}$

This move, which is after the fashion of the move introduced by Steinitz in the Vienna game, is obviously bad. The King is safer placed on KBsq, than on K2, because there he is exposed to direct attack, from which he will have to retire either on to Bsq (where he ought to have moved at once), or to Q2, with a very inferior game. A likely continuation would be:—

6. $\frac{}{\text{Kt to KR3}}$	7. $\frac{\text{P to KR3(best)}}{\text{P to B6(ch)}}$	8. $\frac{\text{P takes P}}{\text{P takes P(ch)}}$	9. $\frac{\text{K to Q3}}{}$

with an unenviable position.

SOLUTIONS.

End position, No. 46, p. 139.—The mate is effected in six moves, instead of five, as stated by mistake.

Problem No. 48, by H. A. N., p. 155.

1. K to B4	1. P to Q4(ch)
2. K to Q4	2. KtP moves
3. K takes P (mate).	

No. 49, by Leonard P. Rees, p. 173.

1. Q to KRsq	1. anything
2. mates accordingly.	

GAMES BY CORRESPONDENCE.

M. J. Hooton *v.* Edward Wilson.
J. H. Walker *v.* Henry Freeman.
Jael *v.* J. Carraway.

The first-named player has the move.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess-Editor.*

A. H. G.—Such a book has not yet been published.

John Simpson.—Problem received with thanks. Will be examined. "H. F. L. Meyer's Guide" deals on problems.

Jael.—Game received. Will be examined.

Y. T. K., Z. Y. H., Tessir.—Problem No. 49: If 1. Q takes RP, 1. P to QB4, and there is no mate on the move.

A. A. B.—Thanks for letter. Will be pleased to receive a good game.

Correct Solutions received of Problems No. 47. E. W. Croskey.

No. 48.—Jael, J. B. B., L. P. Moleque, A. J. H., Henry Freeman, A. A. Dent, G. W., K. B. Kimpton, John Simpson, H. V. T.

No. 49. C. W. Croskey, Henry Freeman, A. A. Dent, John Simpson, H. V. T., K. B. Kimpton, A. J. H., Jael, Herbert Jacobs, Charles Hartley, J. Carraway, Belmont, Moleque.

No. 50.—G. W., H. V. T., John Simpson, J. K. Milne, E. J. J., Berrow, Geo. H. Bonner, C. W. Croskey, A. J. H., J. B. B., Belmont, J. P. Clayton, A. W. Cooke, J. J. Dorrington. Belmont asks is life long enough for four movers?

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, SEPTEMBER 1, 1882.

CONTENTS OF No. 44.

Science and Art Gossip.

REMARKABLE mirages are frequently observed in the southern and central parts of Sweden, and a specially noteworthy one was seen recently over the Lake of Orsa. A number of large and small steamers were reflected as if plying on the lake, and the smoke could even be seen rising from their funnels. Later on, the scene changed to a landscape, the vessels now taking the form of islands in the lake, covered with more or less vegetation, and at last the mirage dissolved itself in a haze. The phenomenon, which lasted from four to seven o'clock p.m., is said to have furnished a most magnificent spectacle.

SOME speculative merchants in Bergen have obtained the right of cutting block-ice for export from the enormous glacier, Fon or Svartisen (69° 25′ north, 35° 15′ east, on the Senjen Island, in Norway, the northernmost of its kind in Europe. The quality of the ice is good. The glacier is about 120 square miles in extent, and the distance from its border to the sea is only a couple of miles. A similar attempt to utilise the glacier Folgefonden was made some years ago, but failed, owing to the blocks in their downward course breaking through the wooden conductor in which they were slid down to the sea.

PROFESSOR CHRISTIAN exhibited at a recent meeting of the Physical Society of Berlin, a new method of preservation by which organic bodies are coated galvanoplastically. A mulberry-leaf, a crab, a butterfly, a beetle, the brain of a rabbit, a rosebud, and other objects were plated with silver, gold, or copper, and showed all details of their outer form, down to the finest shadings. The objects to be preserved are first put into a solution of silver nitrate in alcohol, then dried and treated with sulphuretted and phosphuretted hydrogen, when they form good conductors, which, brought in the usual way into the galvanoplastic bath, can be coated with any desired thickness of a metallic deposit.

ONE of the hardest woods in existence is that of the desert ironwood tree, which grows in the dry wastes along the line of the Southern Pacific Railroad. Its specific gravity is nearly the same as that of lignum vitæ, and it has a black heart so hard, when well seasoned, that it will turn the edge of an axe, and can scarcely be cut by a well tempered saw. In burning it gives out an intense heat.

A SULPHUR mine in Sicily was recently set on fire in a very curious manner. A waggon loaded with sulphur was being drawn up an incline, when the rope supporting it broke, and the waggon rushed back into the mine at a frightful speed. The rapid motion developed heat enough to set on fire the highly combustible ore, and the flames spread so quickly through the mine that thirteen workmen were unable to escape, and thirty or forty others were seriously injured.

A REMARKABLE sand-storm, accompanied by an intensely cold temperature, raged in Iceland for two weeks during the spring. The air was so filled with dry fine sand that it was impossible to see for more than a short distance, and the sun was rarely visible, though the sky was clear of clouds. Nobody ventured out of his house except upon matters of most urgent necessity, and many who were exposed to the storm were frozen. The sand penetrated into the houses through the minutest crevices. It was found mixed with articles of food and drink, and every breath drew it into the lungs. Thousands of sheep and horses died.

DR. SCHWEINFURTH has succeeded in freshening and preserving many of the leaves and flowers from garlands found on the breasts of mummies discovered last year at Deir el Bahari. A small herbarium is thus formed from plants which grew thirty-five centuries ago. A number of the species have been identified with those now found in the East.

THE call for an electrical sheep-shearer made by a New Zealand correspondent in *The Scientific American* some months ago, has apparently brought forth fruit in an unexpected quarter. It is now announced that the head of the Hudson Bay Fur Company, Sir Curtis Lampson, has applied electricity to the trimming of sealskins. The skin is "fed" over a knife-edge bar, above which is stretched a fine platinum wire, which, raised to a white heat by an electric current, meets the longer hairs which rise above the under fur, and mows or burns them down.

AT a recent meeting of the Paris Académie a paper was read on a use of electrolysis in dyeing and printing, by M. Goppelsrœder. For example, he impregnates tissues or paper with an aqueous solution of chlorhydrate of aniline, puts it on a non-attackable metal plate, which he connects with one pole of a battery or small dynamo. On the tissue or paper is placed a second metal plate having a design in relief and joined to the other pole; on pressure and passage of the current the design is reproduced. A modification of the method gives chemical discharge of colour. The current, again, is used to prepare vats of indigo, aniline black, &c., the hydrogen which arises at the negative pole being utilised. It is also used to prevent oxidation of colours in printing.

THROUGH an excess of current accidentally brought about, the wires for conducting the electricity for illuminating the stage of the Paris Opera lately became red-hot, burnt their covering of gutta-percha, and caused a fire, which, however, was speedily extinguished with a few buckets of water. Such events as these are of the class that result from what must be culpable carelessness.

The longest span of wire in the world is used for a telegraph in India, over the river Kistnah, between Bezorah and Seetanagrum. It is more than 6,000 feet and is stretched between two hills each 1,200 feet high.

We are informed that the British Electric Light Company have recognised the fact of their infringement of the Edison patents for electric lighting by paying a substantial sum as royalty to the Edison Electric Light Company Limited.

We are given to understand that "the School of Telegraphy and Electrical Engineering," which has been carrying on its work at 4, George-street, Hanover-square, under the less elegant title of "the School of Submarine and Military Telegraphy, Telephony, Electric Light, and Technical Instruction Company," has removed to 12, Princes-street, Hanover-square, and that the school re-opens after the summer vacation, on Sept. 1.

Asbestos Paint.—A public demonstration of the United Asbestos Company's fire-proof paint, as a preventive of fire, took place recently on a piece of vacant ground in Whitehall-place, adjoining the Thames Embankment. The demonstration had been arranged with special reference to the inquiries now being made respecting the fire-proof qualities of this paint. For the purpose of testing these, two wooden buildings, constructed in the form of theatres, one of them coated with ordinary paint and the other with asbestos paint, were filled with shavings and fired at the same moment, and, in the course of a few minutes, the first named was a mass of blazing ruins, while the only sign of injury shown by the asbestos paint was that it had been blistered with the heat. A second experiment was then made for the purpose of showing the efficacy of a draught-proof curtain, in the event of a fire breaking out upon the stage, in preventing the spread of flames. The experiments were generally regarded as satisfactory in favour of the asbestos paint.

THE BRITISH ASSOCIATION.

By the Editor.

THE tone in which the meetings of the British Association are almost always spoken of by the press, weekly as well as daily, is one of such unmixed gratulation that we hesitate to express what, nevertheless, is our carefully formed opinion to a contrary effect. We see and hear it stated on all sides that these annual visits of the Association to important centres of the population stir up throughout the country an enthusiasm for science which otherwise would not have existed; and the Association itself freely claims as its own work that growth of scientific study which certainly has continued during a large portion of the existence of the British Association. In his opening address this year, Dr Siemens even implied that "those special societies which have sprung into existence since the foundation of the British Association" (the Physical, Geographical, Meteorological, Linnæan, &c., &c.) owe their existence in reality to its influence. Nay, the very development of scientific journalism which began before the founding of the Association, and has done its work in creating and fostering it, is spoken of by Dr. Siemens as part of the work of a body whose meetings occupy but a small portion of each year, and whose work seems to those who contemplate it from the outside, with some apprehension of the real wants of unscientific people, to be quite incapable of producing the effects thus in all good faith attributed to it.

When we come to analyse the actual proceedings of the British Association, at any of its meetings, we cannot but recognise the fact that these holiday gatherings of science can scarcely develope in any useful way (except by the sort of scientific tax levied on the towns visited) the advancement of science. Putting on one side the work of the various sections in as far as it is done by men of science for men of science—which amounts, indeed, chiefly to the kind of work known as "mutual admiration"—what particular effect is likely to be produced on the general public by what comes before them at these gatherings?

At most of them, you will be told, the presidential address is altogether the most interesting part of the affair: at others, addresses on subjects of special interest may invite and attract attention; but nearly always there is a great falling off in attention and attendance after the presidential address. Now the address of the President is nearly always a recapitulation of successes achieved up to the time of the meeting, and chiefly during the preceding year. It may be an able literary work, covering skilfully the whole ground of science, like Sir John Lubbock's address last year at York; it may be a brilliant lecture, such as Professors Tyndall or Huxley have delivered, with so much that is striking—in both senses of the word—that the hearers really are interested (but not more than they would be in a special lecture given by skilful speakers, as are Tyndall and Huxley); or it may be a recapitulation wanting both in oratorical and literary skill, yet still a fair general account of what has been done in the past year; or, lastly, it may be a recapitulation by a specialist of such work only as has been done in his special department. But, in any and every case, in what way can a recapitulation of scientific progress possibly interest either the scientific or the unscientific? The scientific know all about it; the unscientific cannot possibly care at all about it, presented in a crude and condensed form (as it must be in a recapitulation). Such interest as a Lubbock may excite by literary ability in an address, or a Tyndall or a Huxley by lecturing skill, is in reality outside the task specially to be performed in these addresses.

Thus, during Dr. Siemens' address—to take a concrete example, a fair average sample of these things—the audience could be readily classified by an observer of any keenness, into two portions: those who were wearied because they knew already all that the speaker told them, and those who were wearied because they could make nothing of such statements as were flung at their heads, as, for instance, that "a Watt expresses the rate of an Ampère multiplied by a Volt, while a horse-power is 746 Watts, and a Cheval de Vapeur 735." To use the charmingly simple mode of illustration which Dr. Siemens beamingly bestowed on his audience, as something sweet and poetical which they would like to remember, unscientific minds must not be crossed at a sharp angle by scientific statements, but "looked upon as the asymptotes to be approached indefinitely by the hyperbolic course" of scientific exposition.

I am not sure but that the most encouraging feature of the presidential address was the effect produced in the "place of skulls" on the platform. If the scientific part of the audience had been interested, the unscientific might have despaired indeed; "*if this* is what interests men of science," they might have thought, "how *can* men of science have anything to say which would interest us." But when one bald pate after another was bowed in sleep, and of the others on the platform scarce a tenth tried to hide the effects of a "twice" (or twenty times) "told tale," the rest of the audience might have gathered comfort from the thought that science *must* have something better in store than this dried food. As a matter of fact many of the audience seemed to have no such consoling hope, and during the last half of the address, the cries of the coachmen were heard by a much larger section of the audience than the voice of the president. It is not difficult to understand why, during the rest of the Association week, *soirées* and excursions attract more than sectional meetings and evening discourses. We venture to express our strong conviction that for months if not years to come, the interest taken by Southampton in science will be considerably less than it has been during the past few years.

THE PRESIDENT'S ADDRESS.

It will be understood that thus viewing the mere recapitulation of well-known facts, we do not propose to trouble our readers with a full report of an address, nine-tenths of which related to matters long since sufficiently dealt with in these columns. We give in full only those portions of the address which we think likely to prove of interest. The words of one who has done much to advance science must always be worth hearing when he is dealing with his own subject, or expressing his own views; and even in an address intended to be a recapitulation, a man of original thought cannot at times avoid his own subjects or the expression of original ideas.

After touching on the deaths of Charles Darwin in the fulness of years, and of Professor Balfour, when his work was but fairly entered upon (reference to the more recent loss of Professor Stanley Jevons might not ungracefully have been added), Dr. Siemens referred to the past and future of the British Association—to the past as encouraging, to the future as full of promise. He then spoke of the harmony which should exist between theory and practice in science. "The advancement of the last fifty years," he said, "has, I venture to submit, rendered theory and practice so interdependent that an intimate union between them is a matter of absolute necessity for our future progress. Take, for instance, the art of dyeing, and we find that the discovery of new colouring matters derived from waste products, such as coal-tar, completely changes its practice, and renders an intimate knowledge of the science of chemistry a matter of absolute necessity to the practitioner. In telegraphy and in the new arts of applying electricity to lighting, to the transmission of power, and to metallurgical operations, problems arise at every turn, requiring for their solution not only an intimate acquaintance with, but a positive advance upon, electrical science, as established by purely theoretical research in the laboratory. In general engineering the mere practical art of constructing a machine so designed and proportioned as to produce mechanically the desired effect would suffice no longer. Our increased knowledge of the nature of the mutual relations between the different forms of energy makes us see clearly what are the theoretical limits of effect; these, although beyond our absolute reach, may be looked upon as the asymptotes to be approached indefinitely by the hyperbolic course of practical progress, of which we should never lose sight. Cases arise, moreover, where the introduction of new materials of construction, or the call for new effects, renders former rules wholly insufficient. In all these cases practical knowledge has to go hand in hand with advanced science in order to accomplish the desired end. Far be it from me to think lightly of the ardent students of nature, who, in their devotion to research, do not allow their minds to travel into the regions of utilitarianism and of self-interest. These, the high priests of science, command our utmost admiration; but it is not to them that we can look for our current progress in practical science, much less can we look for it to the 'rule of thumb' practitioner, who is guided by what comes nearer to instinct than to reason. It is to the man of science who also gives attention to practical questions, and to the practitioner who devotes part of his time to the prosecution of strictly scientific investigations, that we owe the rapid progress of the present day, both merging more and more into one class, that of pioneers into the domain of nature."

He soon after adverted to the diversity of usage in this country and the Continent as respects weights and measures:—"As regards the measures of length and weight, it is to be regretted that this country still stands aloof from the movement initiated in France towards the close of last century; but, considering that in scientific work metrical measure is now almost universally adopted, and that its use has been already legalised in this country, I venture to hope that its universal adoption for commercial purposes will soon follow as a matter of course. The practical advantages of such a measure to the trade of this country would, I am convinced, be very great, for English goods, such as machinery or metal rolled to current sections, are now almost excluded from the Continental market, owing to the unit measure employed in their production. The principal impediment to the adoption of the mètre consists in the strange anomaly that, although it is legal to use that measure in commerce, and although a copy of the standard mètre is kept in the Standards Department of the Board of Trade, it is impossible to procure legalised rods representing it, and to use a non-legalised copy of a standard in commerce is deemed fraudulent."

Dr. Siemens spoke next at considerable length on the subject of electrical measurement—suggesting the use of two further units—a unit of magnetic quantity to be called a "Weber" (Clausius's suggestion), and a unit of magnetic power to be called a "Watt." His remarks on electrical energy, on telegraphy, the telephone, and the electric railway, contained nothing which would be new to our readers, or which will not presently be dealt with in a more readily understood manner in these columns. In addition to what has already appeared in KNOWLEDGE respecting Dr. Siemens' experiments on the influence of the electric light upon vegetation, the following may be added as of interest, "In experimenting upon wheat, barley, oats, and other cereals sown in the open air, there was a marked difference between the growth of the plants influenced and those uninfluenced by the electric light. This was not very apparent till towards the end of February, when, with the first appearance of mild weather, the plants under the influence of an electric lamp of 4,000 candle power placed about five mètres above the surface, developed with extreme rapidity, so that by the end of May they stood above 4 ft. high, with the ears in full bloom, when those not under its influence were under 2 ft. in height, and showed no sign of the ear."

Dr. Siemens next referred to electric railways, remarking that while they possess great advantages over horse or steam power for towns; in tunnels, and in all cases where natural sources of energy, such as waterfalls, are available, it would not be reasonable to suppose that they will (in their present condition) compete with steam propulsion upon ordinary railways. What followed on the definition of metals from their solutions, on electric lighting, and on secondary batteries, would not be new to readers of KNOWLEDGE. Speaking of by-products in gasworks—a subject on which Mr. Mattieu Williams has already written to these pages Dr. Siemens made the following remarkable statements:—

"The total annual value of the gasworks by-products may be estimated as follows:—Colouring matter, £3,370,000; sulphate of ammonia, £1,947,000; pitch (325,000 tons), £[illegible]; creosote (25,000,000 gallons), £[illegible]; crude carbolic acid (1,000,000 gallons), £[illegible]; gas coke, 4,000,000 tons (after allowing [illegible] tons consumption in working the retorts), at [illegible], £[illegible]; total, £8,370,000. Taking the coal used, [illegible] tons, at 12s., equal £5,100,000, it follows that the by-products exceed in value the coal used by very nearly £3,000,000. In using raw coal for heating purposes these valuable products are not only absolutely lost to us, but in their stead we are favoured with those semi-gaseous by-products in the atmosphere too well known to the denizens of London and other large towns as smoke. Professor Roberts has calculated that the soot in the pall hanging over London on a winter's day amounts to fifty tons, and that the carbonic oxide, a poisonous compound, resulting from the imperfect combustion of coal, may be taken as at least five times that amount. Mr. Aitken has shown, moreover, in an interesting paper communicated to the Royal Society of Edinburgh last year, that the fine dust resulting from the imperfect combustion of coal is mainly instrumental in the formation of fog, each particle of solid matter attracting to itself aqueous vapour; these globules of fog are rendered particularly tenacious and disagreeable by the presence of tar vapour, another result of imperfect combustion of raw fuel, which might be turned to much better account at the dye works. The hurtful influence of smoke upon public health, the great personal discomfort to which it gives rise, and the vast expense it indirectly causes through the destruction of our monuments, pictures, furniture, and apparel are now being recognised, as is evinced by the success of recent Smoke Abatement Exhibitions. The most effectual remedy would result from a general recognition of the fact that wherever smoke is produced fuel is being consumed wastefully, and that all our calorific effects, from the largest down to the domestic fire, can be realised as completely, and more economically, without allowing any of the fuel employed to reach the atmosphere unburnt. This most desirable result may be effected by the use of gas for all heating purposes with or without the addition of coke or anthracite."

We must not pass over references to the probable future improvement of our merchant steam shipping by the use of more perfect engines (gas-engines), of half the weight of the present, and working with only half the present expenditure of fuel; of the new kind of steel (mild steel) introduced by the Admiralty in 1876-78, by which 20 per cent. of the weight of a ship's hull can be saved, of double [illegible] bulkheads for the division of a ship's [illegible]. "With such improvements," said Dr. Siemens, "the [illegible] steam vessel (or, rather, [illegible]) sufficient to restrict the use of [illegible] of Southampton and neighbouring ports."

After [illegible], and recent improvements [illegible], Dr. Siemens referred to the proposed [illegible] of Panama, and the suggested [illegible]. He spoke of [illegible] and the St. Gothard [illegible] proposed tunnel below the English Channel, [illegible] respecting [illegible]. After [illegible] other [illegible] works, suggested [illegible] progress, Dr. Siemens spoke of the improvement of explosive agents, cannon, &c.

His remarks on the phenomena of electric discharges were of considerable interest. "By the discharge of high tension electricity through tubes containing highly-rarefied gases (Geissler's tubes), phenomena of discharge were produced which were at once most striking and suggestive. The Sprengel pump afforded a means of pushing the exhaustion to limits which had formerly been scarcely reached by the imagination. At each step the condition of attenuated matter revealed varying properties when acted upon by electrical discharge and magnetic force. The radiometer of Crookes imported a new feature into these inquiries, which at the present time occupy the attention of leading physicists in all countries. The means usually employed to produce electrical discharge in vacuum tubes was Ruhmkorff's coil; but Mr. Gassiot first succeeded in obtaining the phenomena by means of a galvanic battery of 3,000 Leclanché cells. Dr. De La Rue, in conjunction with his friend Dr. Hugo Müller, has gone far beyond his predecessors in the production of batteries of high potential. At his lecture 'On the Phenomena of Electric Discharge,' delivered at the Royal Institution in January, 1881, he employed a battery of his invention consisting of 11,400 cells (14,832 volts), which gave a current of 0·051 ampère, and produced a discharge at a distance of 0·71 inch between the terminals. During last year he increased the number of cells to 15,000 (15,450 volts), and increased the current to 0·4 ampère, or eight times that of the battery he used at the Royal Institution. On the occasion of his lecture, Mr. De La Rue produced, in a very large vacuum tube, an imitation of the aurora borealis; and he has deduced from his experiments that the greatest brilliancy of aurora displays must be at an altitude of from thirty-seven to thirty-eight miles—a conclusion of the highest interest, and in opposition to the extravagant estimate of 281 miles at which it had been previously put."

It was hardly to be expected that the eminent electrician should not make an attempt to galvanise into the semblance of life his defunct theory of the conservatism of solar energy. In some way peculiar to the inventors of impossible theories, he finds evidence for his speculations where others recognise decisive (though in this case little needed) evidence against it. The long extensions of the corona not far from the equatorial regions, seen during the American eclipse of 1878, if constantly visible, would correspond with the theory. But if the theory were true, they should be always visible. During the Egyptian eclipse last May they were absent; but "No matter," Dr. Siemens thinks; "the outflowing equatorial streams I suppose to exist could only be rendered visible by reflected sunlight, when mixed with dust produced by exceptional solar disturbances, or by electric discharge; and the occasional appearance of such luminous extensions would serve only to disprove the hypothesis entertained by some that they are divided planetary matter, in which case their appearance should be permanent"—it being, he might as soundly have added, a well-known property of planetary matter to remain permanently at rest.* "Stellar space filled with such matter as hydrocarbon and aqueous vapour would establish a material continuity between the sun and his planets, and between

* The argument is this. If there were the constant streaming forth from the equator imagined by Dr. Siemens, the equatorial streams should always be there. If there is cosmical dust travelling round and about the sun in orbits of all degrees of eccentricity, not only would eclipses seen in different months differ much *inter se*—but owing to the constant motion of the cosmic matter, so also would eclipses seen in different years in the same month. Dr. Siemens thinks just the reverse—doubtless having some reasons. Unfortunately he omits to mention them.

the innumerable solar systems of which the universe is composed." We are not told what would be the extreme tenuity of such matter necessary that even the nearest sun should show his light through twenty millions of millions of miles of it, or of what possible benefit the action of rays on matter midway between our own sun and the nearest sun (*i.e.* matter ten billions of miles from either) could possibly be to the systems circulating either around our own sun or around Alpha Centauri (and the like for other stellar neighbours not quite so near). Still,—No matter. In a vague sort of way, we may be able—at least Dr. Siemens says we may—"to trace certain conditions of thermal dependance and maintenance, in which we may recognise principles of high perfection, applicable also to comparatively humble purposes of human life. So then" (though the *sequitur* may not be very obvious to all, the idea itself is worthy of all praise), "we fellow-workers in every branch of science my exhort one another in the words of the American bard who has so lately departed from among us:—

> Let us then be up and doing,
> With a heart for any fate;
> Still achieving, still pursuing,
> Learn to labour and to wait.

Mathematical Section.

From the address by Lord Rayleigh, president of this section, we extract the following well-considered remarks:—"In one important part of the field of experimental science, where the subject-matter is ill understood, and the work is qualitative rather than quantitative, success depends more directly upon sagacity and genius. It must be admitted that much labour spent in this kind of work is ill directed. Bulky records of crude and uninterpreted observations are not science, nor even in many cases the raw material out of which science will be constructed. The door of experiment stands always open; and when the question is ripe, and the man is found, he will, nine times out of ten, find it necessary to go through the work again. Observations made by the way, and under unfavourable conditions, may often give rise to valuable suggestions, but these must be tested by experiment in which the conditions are simplified to the utmost, before they can lay claim to acceptance. When an unexpected effect is observed, the question will arise whether or not an explanation can be found upon admitted principles. Sometimes the answer can be quickly given, but more often it will happen that an assertion of what ought to have been expected can only be made as the result of an elaborate discussion of the circumstances of the case, and this discussion must generally be mathematical in its spirit, if not in its form. This is shown by the investigations of the well-known experiment of the inaudibility of a bell rung in vacuo. Leslie made the interesting observation that the presence of hydrogen was inimical to the production of sound. Years afterwards Stokes proved that what Leslie observed was exactly what ought to have been expected. The addition of hydrogen to attenuated air increases the wave-length of vibrations of given pitch. Examples such as this, which might be multiplied *ad libitum*, show how difficult it often is for an experimenter rightly to interpret his results without the aid of mathematics. The experimenter himself should be in a position to make the calculations to which his work gives occasion. I should like to see a course of mathematical instruction arranged with especial reference to physics, within which those whose bent was plainly towards experiment might, more or less completely, confine themselves. Probably a year spent judiciously on such a course would do more to qualify the student for actual work than two or three years of the usual mathematical curriculum. On the other side, it must be remembered that the human mind is limited, and that few can carry the weight of a complete mathematical armament without some repression of their energies in other directions. The different habits of mind of the two schools of physicists sometimes lead them to the adoption of antagonistic views on doubtful and difficult questions. The tendency of the purely experimental school is to rely almost exclusively upon direct evidence. The tendency of the mathematician is to overrate the solidity of his theoretical structures, and to forget the narrowness of the experimental foundation upon which many of them rest."

Chemical Section.

In the course of his address to this section by Professor Liveing, the following interesting remarks were made on two matters which have recently been the subject of controversy, now regarded, however, as disposed of. "When we find that the combinations of particles of the same kind are as definite as those of particles of different kinds, and that they are both subject to precisely the same mechanical laws, we are hardly justified in regarding the forces by which they are produced as essentially different. To get rid of a gratuitous hypothesis in chemistry must be a great gain. But, it may be asked, why stop here? Why may not the chemical elements be further broken up by still higher temperatures? *A priori*, and from analogy, such a supposition is extremely probable. The notion that there is but one elementary kind of matter is at least as old as Thales, and underlies Prout's hypothesis that the atomic weights of our elements are all multiples of that of hydrogen. This famous hypothesis has gone up and down in the scale of credibility many times during the present century. Quite recently," said the speaker, "a fresh revision of the combining weights has been made on the other side of the Atlantic by Professor F. W. Clarke, who, on the whole, concluded that Prout's hypothesis, as modified by Dumas, is still an open question—that is to say, his final numbers differ from whole multiples of a common unit by quantities which lie within the limits of errors of observation and experiment. Let us turn again to the evidence afforded by our most powerful instrument for inspecting the inner constitution of matter, the spectroscope. A few years ago Mr. Lockyer supposed that the coincidence of rays emitted by different chemical elements, particularly when those rays were developed in the spark of a powerful induction coil and in the high temperatures of the sun and stars, gave evidence of a common element in the composition of the metals, which produced the coincident rays. Later results cannot fail to shake our belief in the existence of any common constituent of the chemical elements; but it does not touch the evidence which the spectroscope affords us that many of our elements, in the state in which we know them, must have a very complex molecular structure. The spectroscope has in the last few years revealed to us several new metals. Why may there not be elements which, while they differ as little in atomic weight as do nickel and cobalt, are, on the other hand, so similar to one another in all characters that their chemical separation is a matter of the greatest difficulty, and their difference only distinguishable by the spectroscope? The spectra may be thought to suggest so much, and how shall we decide the question? At any rate, the complications of the spectroscopic problem can only be unravelled by the united efforts of chemists and physicists, and by the exercise of extreme caution." Prof. Liveing said he could not dismiss the subject of chemical dynamics without alluding to the ingenious theory by which the President of the Association has proposed to account for the conservation of solar energy. Commenting on this, he remarked that, "if it be true that the compounds are decomposed by absorbing the sun's rays, we ought to find in our atmosphere the products of decomposition; we ought to find it in free hydrogen, carbonic oxide, and acetylene, or some other hydrocarbons. The hydrogen, from its small specific gravity, would not be concentrated in the lower regions of our atmosphere in the same proportions as the denser gases, but carbonic oxide and hydrocarbons could not fail to be detected in the air if they formed any sensible proportion of the gases in interplanetary space."* Dewar and he had recently shown that if nitrogen already in combination—as, for instance, ammonia—be brought into a hydrocarbon flame, cyanogen is produced in sufficient amount to give in a photograph (though not so as to be directly visible) the characteristic spectrum of cyanogen as it appears in the comet. It is therefore, he said, "no longer necessary to make any other supposition to account for the cyanogen bands in the spectra of comets, than that ammonia, or some such compound of nitrogen, is present as well as hydrocarbons in a state of ignition." Quite recently Dr. Huggins has observed that the principal comet of this year has a spectrum of an entirely different character, but he is not yet able to say to what elements or compounds it is probably due. The notion that comets may bring us news of distant parts of stellar space, towards which our system is driving, where the atmosphere is not like ours—oxygen and nitrogen—but hydrogen and hydrocarbons, may fascinate the fancy, but the laws of occlusion oblige us to think that the meteorites have not merely wandered through an attenuated atmosphere of hydrogen and hydrocarbons, but have cooled in a much denser atmosphere of those substances, which we can only conceive as concentrated by the presence of a star or some large aggregation of matter. No comet on visiting our system a second time can repeat the exclusion of its occluded gases unless its store has been replenished in the interval: and it will be interesting to see, when Halley's comet next returns, whether it shines only by a reflected light or gives us, like so many others, the banded spectrum of hydrocarbons.

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

By Amelia B. Edwards.

VII.—THE TWIN CITIES, PA-TUM AND PA-RAMESES.

Having endeavoured to show how the foregoing monumental and Bible dates are capable of being brought into concordance, and how the chronological problem (which some have pronounced to be insoluble) ceases to be formidable when carefully tabulated, I now propose to examine, not the chronological, but the historical evidence which connect Rameses II. with the period of the oppression.

M. de Rougé's identification, it will be remembered,† is founded in the first place on the name of the city which was built by the forced labour of the Hebrew settlers; and, in the second place, on the length of the reign of Rameses II.

* [illegible] Professor [illegible] under [illegible] theory already [illegible] physical and [illegible] reasoning is worth observing.

† See Knowledge No. 35, Vol. II., p. 2.

Now, if it were possible to identify the site of this city (Raamses), or, better still, the sites of both the "treasure-cities" specified in the Bible, and if it could also be shown beyond reasonable doubt that they were indeed built by Rameses II., then the correspondence between Hebrew and Egyptian evidence would amount to positive proof.

The Hebrew evidence is brief and precise:—"And they built for Pharaoh treasure-cities, Pithom and Raamses." (Exodus i., 11.)

That is to say, they built a treasure-city (in Egyptian, a *Bekhen*) called Pa-Tum, or Pi-Tum, and a treasure-city called Pa-Rameses, or Pi-Rameses; the one signifying the "*Pa*," or abode, of Tum, and the other the "*Pa*," or abode, of Rameses. Tum was a solar Deity chiefly worshipped in the East of Delta, where lay the land of Goshen. Rameses is a royal and divine name, meaning the Son of Ra. It was borne as a proper name by two Pharaohs of the XIXth Dynasty, and also by a long succession of Pharaohs of the XXth Dynasty; but in the hands of Rameses II. of unbounded arrogance, it became something more than a mere affiliation of the King to the Sun-god Ra. It became the name of a living and personal God, Rameses Mer-Amen, Pharaoh and deity, self-elected in the flesh to the circle of the Gods. In this sense, Pa-Rameses, no less than Pa-Tum, was a city dedicated to a deity: and we may be certain that Pa-Tum and Pa-Rameses each contained a temple in honour of the tutelary God of the place. Nor is the juxtaposition of these two names, Pa-Tum and Pa-Rameses, altogether fortuitous. The God Ra and the God Tum were closely related in the system of Egyptian solar myths; the one representing the diurnal, and the other the nocturnal, sun. Or, in other words, Ra was the risen sun, the giver of life and light, while Tum was the setting sun, precursor of the shades of night. They were even said (as M. Grébaut has shown in his celebrated translation of a "Hymn to Amen-Ra") to engender each other—day giving birth to night, and night becoming in turn the parent of day. And it is in this sense, as symbolising life, death, and resurrection, that we frequently find Ra and Tum represented together on funereal tablets.

Pa-Rameses and Pa-Tum were therefore twin cities, sanctified by the twin temples (the "Abodes" of Tum and Rameses) after which they were named; the cult of the one temple being the complement of the cult of the other. Hence it is reasonable to conclude that Pa-Rameses and Pa-Tum were situate not very far apart.

The question next arises—where *were* they situate? To this it may be answered that they were undoubtedly situate in the land of Goshen; that same land which, in the XLVIIth chap. of Genesis is called indifferently both Goshen and Rameses. That it should be called "Rameses" thus early in the sacred narrative is in itself a very significant fact. It shows that at the time when the Mosaic books were compiled—or, in modern phrase, edited—this province was no longer exclusively called by the name of its ancient capital, Gessen, or Goshen, but was also familiarly known by the name of the Pharaoh who ordained the building of the treasure-cities. It also shows that it is in this district of Goshen, or Rameses, that we must look for the site of that *Bekhen* called "Raamses," which is the object of our present inquiry.

There has been a great diversity of opinion among Egyptologists as to the site of this famous *Bekhen*, the difficulty of identifying which is considerably increased by the fact that it was the supreme will and pleasure of Rameses II. to give his name, not only to every new city of his own creation, but even to cities built long before his time and already famous in history. Thus at Aboo

Simbel, to the town which sprang up in connection with the great rock-cut temples of Ra and Hathor, this Pharaoh gave the name of Pa-Rameses. To a town—or perhaps a new out-lying suburb—south of Memphis, he gave the name of Pa-Rameses. To at least three towns in the Delta, he gave the name of Pa-Rameses. And Brugsch-Bey some years since discovered a hieroglyphic text which shows that he even imposed the name of Pa-Rameses upon the ancient and magnificent city of Zoan. Basing his opinion upon this text, Brugsch maintains that Zoan (in Egyptain, Tān; in Greek, Tanis; in modern Arabic. Sān) and the "Raamses" of the Bible are one and the same. M. Chabas proposes Pelusium, a lonely mound in the midst of a waste of marshes by the sea-shore, about twenty miles due east of Port Said. Others have suggested Heliopolis (On), Babloon (old Cairo), and Toossoom, on the Suez Canal. Lepsius and Ebers, both of whom have personally inspected the locality, give their verdict in favour of a mound locally known as Tel-el-Masroota, or Maskhuta, better known to travellers in Egypt as the station called "Ramsis," which is the last station but one on the line between Cairo and Ismailiah.

THE AMATEUR ELECTRICIAN.

ELECTRICAL MEASUREMENT—II.

Following upon what was said in the preceding article, electromotive force may be defined as "a difference of electrical potential, in virtue of which electricity is transferred from one place to another." If, then, we connect two bodies of equal potential, there being no difference between their potentials, there will be no electromotive force, and consequently no current. If we were to connect two boilers with steam at a high pressure, by means of a pipe, no movement or reduction of pressure could take place. The pressure is there, nevertheless, and were either of the boilers but partially exhausted, the energy laid up in the other would develope an equilibriating flow which would continue until the unequal pressure no longer existed. In the battery cell a difference of potential is maintained by the series of chemical changes which help to upset the equilibrium as quickly as it is established. This action is well described by Tyndall, who says, "An incessant effort, never fully satisfied, is made to establish electric equilibrium; the incessant renewal of the effort maintains the electric current." In dynamo-electric machines a difference of potential is maintained by the rotation of the armature. Returning to our connected boilers, it should be apparent to all that the pressure in both will be the same, whatever may be their relative capacities: that is to say, if one is twice the size of the other, the pressure in the smaller one will be exactly the same as in the large one, but the amount or weight of steam varies in proportion to the capacities.

The same principle is seen in electricity. The intensity, or, more correctly speaking, the electro-motive force, of a battery is solely dependent upon the sum of the differences of potential, and is quite independent of the size, weight, or shape of the plates. A little reflection will make clear the fact that the force or intensity of the action, say, of sulphuric acid on a single atom of zinc, is identical with that exerted upon a million atoms. Discard for a moment, if you like, the electrical side of the question, and regard only the affinity existing between the metal zinc and the acidulated water, and the same conclusion will enforce itself. The easiest way, perhaps, of making this point clear is by analogy. Let us liken the action to a battle between equally numerous armies, in which every combatant fights his hardest, and supposing the men on each side to be all of the same strength, and filled with exactly the same desires towards their opponents, it is clear that the struggle will be as strong between any two opposing men as it will be between the whole of the two contending armies. The numerical equality assumed in this simile is warrantable, because however much water we may use, a single atom of zinc can enter into union with but one atom of oxygen (one of the two constituents of water). What, then, is the advantage of increasing the size of our plate? If there is nothing gained by so doing, a pin's point of zinc opposed to a pin's point of copper should give us the highest attainable intensity. The advantage gained is somewhat similar to that which would result from increasing the size or capacity of our boiler. We generate more electricity, a greater amount or quantity of it, a current capable of doing more work of certain kinds. We shall see more clearly what this means when we take into consideration the applications of Ohm's law.

The electro-motive force imparted to a current by any particular source of electricity is a matter of great importance, and becomes a factor requiring careful and accurate measurement. The unit of E.M.F. (electro-motive force) is called a *volt*, in honour of Volta, one of the pioneers of electric Science.

A committee, appointed in Paris last year, is now occupied in settling the method of determining the value of a volt; but even were this task accomplished, the term involves so many complex calculations, that before we could give a satisfactory definition, we should have to monopolise two or three whole numbers of Knowledge. Approximately, the volt is equal to a Daniell cell in good condition. Consequently, this battery is generally used as a standard of E.M.F.

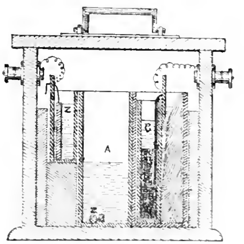


Fig. 1.

Fig. 1 represents the form of standard cell used in the Postal Telegraph Service. It is easily constructed, very reliable, constant, and altogether may be fairly regarded as the best form. In a wooden trough or case are three chambers. The left hand one contains water, in which a zinc plate (Z) is suspended. The right hand chamber contains the flat, porous pot, immersed in water. A copper plate (C) and sulphate of copper crystals are placed in the porous pot. The centre chamber (A) is about half filled with a semi-saturated solution of sulphate of zinc, in which the zinc plate and porous pot are immersed when the battery is in use. A small rod of zinc (z) is placed in a small compartment at the bottom of the chamber, its function being to displace any copper which may get into the zinc solution, thereby keeping that solution clear, and so maintaining the constancy of the cell. The two side chambers are called "idle" cells, as the zinc plate and porous pot are placed in them when the cell is not working. The E.M.F. of this standard is a little more than one volt — viz., 1·07.

A POISONOUS LIZARD.

By Dr. Andrew Wilson, F.R.S.E., F.L.S.

THE possession of a poison apparatus is by no means a common event in the animal world; although, indeed, very few animals are possessed of offensive means of this kind. Low down in the animal scale we find the jelly fishes, sea anemones, and their neighbours, possessing these curious stinging organs called "thread-cells," the virulence of which many an unwary bather has experienced to his cost. Each thread-cell is really a minute bag, tensely filled with fluid, and containing, coiled up in its interior, a thread or filament. When, from any cause — as by pressure, for example — the cell is ruptured, the fluid escapes, and if the thread and fluid together come in contact with the tissues of any animal liable to be affected, the animal in question will be paralysed, or even killed. In this way the *Hydra*, or "fresh-water polype," captures its prey, and even in the lower deeps of the animal world (as amongst the *Infusoria*, for example), these thread-cells appear to be represented. Higher up in the animal series, we come upon the poison apparatus of insects, carried in their tails, as also is the "sting" of the scorpion. The centipede's poison-fangs are situated, on the contrary, in its mouth. Amongst the shell-fish, or *Molluscs*, no poison-secretions occur. In fishes, as the lowest Vertebrates, we certainly know of one or two cases in which an approach to a poison apparatus is found. The frogs and toads, "ugly" as they may be, are yet not "venomous," Shakespeare notwithstanding. Acrid and irritating secretions may be poured out from the skin-glands of these animals. Such secretions are seen typically developed in the toads; but they are not "poisonous," in the common sense in which we use that term.

It is in the class of reptiles that the venomous attains its full development. Here, in the group of the snakes, we reach the acme of poison evolution. A typically poisonous snake, like the Rattlesnake or Viper, possesses two elongated and hollow "fangs," borne on its upper jaw. These fangs are merely largely developed teeth, and their hollow interiors each communicate by means of a canal with the poison gland. This gland, placed in front of and below the eye on each side, is merely a modified *salivary gland*, and corresponds to that gland in man known as the *parotid*, and which becomes enlarged in children suffering from "mumps." It is highly interesting to find that whilst the poison-secretion of a snake is merely permanently modified *saliva*, we know of cases among quadrupeds in which the fluid of the mouth becomes temporarily venomous. The case of the rabid dog is the most familiar example of this fact; and it is curious to reflect on the similarity in nature which exists between the venom of animals so widely separated as are snakes and quadrupeds.

The class of lizards is well known to be related to that of the snakes by many ties of structural kinship. Both are groups of the reptilian class, and we find certain lizards (*e.g.*, the harmless blind-worm of Britain), which are, like it, destitute of legs as any snake. No lizard, until within a few days since, was known to be poisonous, or to possess any structure suggestive of the possession and manufacture of a poisonous secretion. Horrible, ungainly and ugly as many lizards are, no fear of evil consequences could have been experienced in handling them, and naturalists would have given a very decided negative to any inquiry respecting the existence of a poison-secretion in the lizard group. But as it is the unexpected which happens proverbially in political and social life, so zoological existence has been startled by the news that a truly poisonous lizard has at length been discovered.

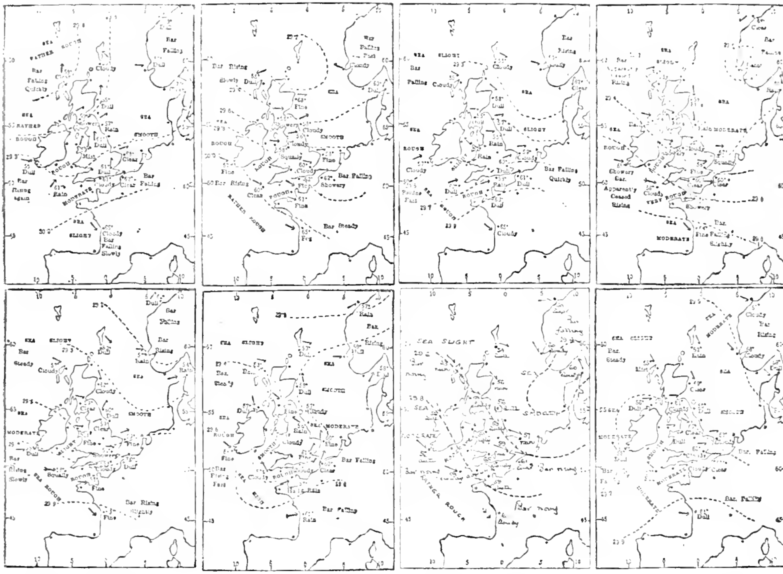
This lizard is named the *Haloderma horrida*, and hails from the neighbourhood of Puebla. It is, therefore, a denizen of the New World, and has found its way to the reptile house in the London Zoo' through the kindness of Sir John Lubbock. The traditions of the lizard are, it appears, unfavourable, if its Indian character is to be believed. The natives appear to regard it as a malignant deity, and are said to endeavour to propitiate the supposed evil power by the offer of sacrifices to the lizard god. When first brought to London, the reptile was regarded as an interesting example of a rare species of lizard. Like the rest of its brethren, it was believed to be thoroughly and completely harmless. True, stories had now and then been circulated by travellers in Mexico, that there existed in that country a lizard, or reptile of allied nature, whose bite was believed to be terribly fatal. But naturally enough, without evidence of the existence of such an animal, naturalists relegated the story to the domain of legend and exaggeration. Without direct evidence of such a statement, no man of science, basing his knowledge of lizard nature on the exact knowledge to hand, would have hesitated in rejecting the story as, at least, improbable. Yet it is clear that the stories of the New World may have had an actual basis of fact; for the *Haloderma horrida* has been, beyond doubt, proved to be poisonous in as high a degree as a cobra or a rattlesnake.

At first the lizard was freely handled by those in charge at Regent's Park, and being a lizard, was regarded as harmless. It was certainly dull and inactive, a result probably due to its long voyage and to the want of food. Thanks, however, to the examination of Dr. Günther, of the British Museum, and to actual experiment, we now know that *Haloderma* will require in future to be classed among the deadly enemies of other animals. Examining its mouth, Dr. Günther found that its teeth formed a literal series of poison-fangs. Each tooth, apparently, possesses a poison gland: and lizards, it may be added, are plentifully supplied with these organs as a rule. Experimenting upon the virulence of the poison, *Haloderma* was made to bite a frog and a guinea pig. The frog died in one minute, and the guinea-pig in three. The virus required to produce these effects must be of singularly acute and powerful nature. It is to be hoped that no case of human misadventure at the teeth of *Haloderma* may happen. There can be no question, judging from the analogy of serpent-bite, that the poison of the lizard would affect man. The sacrifice of a guinea pig and a frog may be, and most probably will be, cited by rabid anti-vivisectionists as a cruel experiment. Sensible persons will apply another term to the test whereby the virulence of the lizard was established, and humanity thereby placed on its guard. Forewarned is forearmed, whether we consider the case of a burglarious attack on our premises, or the bite of a lizard.

Are Toads Poisonous? — The large wart-like glands on the head and back of the toad secrete a thick, yellowish-white fluid of an exceedingly acrid and offensive nature. If these glands are squeezed or roughly handled, the secretion is exuded through a number of pores, like pin-holes, in the surface of the glands. No doubt it is owing to this fact that the toad has gained its name as a venomous reptile. — W. B. Wilkes.

WEATHER CHARTS FOR WEEK ENDING SUNDAY, AUG. 27.

Sunday, Aug. 20th. Monday, Aug. 21st. Tuesday, Aug. 22nd. Wednesday, Aug. 23rd.



Thursday, Aug. 24th. Friday, Aug. 25th. Saturday, Aug. 26th. Sunday, Aug. 27th.

In the above charts the dotted lines are "isobars," or lines of equal barometrical pressure, the values which they indicate being given in figures at the end, thus—30·1. The shade temperature is given in figures for several places on the coast, and the weather is recorded in words. The arrows fly with the wind, the force of which is shown by the number of barbs and feathers, thus:— ⟶, light; ⟶, fresh or strong; ⟶, a gale; ⟶, a violent gale; ⊙ signifies calm. The state of the sea is noted in capital letters. The * denotes the various stations. The hour for which each chart is drawn is 6 p.m.

THE PUBLIC HEALTH.

THE Registrar-General's weekly return shows that the annual rate of mortality last week in 28 of the largest English towns averaged 22·7 per 1,000 of their aggregate population, which is estimated at 8,469,571 persons in the middle of this year. The six healthiest places were Derby, Bristol, Halifax, London, Birkenhead, and Brighton. In London 2,551 births and 1,401 deaths were registered. Allowing for increase of population, the births were three and the deaths 94 below the average numbers in the corresponding week of the last ten years. The annual death-rate from all causes, which had slowly but steadily increased in the five preceding weeks from 17·7 to 20·5 per 1,000, declined again last week to 18·8. During the first eight weeks of the current quarter the death-rate averaged only 18·6 per 1,000, against 21·1 and 22·9 in the corresponding periods of 1880 and 1881.

The 1,401 deaths included one from small-pox, 27 from measles, 36 from scarlet fever, 18 from diphtheria, 40 from whooping-cough, one from typhus fever, 14 from enteric fever, one from an ill-defined form of continued fever, 158 from diarrhœa and dysentery, and six from simple cholera. Thus 302 deaths were referred to these diseases, being 77 below the corrected average number in the corresponding week of the last ten years. Different forms of violence caused 48 deaths; 42 were the result of negligence or accident, among which were 20 from fractures and contusions, 11 from drowning, 2 from poison, and 4 of infants under one year of age from suffocation. The 20 deaths from fractures and contusions were thus caused:—A male, aged 40 years, fell from a brougham; males 1, 1, 4, run over by van; male 6, crushed by van; male 27, run over by waggon; male 8, crushed by waggon; female 4, run over by tram-car; male 12, run over on London and South-Western Railway; female 2, fell from perambulator; male 2 and female 58, fell down stairs; male 35, fell from ladder; female 8, fell from window; female 92, fell out of bed; male 13, fell while at play; male 55 and female 45, by fall; male 25, crushed by machinery; and female 10, by blow of stone. An inquest was held in each of these 20 cases. Three cases of suicide were registered. In greater London 3,215 births and 1,760 deaths were registered, equal to annual rates of 34·6 and 18·8 per 1,000 of the population. In the outer ring the 55 fatal cases of diarrhœa corresponded with the number in the previous week, and included 20 in West Ham district. Of the 8 deaths from scarlet fever, 4 occurred in West Ham, and 3 in Tottenham sub-districts.

HOW TO GET STRONG.

TO STRENGTHEN THE MUSCLES OUTSIDE THE CHEST.

(Continued from page 181.)

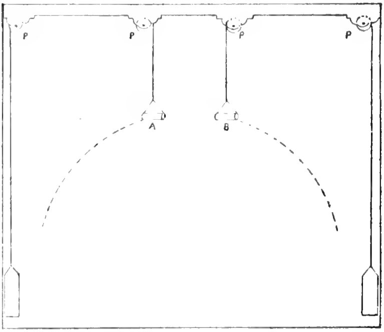
THE exercises we have hitherto considered have been directed to the enlargement of the chest itself—first, directly, by actual expansion of the frame enclosing the space we call the chest (I do not here limit the word to the front of the trunk, or breast); secondly, indirectly, by their action on the respiratory organs. We have now to consider how those muscles may be strengthened and enlarged which lie outside the chest, viz., the pectoral muscles, which have their origin near the breast-bone and inner edges of the upper ribs and are attached to the upper arm, and the dorsal muscles, which, rising from near the lower two-thirds of the vertebral column, are also attached to the upper arm. Speaking roughly, we may say that the pectorals carry the arms forward, as when we bring them upon the chest, while the dorsal muscles carry the arms backward, as when we finish the stroke in rowing. In boxing, both sets are very freely used, the dorsals when we prepare to hit out from the shoulder, the pectorals when we carry that laudable purpose into execution.

It should be noticed in passing that the development of both these sets of muscles often gives to the chest the appearance of being very well developed, when in reality it may not be so. This is especially the case with the pectoral muscles, which often are so developed as to suggest the idea of splendid chest development, when in reality the chest is flat and small. Blaikie very well remarks on this point, and we have repeatedly noticed the fact in the gymnasium, that "whoever knows many gymnasts, and has seen them stripped, or in exercising costume, must occasionally have observed that, while they had worked at exercises which brought up their pectoral muscles until they were almost huge, their chests under their muscles had somehow not advanced accordingly. Indeed," he adds, "in more than one instance which has come under our observation, the man looked as though, should you scrape all those great muscles completely off, leaving the bare framework, he would have actually a small chest, much smaller than many a fellow who had not much muscle. There hangs to-day—or did some time since—on the wall of a well-known New York gymnasium, a portrait of a gymnast stripped above the waist, which shows an exact case in point. The face of such a man is often a weak one, lacking the strength of cheek-bone and jaw, so usual in men of great vitality and sturdiness—like Morrissey, for instance—and there is a general look about it as if the man lacked vitality. Many a gymnast has this appearance, because he takes so much severe muscular work that it draws from his vitality, and gives him a stale and exhausted look, a very common one, for example, among men who remain too long in training for contest after contest of an athletic sort." It has been for this reason chiefly, that we have set first the exercises for enlarging and deepening the chest itself, as a matter more vitally important than the enlargement of any special muscles whatever. We can now, however, turn with advantage to exercises directed to enlarge particular sets of muscles.

The most effective exercise for strengthening the pectoral muscles is one which cannot be safely taken until these muscles are already tolerably well developed, viz., dipping from the parallel bars, or between the backs of two stout chairs. This exercise is usually given specially for the triceps muscles, but it depends even more on the action of the pectorals, insomuch that while men with strong pectorals and moderately strong triceps muscles can accomplish these dips pretty well, men with strong triceps and only moderately-strong pectorals often fail to accomplish a single dip without pain. To take the simplest form of the exercise:—Set two strong and rather heavy chairs back to back (you may with advantage put half-a-dozen heavy books on the seat of each.) Rest one hand on each, and lifting the feet from the ground, steadily lower the body, till the chin is nearly on a level with the hands. So far all is fairly easy; but now comes the work. Steadily lift the body to its former position. Then, if you can, repeat the dip, and continue dipping till you have had enough of it: it is not likely to take long at first. (The feet must not touch the ground from the beginning of the first dip to the end of the last.) But *do not attempt even a single dip unless you find, after lowering yourself, that you can, without very great effort and without pain near the breast-bone, begin and continue the rising movement.* You will only hurt yourself, and stop for several days all exercises directed to that strengthening of the pectoral muscles which is what, in this case, you particularly want.

Some such exercise as the following may be used, before attempting the dips, to test and afterwards to enlarge the pectorals:—

Using the instrument already described at p. 180, but the weights much heavier than for the exercise there described, stand under the handles A and B (fig.). Draw them



down till they reach the chest, and then change the hold, so that you can thrust them down on each side of you—that is, till the arms are extended straight down from the shoulders. Now slowly raise the hands, carrying them up slightly in front of the body till they reach nearly to the shoulder; then thrust them down again to their full extension. Repeat, making all the movements steadily and slowly, till you are comfortably tired. After a short rest, or turning for awhile to other exercises, return to this work, till you are tired with it yet once more. After a fortnight of such work, you can safely try your first dip; and once you have begun dipping exercise, there is no limit to the amount of work you can give the pectoral muscles in this way.

The following exercise is good for the upper parts of the pectorals: Hold out a pair of tolerably heavy dumb-bells, one in each hand, so that the arms are extended horizontally on either side of the body; then slowly lower the dumb-bells a foot, and as slowly raise them two feet. Repeat this for as many seconds as you find convenient. Do not try minutes, unless you feel that you *must*; but if you time yourself, using 10 lb. dumb-bells, you will feel no absolute obligation to continue the exercise after the first half-minute or so, especially in your earlier trials.

(*To be continued.*)

BOOKS ABOUT HEALTH.

THERE is no branch of literature in our day in which the activity is more constant than that devoted to popular instruction in the art of keeping healthy. There are periodicals devoted to it exclusively. Every year half a dozen books make their appearance, mainly at this season, telling us what to eat, drink, and avoid, how to live long, how to escape sickness, with sub-directions telling us how to chew, what time to go to bed, how many blankets we should sleep under, what sized pillow we should use, what time to rise, the proper temperature of our bath, how to rub ourselves on getting out of it, how often we should wash our feet, how much exercise we should take, and at what hour we should take it, what we should wear next our skin, and what kind of hat we should wear in summer. In fact, most of the books on health now closely resemble in minuteness of information the useful little manuals for mothers, regarding the care and treatment of children in the nursery, with which the world has so long been familiar. The adult who chooses to avail himself of them, consequently, need never take the smallest step in the care of his person without the best medical advice. There is nothing, from the brushing of his teeth in the morning to the blowing out of his candle at night, which he may not perform under professional judgment, without looking into the strictly technical books at all.

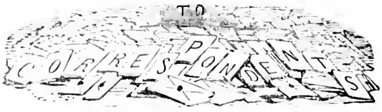
From one point of view the abundance of this hygienic literature is an excellent sign, because it shows the rapidly increasing attention of the medical profession to the art of prevention, which will probably before many years greatly overshadow, if it does not supersede, the art of cure, and which there is no doubt has of late outstripped the art of cure in efficacy, and stands higher in the estimation of all the older doctors. Telling people what to eat, drink, and wear, and how to work and play in any particular climate, is simply advising them, in Darwinian phrase, to adapt themselves to their environment so as to escape the remorseless law of natural selection, which makes such short work of those lower animals which pay no attention to hygiene, or are born with feeble constitutions or the wrong colour. But then there is the danger of giving people more advice about their bodies than their minds can bear, and to this the literary doctors are undoubtedly exposing us. They have done much good, especially among the women, who fifty years ago lived in violation of even the elementary rules of a healthy existence. They have improved people's food and clothing a good deal, and have almost effected a revolution in popular habits in the matter of ventilation, for instance. But in the minuteness of the directions they are now giving about exercise, digestion, bathing, and the like, they are either deepening the morbid streak in the human mind, or leading people into mistaken and often injurious experimentation. Nothing, for instance, is more prejudicial to health than too much thought about health, and this the health literature of the day undoubtedly tends to foster. In fact, that it does not do more mischief among the men is probably due to the fact that most of them are so busy that they have no time to study their own sensations. An idle man who tried to regulate his life by the rules of any popular health manual, and watched the effect of his regulated food and his regulated exercise, would almost certainly become a hypochondriac; and that many who start with some trifling constitutional weakness do become hypochondriacs in this way there is little doubt; in fact, with regard to the body, as with regard to the soul, there is much danger in casuistry, and the rules of health are very apt to be the casuistry of the body. A man who ran to a spiritual director every day to find out the exact moral quality of each of his acts, and its bearing on his spiritual health, would soon find that there was but little spiritual health left in him, and the man who is constantly asking himself whether this or that is good for his body, and getting his answer out of a guide-book, is very likely to have an analogous experience. In fact, so true is this, that one of the conditions of health may be said to be the diversion of the mind from all thoughts about disease.

Another defect in the kind of literature of which we are speaking is the too great absoluteness of its teachings. There are but few health books, if any, read by the young. The young are generally well, and generally indisposed to introspection, either mental or physical. They find they can eat anything at any hour, and they find that the proper amount of exercise for them is the amount they like to take. They are not interested in indigestion or sleeplessness, or any of the other ills for which the books seek to provide. If one happens to be with a party of young men in which the subject of food, or drink, or clothing comes up, one finds that it is discussed wholly from the standpoint of taste. They exchange views about what they like and dislike, and are immensely bored by observations on the hygienic quality of their tastes. Rules of health, in fact, are seldom perused or called for by anybody below the age of forty—at which, as the proverb says, "every man is a fool or a physician"—that is, he is either a person on whom health preaching would be wasted, as it would be on a cow or a horse, or a person who has through experience accumulated a body of hygienic doctrine of his own which no doctor can shake. Go into any company of middle-aged men, and listen to a discussion of meat or clothing, and you find that the question of healthfulness dominates the discussion. Each man's contribution to it is apt to be in the main an account of his own experience of what "agrees" with him; that is, he passes judgment on food, on dress, on exercise, on bathing, on hours of sleep, according to his experience of his subsequent physical sensations. It is this class, in fact, which buys and reads most of the health books, because it is most interested in morbid conditions of the body. But it makes the health-books, with their *ex-cathedrâ* tone, very strange guides, when we discover that in such a company as we have mentioned probably no two men's experience is the same about anything. One finds unlimited cucumbers most refreshing, another the smallest piece of cucumber deadly poison. One finds tea late in the evening necessary to a good night's rest; another finds tea later than five o'clock in the afternoon fatal to sleep on the following night. One finds a light breakfast the best preparation for a good day's work, and a sure cure for rheumatism; another finds a hearty breakfast indispensable to any activity, either mental or bodily, and the only safeguard against dyspepsia. One cannot dine later than two p.m.; another is miserable if he dines before seven. One cannot drink coffee; another finds coffee essential. Early rising clears one man's brain; it makes another stupid and incapable all day. One finds a daily cold bath the making of him; another tried it once and nearly died of it. One needs two hours' daily exercise for any effective brainwork;

another finds the less he takes the better he thinks. So it is about tobacco and about alcohol, and about bed blankets and about woollen undershirts, and about almost every habit, article of diet, or of clothing. Not only are there, in the matter of physical health, as many tastes as there are men, but apparent nearly as many requirements. In fact, if we go behind the health books to the sources from which the authors extract their conclusions, we shall find that almost the only certain and unassailable rule of hygiene which will bear universal application, is that pure air is good for the human animal, and that the more of it he has the better. All else is doubtful and disputed, or weakened by inscrutable peculiarities of individual constitution.—From the *Nation*.

Spontaneous Combustion of Cotton.—During one of the hot days of June, a Connecticut lady thought she smelled something burning upstairs. In searching for the fire she entered a small close garret room used for storage. She opened a window, and instantly a bag of carpet rags hanging there burst into flame. The rags had been there all winter. The fire was promptly smothered; and when the bag was opened it was found that only balls of cotton rags were burned. Whether the rags had been dyed is not stated.

Miss Amelia B. Edwards has received a letter about Prof. Maspero, dated August 13, from which the following is extracted:—"As for Maspero, I have news of him from his brother. Notwithstanding that our consul, M. Monge, urgently recommended him to leave as long since as July 8, he persisted in remaining at Boolak, where he was working day and night upon the completion of the new rooms lately added to the museum. For these rooms he had but lately received the necessary credit which should enable him to decorate and fit them up. On the 13th, however, our Minister of Public Works, under whose control he acts, despatched a formal order for his immediate departure. Despite this order, I believe he would still have remained had he been alone; but he had with him his young wife, who is but just recovering from a severe illness, caused by the extreme heat on board the steamer in which they have been living, and his mother-in-law, Madame la Baronne d'Estournelles (the mother of our *chargé d'affaires* at Tunis), and these ladies refused to desert him. The railway lines of the Isthmus were threatened; his brigade of soldiers had been withdrawn; and his steamer was in danger of being requisitioned for purposes of war. This boat was his only home. The hotels were empty and shut up. The European shops were all closed. He had no resource but to obey. He has left the museum in charge of his Nazir, the faithful Kourschid Effendi, a brave old Circassian, who was especially valued by Mariette on account of his energy and integrity. All the precious relics in wrought gold, and everything which might tempt the cupidity of mere spoilers, have been removed; and I think there is nothing to fear from ordinary thieves; but, if it comes to burning, pillaging, and assassination, as at Alexandria, I do not see how even Maspero's presence would avail to defend the building. As in war time a house which it is particularly sought to protect is converted into an ambulance, the old tumble-down dwelling in which Mariette lived has been assigned to some Arab hareems. . . . It was not possible for M. Maspero to remain at Ismailiah; he has therefore started for France by way of Italy, where he is at the present moment. He is expected to arrive in Paris about the 20th inst., where he will hold himself in readiness to return to his post as soon as such return is possible."



Letters to the Editor.

The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

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∴ All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

ALCOHOL AND INHERITED VICES.

[530] I am rather amused on reading the little sermon with which my friend Mr. Proctor has supplemented my letter, No. 514, page 201, especially with the latter part as applied to myself. My own position, as explained in my penultimate paragraph, is rigidly logical. How Mr. Proctor can approve of the rest of my letter and find fault with this is inscrutable. If I am right in what I stated as the results of my experiments and observations, the drinking of wine or beer, or tea or coffee (except as medicines when ill), is a pure vice, a *physical* vice, of course. Its essential nature remains absolutely the same, whether it be big or little.

I said "folly or vice," using the synonym to prevent that misunderstanding of my meaning into which Mr. Proctor has evidently fallen. He reads the word "vice" as implying immorality. I used it properly, in accordance with the definition which I find on referring to the first dictionary that comes to hand, viz., "a defect, fault, blemish, or imperfection."

Having stated my own case, I say, "If all would do this," &c. Here, perhaps, I ought to have been more explicit, in order to except those who really do believe that alcohol is the "concentrated nutriment" described by Dr. Epps, or who have disinterred the dead and buried paradox of Liebig, who imagined that certain drugs may increase the activity of the animal machine by checking the waste of its tissues.

I am as well satisfied that alcohol, nicotine, morphia, theine, caffeine, &c., are not constituents of the healthy human brain, or any other part of the healthy human frame, as Mr. Proctor is of the rotundity of the earth, and when I hear of a man proposing to improve a sound brain or sound body by the addition of any of these, I regard him as Mr. Proctor would regard John Hampden, had he contemplated an excursion to the limits of his flat earth in order to peep over its boundary edge.

This, as I said, does not prevent me from taking a cup of tea or glass of wine occasionally, but I do so as I do a thousand other things, from purely sensual motives, and not from any high moral or intellectual convictions. I recommend others to admit that they are not angels, that they are not always influenced by purely moral, intellectual, and spiritual motives. If we thus frankly acknowledge the true character of our many small vices, their growth would be materially checked. This is especially the case with inherited vices.

I will cite only one example. Our Universities, our public and private schools and colleges, have inherited from the middle ages the dirty fables of the Greek mythology and the Latin poets. Instead of treating these as we treat the corresponding literature of Holywell-street, they are described as conducive to "culture," &c. Everybody who dares to think freely, and is capable of doing so, knows that this is humbug, however "respectable" it may have become. We know that the stated reasons for retaining the dead languages in their present educational position are not reasons at all, but mere apologies. The dead languages were not introduced for the purposes which they are now said to serve; they are mere educational inheritances sustained by the fact that the majority of teachers know little else. If these men, instead of hunting up virtuous descriptions of their own intellectual vice (see definition of this word quoted above) had frankly admitted its true character, their natural ambition and desire to do right would have led to their better qualification, and have swept away this monstrous educational incubus in the course of a single generation. The same with a multitude of minor vicious inheritances that are sustained and enforced by conventional pressure; they would all yield to vigorous self-scrutiny and frank admission of actual motives.

W. Mattieu Williams.

[I thought it would be clear enough to Mr. Williams that whatever in my remarks may have read like sermonising, was not applied to him. But he mistakes in supposing he had proved the folly or vice (whether in his own or the usual sense) of taking an occasional glass of wine or smoking an occasional cigar. He has proved by his own experience (and really only in his own case, but let us take it as proved generally) that to anyone taking much exercise in the open air, alcoholic stimulants taken daily are useless, and worse. He has not proved, or gone anywhere near proving, that an occasional glass of wine or beer does any injury whatever to any, far less to all; until this is proved, nothing has been done to show that there is either folly or vice in taking a glass of wine. If it is pleasant to take a glass of good wine, and Mr. Williams admits it is, and if it does no harm whatever, and he has not shown that it does, the balance of advantages is in favour of taking it, in just such degree as is found to be innocuous. That some persons who lead a sedentary and studious life absolutely require an occasional glass (not necessarily even one a day, but one at times) is believed by many who know much more about human physiology than either Mr. Williams or myself. A learned friend of mine to whom I mentioned a few years ago that for more than a year I had taken no stimulants whatever, warned me from his own experience against a course which he considered (but I do not) to be full of danger. But this, after all, is not the point. The question is, is it or not innocuous to take an occasional glass of wine, or spirits, or beer. Until it is proved that it is not, and cannot be innocuous, I hold that there can be no folly—for those who can readily afford the indulgence—in taking the glass, whenever it suits our convenience and gives us pleasure, to do so. The definition of vice quoted by Mr. Williams is a special one—no more the usual one than the other definition, according to which a vice is a character in old mystery-plays. Mr. Williams would find, I think, that if he said a man had a "vice" the general meaning put on the word would not be precisely that which it bears when, for instance, I speak of the "vice" of Mr. William's mode of reasoning in this alcoholic question.—Richard A. Proctor.]

BICYCLES AND THEIR DEFECTS.

[531] Having been a bicycle rider for nearly fifteen years, and riding during that time all kinds of bicycles, from the 34-in. boneshaker—upon which I rode forty and fifty miles a day many times with the greatest pleasure—to a 55-in. modern Stanley-tread spider machine, and having read everything upon bicycling that I could get, I think I am in a position to state some of the defects of the modern bicycle. The principal defects in the old-fashioned machine were the weight and appearance. In the modern bicycle these defects have been removed, but, in carrying out the remedy, bicycle makers have gone to the extreme. To reduce the weight the spring of the bicycle has been almost done away with, and the back wheel reduced almost to a castor.

The modern bicycle has many advantages over the old-fashioned one, the increased number of spokes, and the ball bearings, and the lighter weight behind; but these I need only mention as I wish to speak of the defects. I consider the greatest defect in the modern bicycle to be the very short spring, which causes the rider to experience, when riding over rough ground, a continous jar or vibration, almost as bad as when riding in a cart without springs. When I rode a bicyle with a long elastic spring the machine ran over the rough ground easier than with the short spring bicycle of to-day, and there was no vibration, and I could see objects around distinctly. With a short spring the objects have a tremulous appearance except when riding on very smooth roads. Another defect in the modern bicycle is the very small back wheel. A small back wheel will not run over inequalities so easily as a large one. The experience of modern bicycle-riders is, as a rule, that their bicycles shake them a good deal. I believe the cause to be the very small back wheel. Bowl two iron hoops, a 10 in. one and a 50 in. one over rough ground, and watch the motions of both, and seo which runs the steadier. Another defect is a very small saddle. If a man wants to "sit at ease" he chooses an easy chair, and not the top of a post to sit upon; the same holds good with a bicycle-saddle. If, therefore, bicycle-riding is to be a pleasure, I conclude that the spring must be as long again as now made, and the back wheel must be 20 in. to 24 in. in diameter. Bicycle makers have perfected the machine for racing purposes on the track or path, but they have forgotten that all bicycle riders are not sportsmen and racers. In making machines, let them study ease in propulsion and comfort in riding, and there will not be so many give up riding after a few runs as there now are. My longest journeys, and those done with the greatest ease and pleasure, were on a 48-in. "Challenge," with a long spring and a 20-in. back wheel, which machine was made in the year 1875.

Caleb Adams.

FAIRY RINGS.

[532] I would respectfully suggest to Mr. Mattieu Williams that his theory of the cause of these interesting phenomena does not account for the appearance of fairy rings in pastures. I have in my mind several pastures (where in all probability the grass had been grazed by sheep for many years) in which these rings were common; and, if I am not mistaken, the common "puff ball" is the fungus these rings produce. May not the rings be produced from a central point? Say a nucleus of fungus, takes root in the turf. The peculiar adaptability required in the soil for their growth becomes annually exhausted, and the plant (if I may so call it) extends its roots into the fresher soil in an ever-extending circle. If some of our country observers and botanists would look for these rings in pastures, and ascertain if they are found in circles of varying circumference, I should be inclined to think that fact would go far to prove my theory.

The green colour of the grass, "Whereof the ewe not bites," in my opinion is the effect of the fungus itself, and not of any local excess of manurial matter; but I fancy some of our botanical readers can tell us all about the matter, for I have a vague recollection of seeing an account of the nature of fairy rings in some botanical work.

W. B. Wicken.

[533]—Mr. Mattieu Williams, in attempting to disprove Mr. W. G. Smith's explanation of the origin of fairy rings says that "the large fairy rings on the South Downs have been explained over and over again as the result of special manuring in the boundary track of tethered animals." Now this cannot apply to the South Downs in this neighbourhood. On the hills about Lewes fairy rings of all dimensions, up to more than 50 ft. in diameter, abound, and it is well known that cattle are never pastured on these hills, whether tethered or otherwise; the only animals fed are sheep, which roam in any direction. I have for years watched these rings, which, in the autumn, are always accompanied by fungi, the fungi growing outside the crop of rank grass. When these fungi decay they supply a highly nitrogenous manure to the ground where they grew, consequently their place is occupied the succeeding year by rank grass, and the fresh fungi are again uppermost, that being the only place where their spores can germinate. Thus the increasing size of these rings is explained and as easily witnessed, and we can see that a single fungus is capable of starting a ring which may grow to very large dimensions.

J. H. A. Jenner.

HOT AND COLD DRINKS.

[534] In reply to J. Williams, jun. (498), allow me to state that cold drinks are natural to man, though most humans now-a-days are so used to hot drinks, that they do not feel satisfaction—really stimulation—unless they have them. Hot drinks are injurious to the tongue, teeth, gullet, and stomach.

They are injurious to the tongue, for they deaden its sensation, and, after taking hot soup or drink, the tongue becomes quite numb, and unable to taste the finer flavours of a dish.

The teeth are greatly injured by them, and many dentists say caries (decay) is due to them alone. They crack the enamel, and thus allow caries to set in. When caries has once set in, hot drinks are a common cause of neuralgia. Who has a bad, unstopped tooth, who has not often had face-ache from a hot drink?

Again, experiments were made on cows; some were given food cold and some hot. Those who got it hot soon showed signs of caries of the teeth.

Hot drinks cause a slight dilation of the bloodvessels of the gullet, and scalding hot drinks cause stricture of the gullet. They are specially hurtful to the stomach. They cause irritation of the nerves of the stomach, and consequent mild inflammation of that organ, so that after a hot drink the stomach is red and congested; in time a debilitated condition is set up.

A temperature of 100 Fahr. also destroys the active ferment of the gastric juice—pepsin, and so leads to indigestion.

In China, where hot drinks are the rule and water the exception, the people are subject to hematemesis (vomiting of blood), said to be caused entirely by their habit of taking hot drinks.

If the stomach is at all disordered, hot drinks give rise to much griping pain, and in many cases to vomiting. In cases of diarrhœa, too, hot drinks only increase it, whilst cold ones tend to lessen it.

In answer to the second part, thirst is not common in winter, unless sugary, salty, or hot spiced foods have been taken. In cold [illegible] hot, and in cold [illegible] from the extra [illegible] the system. Hot drinks [illegible] the body, and if that is not required, [illegible] much perspiration in hot [illegible]

[illegible] simple food be taken, [illegible] I know many vegetarians [illegible] month to month, the only fluid [illegible] the fruits which they eat.

[illegible] drinks may be taken lukewarm for a very [illegible]. The least injurious [illegible] and allowed to stand until nearly [illegible] ginger to the drink, and if [illegible] taken. Yours truly,

[illegible] ALLINSON, L.R.C.P., &c.

TIME OF FULL MOON.

[illegible] of Professor De Morgan's "Book of Almanacks," [illegible] your correspondent, that the time of full moon [illegible] on Tuesday, July 11.

HENRY M.

Answers to Correspondents.

**** All communications for the Editor requiring early attention should reach the Office [illegible] the current issue of* KNOWLEDGE, *the [illegible] the week.*

[illegible] scientific information [illegible] correspondents [illegible] in reply to a letter, reference should be made to its number, the page on which it [illegible].

[illegible] I am sorry, but there is absolutely no space for [illegible] Egyptian [illegible] you mention. [illegible] Thanks for pointing out shortcomings as to astronomical [illegible] there was too much. W. NAPIER. If [illegible] Nautical Almanac the directions will be rather complex, [illegible] a morning tide table for Ipswich, take the [illegible] from the Nautical Almanac, [illegible] 13 h. 23 m., and deducting [illegible] the morning tide hour for the day following [illegible] opposite February 7, in second column, [illegible] deduct 13 h. 23 m., giving 7 h. 11 m. [illegible] for February 8 at Ipswich. [illegible] 12 h. [illegible] 13 h. 23 m., deduct [illegible] left-hand column increased by [illegible] day named. Thus, [illegible] 12, 1881, [illegible] in the two columns [illegible], 12 [illegible] 1h. 23m., giving 10h. 11m., [illegible] on January 12. For the [illegible] column where they [illegible] hours for the day [illegible] 22 1881, where 6h. 11m. is named, the afternoon [illegible]. Where the hour named in first [illegible] and diminish [illegible] 12 1881 [illegible] second column is [illegible] afternoon tide at Ipswich. If, [illegible] a Whitaker's [illegible] by taking 1h. 23m. [illegible] London Bridge, in a page [illegible] the rules [illegible] to get out [illegible] cannot leave [illegible] encountering the [illegible] diminished, [illegible] the planet [illegible] 24 for the [illegible] the matter was [illegible] we have [illegible] its subscribers (and most fairly) 2d. yearly for index; we have charged them nothing. It prices the index number at 3d., so that every one has to buy the index who takes in the *English Mechanic* regularly, whether he wants to bind the back numbers or not (and not one in six wants to do so). Our publishers supply those only who want the index. The index would be very profitable if priced at one penny, and included with a 32-page number priced at 3d.; and still more profitable if, as in *Nature* and some other weeklies, it simply occupied so much space in a number of the usual size. As it is, though the publishers *do* charge other than subscribers 2d. for the index, its publication does not cover its cost. This, I imagine, will satisfy yourself and the other readers you speak of. I must confess supporters of that kind are disheartening enough. A publication is started on the most generous terms to readers and contributors (I venture to say no publication of the same kind has ever been started on so generous a plan), yet a certain section of its readers raise objections on every paltry point they can think of, mostly in utter ignorance of the real state of things. Thus we are asked, after we have been in existence a certain time, to oblige some readers by publishing monthly parts; the publishers find that for the additional expenses, as well as risk in keeping back so many single numbers to make up parts, the price of each monthly part must be 2d. beyond the price of the single parts included in the month: immediately an outcry is raised over this paltry 2d., which does not in reality compensate for the cost of our attempt to oblige monthly subscribers. We are asked for an index, and the publishers immediately make a present of it to subscribers, and charge those who care to buy it separately 2d. per copy, losing money by the arrangement, because five-sixths of the readers of journals like this do not bind. For thus bringing a loss on themselves in trying to oblige readers, they get such thanks as your letter conveys. Let me once for all point out that the object of KNOWLEDGE was to supply sound and clear scientific writing by leading writers at a very low price to readers, and at a better price than has been usual in such cases, to writers. I, as editor, gave to KNOWLEDGE time and work, worth to me ten times as much as I could possibly hope to receive for my services. I am ready to continue this; I am anxious to see the publishers responding to every advance we make by giving better and better matter to readers, better and better terms to writers. They share these views with me. But conceive how encouraging we find it under these circumstances to receive letters showing such kindly feeling as yours, such thorough appreciation of what we have tried to do. A STUDENT. Much obliged, but not one in a thousand of our readers would care for quaternions.—B. M. It is singular how difficult you seem to find it to understand my position. Can you not see that I have nothing to do with the cruelties of continental vivisectionists? I have reviewed what Prof. Owen has said as to his own opinions, which seem to me reasonable and sound. Why should I be guilty of the impertinence of asking him whether he abominates, as he ought to do, certain atrocities of which he does not speak? I take it for granted that he does, and that so also does Prof. Huxley, but to ask either whether they do would simply be to insult them. You say that I am unwilling to show both sides of the question; permit me to point out that I show neither side, but the middle.—H. A. BULLEY. Pardon me, I believe sufficient attention *has* been given by science to the influence of the moon on the weather, with the result of showing there is none. Saxby's Almanac I have tested myself, with the result of finding that whatever in it is new is not in the least true, except by accident; what is true and trustworthy in it can be found in Whitaker's Almanac.—J. SANDERS. You take Mr. Williams too much in earnest. Drunkenness is certainly an evil, and every man should do his best in his own circle to diminish it as far as possible. It would be as reasonable to sow the seeds of plague and pestilence as to wilfully encourage drunkenness; and you may be sure Mr. Williams meant nothing of that kind. His vein of humour is too subtle for many of our readers.—IGNORAMUS. I do not know how Cetewayo should spell his name, and, "not to put too fine a point upon it," I do not care. It is bad enough to fight the "nigger" kings; but to talk of them, about them, or with them (I speak from experience, having been a fellow passenger of one of the charming lot), is a little too much. To see our nigger king come on board with a garland of leaves round his neck, and attended by white men (some were Americans, too), made similarly ridiculous, while his gallant army of full 150 stood in single line, or marched to the strains of "Pinafore;" to hear his attendants, one at least among whom was a gentleman by birth and standing, address him as "Your Majesty," and even some of the passengers followed suit, and then to gauge his intellect, and find it as shallow as a negro barber's in a one street village, out West, was enough, in my humble judgment, to sicken the conventional dog. Yet, after all, it was but a small-scale copy of what happens sometimes outside of Zululand and the Sandwich Islands.

Our Mathematical Column.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.
No. IX.

By RICHARD A. PROCTOR.

TWO functions still remain to be dealt with, $\log x$ and a^x, after which the student will be able to differentiate any functions whatever, simple or complex.

First, then, let $y = \log_a x$. Increasing x to $x + \Delta x$, whereby y is increased to $y + \Delta y$, and then subtracting, we have

$$\Delta y = \log_a (x + \Delta x) - \log_a x$$
$$= \log_a \left(\frac{x + \Delta x}{x}\right)$$
$$= \log_a \left(1 + \frac{h}{x}\right) \text{ writing } h \text{ for } \Delta x, \text{ for convenience.}$$
$$= \frac{1}{\log_e a}\left[\frac{h}{x} - \frac{h^2}{2x^2} + \frac{h^3}{3x^3} - \&c.\right]$$
$$\therefore \frac{\Delta y}{\Delta x} = \frac{1}{\log_e a}\left[\frac{1}{x} - \frac{h}{2x^2} + \frac{h^2}{3h^3} - \&c.\right]$$

Now when h is very small, all the terms within brackets, except the first, may be neglected, for they are less in absolute value than

$$\frac{h}{2x^2}\left[1 + \frac{h}{x} + \frac{h^2}{x^2} + \&c.\right]$$
$$< \frac{h}{2x^2} \div \left(1 - \frac{h}{x}\right)$$
$$< \frac{h}{2x(x-h)} \text{ a quantity vanishing with } h. \text{ Hence, finally,}$$

when Δy, Δx are both indefinitely small, we have

$$\frac{dy}{dx} = \frac{1}{x \log_e a}$$

It follows that if $y = \log_e x$

$$\frac{dy}{dx} = \frac{1}{x}$$

Next let $y = a^x$. Here we shall content ourselves by proceeding as follows:—

$$x = \log_a y$$
$$\therefore \frac{dx}{dy} = \frac{1}{y(\log_e a)} = \frac{1}{a^x \log_e a}$$
$$\text{and} \quad \frac{dy}{dx} = a^x \log_e a.$$

[There is in reality no objection to regarding $\frac{dy}{dx}$ as the reciprocal of $\frac{dx}{dy}$, however true it may be that $\frac{dy}{dx}$ is to be regarded as a single expression.]

It follows that if $y = e^x$

$$\frac{dy}{dx} = e^x \text{ also.}$$

We can now differentiate any expression we please, however complex. There is scarcely ever any room for much ingenuity in the choice of methods in differentiating. Still at times we find that space is saved, and we avoid the chance of errors in writing, by modifying our method of procedure.

Here are a few examples of differentiation:—

1. Let $y = x\,(a^2 + x^2)\,\sqrt{a^2 - x^2}$

Here, proceeding on the straightforward course, we get

$$\frac{dy}{dx} = (a^2 + x^2)\sqrt{a^2 - x^2} + 2x^2\sqrt{a^2 - x^2} - \frac{x^2(a^2 + x^2)}{\sqrt{a^2 - x^2}}$$
$$= \frac{a^4 - x^4 + 2a^2x^2 - 2x^4 - a^2x^2 - x^4}{\sqrt{a^2 - x^2}}$$
$$= \frac{a^4 + a^2x^2 - 4x^4}{\sqrt{a^2 - x^2}}$$

But we might have proceeded thus:

$$\log y = \log x + \log (a^2 + x^2) + \tfrac{1}{2} \log (a^2 - x^2)$$

$\therefore$ differentiating with respect to x

$$\frac{1}{y} \cdot \frac{dy}{dx} = \frac{1}{x} + \frac{2x}{a^2 + x^2} - \frac{x}{a^2 - x^2}$$
$$= \frac{a^4 + a^2x^2 - 4x^4}{x(a^2 + x^2)(a^2 - x^2)}$$
$$\therefore \frac{dy}{dx} = \frac{a^4 + a^2x^2 - 4x^4}{\sqrt{a^2 - x^2}}$$

2. $y = \log (\log x)$

$$\therefore \frac{dy}{dx} = \frac{1}{x} \frac{1}{\log x}$$

3. $y = \log (\log [\log x])$

$$\frac{dy}{dx} = \frac{1}{x} \frac{1}{\log x} \cdot \frac{1}{\log (\log x)}$$

4. $y = a^{x^x}$. Here we treat x^x as the variable exponent.

$$\therefore \frac{dy}{dx} = \log a \,.\, a^{x^x} \cdot \frac{d}{dx}\,(x^x)$$
$$= \log a \,.\, a^{x^x}\,(x \,.\, x^{x-1} + x^x \,.\, \log x)$$
$$= \log a \,.\, a^{x^x}\, x^x\,(1 + \log x).$$

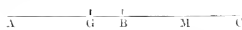
5. $y = a^{\log x}$

$$\frac{dy}{dx} = \frac{\log a \,.\, a^{\log x}}{x}$$

6. $y = e^{x^x}$

$$\frac{dy}{dx} = \log e \,.\, e^{x^x}\, x^x\,(1 + \log x) + x^x\,(e^{x^{x-1}})$$
$$= \log e \,.\, e^{x^x}\, x^x\,(1 + \log x) + e^{x^x}\, x^{x-1}$$

I have occasion for a hearty laugh at a mistake of my own, of a full size—nay, overgrown. Gulliver tells us that the tailors of Laputa measured folk for their clothes by mathematical methods—observing altitudes, triangulating, and so forth, but that generally some mistake in the computation caused the clothes to be exceedingly ill-fitting. I made the captain of a racing eight calculate by the differential calculus the proper size for one of his crew, but a very bad blunder made him obtain a wrong result. And really the blunder was *so* bad that the wonder is he did not deduce by the differential calculus a man two feet or twenty feet high, which might have involved him in difficulty. An odd thing is that my blunder was made eleven years ago, the problem having originally appeared in my short series of Easy Lessons in the *English Mechanic* (which lessons must have interested many, seeing that no one noted the mistake; thirteen readers of KNOWLEDGE have already pointed it out). In our columns the problem was simply reprinted and corrected from the printed original: (I think an additional error crept in; but have no means of knowing, being away from my back volumes of the *English Mechanic*.) The solution should, of course, have run thus:—



Let AM (breadth of man) $= 2x$; man's weight $= mx^3$; moment of his weight around centre line of boat's length $= mx^3$. GB $= mx^3(1 - x) = mx^3 - mx^4$. Therefore $\frac{dy}{dx} = 3mx^2 - 4mx^3$; and equating to zero, $x = \frac{3}{4}$, or AM $= \frac{3}{2}$; so that since a man 1 ft. broad weighs, according to our assumption, 6 stone, our new oarsman should weigh $6\left(\frac{3}{2}\right)^3 = 8\frac{1}{4} = 20\frac{1}{4}$ stone.

I need hardly say that if, eleven years ago, my solution had been correctly obtained, with this ridiculous result, I should have slightly modified the conditions. For instance, I might have assumed that a one-foot seat corresponded to a weight of 4 stone instead of 6, in which case the reasonable weight $13\frac{1}{2}$ stone would have resulted for the new oarsman.

The value of the differential calculus is not affected by my mistake, which, however, teaches the value of care, especially in dealing with very easy problems.

A. W. Bawtree, one of the thirteen who note the above mistake, points out the following clerical errors in the Easy Lessons (I am only able to check his corrections for articles in Part 10, being away from home, and not having Part 9 by me):—

p. 136[1], l. 14 from bottom, 1,000 should be 10,000.

" l. 13 " " y should be x.

p. 154[1], l. 8, tan x and tan $(x + \Delta x)$ should be cot x and cot $(x + \Delta x)$.

p. 155[1], l. 2, $\frac{dy}{dy}$ should be $\frac{dy}{dx}$

p. 171[2], bottom line, "functions of z" should be "functions of x."

p. 188[2], l. 18 from bottom, the equation should be

$$\frac{dy}{dx} = \frac{2x}{2(a^2 + x^2)^{\frac{1}{2}}}$$

p. 204[1], l. 21 from bottom, $5 = $&c., should be $y = $&c.

Most of these are obvious misprints, but they should be corrected in the text.

Our Chess Column.

By Mephisto.

[illegible] A FEW DAYS AGO AT MEPHISTO'S ROOMS.

[illegible] GAMBIT.

[illegible]	White. Mephisto.	Black. Amateur.		White. Mephisto.	Black. Amateur.
1.	P to K4	P to K4	16.	B to B4	Q to Q2
2.	Kt to KB3	Kt to QB3	17.	Kt to Q5	Kt to Kt4 (i)
3.	P to Q4	P takes P	18.	B takes Kt	P takes B
4.	Kt takes P	P to Q3 (a)	19.	Q takes R (ch) (j)	B takes Q
5.	Kt takes Kt	P takes Kt	20.	R takes B (ch)	K to Kt2
6.	B to Q3	P to Kt3 (b)	21.	R(Qsq) to KBsq	B to R3 (k)
7.	Castles	B to KKt2	22.	Kt to B6 (l)	Q to K2 (m)
8.	P to KB4	Kt to K2 (c)	23.	Kt to R5 (ch)	K to R3
9.	P to K5	P to B3	24.	R (B8) to B6 (ch)	K takes Kt
10.	Kt to QB3	Castles	25.	R (Bsq) to B5 (ch)	K to Kt5
11.	Q to B3	P to Q4	26.	B takes B (n)	P to B5 (o)
12.	B to K3 (e)	P to Q5 (f)	27.	B takes P	P to Q6
13.	QR to Qsq	K to Rsq	28.	B takes P	Q to B4 (ch)
14.	B to QB4	P to B4	29.	K to Bsq	resigns (p)
15.	P takes P	Kt takes P			

NOTES.

(a) It is not a very easy thing to support an opinion based upon [illegible] ; this move calls for an adverse criticism of [illegible]. It brings the position somewhat analogous to a [illegible] defence, which, in itself, is weak. Black's King Bishop [illegible] game will soon assume a cramped aspect.

(b) [illegible] nothing to be gained by 5. B to QKt5, as Black will reply with 5. B to Q2, but by first exchanging Knights (to prevent Kt to QKt5) and then playing 6. B to Q3, White creates a break in Black's game and furthers his own development.

(c) This seems best for Black.

(d) We think 8. P to Q4 would have given Black more freedom [illegible] if White replied with Kt to B3. Black would take the [illegible], or in reply to Q to B3 Black might have played Kt to K2.

(e) Somewhat premature.

(f) 12. P takes QP, followed after P takes P by 13. P takes [illegible] and play.

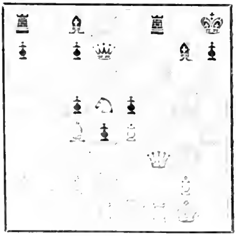
(g) Black [illegible] into the trap which White set, at some considerable [illegible] his own game, for Black might have obtained a good game [illegible] 12. P takes KP, followed by B takes BP.

(h) This move gives White a superior game. Black cannot take [illegible] of B to B4 ch winning the Queen.

(i) If 17. Kt takes B, 18. Q takes Kt, R to B2, 19. Kt to K3, [illegible] Bsq, 20. Kt to B5 with a good game.

Position after Black's 18th Move.

Black. (Amateur.)



White. (Mephisto.)

[illegible] R [illegible] and the attack [illegible] without [illegible] Black Queen but he would [illegible]

22. $\frac{\text{Kt to B7}}{\text{Q takes R.}}$ 23. $\frac{\text{[illegible] Q (ch)}}{\text{K takes R}}$ 24. $\frac{\text{Kt takes BP (ch)}}{\text{B takes B}}$ 25. $\frac{\text{Kt takes R.}}{\text{B takes P}}$

and Black has a good game. Or if White should win the exchange, which Black offers him, he would not fare any better, i.e.,

22. $\frac{\text{R takes R}}{\text{B takes B}}$ 23. $\frac{\text{R (Bsq) to B8}}{\text{B takes Kt}}$ 24. $\frac{\text{P takes B}}{\text{Q takes P}}$ and again Black has a fair game.

(l) This move wins by force.

(m) Even giving up the Queen would not help him, i.e.,

22. $\frac{}{\text{R takes R}}$ 23. $\frac{\text{Kt takes Q}}{\text{R takes R (ch)}}$ 24. $\frac{\text{B takes R}}{}$ and White wins by being a piece ahead.

(n) Decisive. 26. P to R3 (ch) would be less certain, as no mate can be forced.

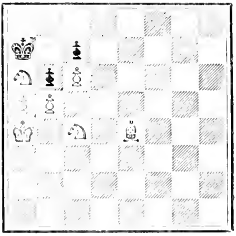
(o) Merely to prolong the game.

(p) White threatens B to K2 (ch) and R to R5 mate.

PROBLEM No. 51.

By H. A. N.

BLACK.



WHITE.

White to play and mate in three moves.

SOLUTION.

Problem No. 50, by Alfred B. Palmer, p. 189.

1. K to Kt7	1. P to B7
2. B to Bsq	2. P to Q4
3. B to B8	3. P to K3
4. B to Kt5 mate	

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess-Editor.*

Alfred B. Palmer. Problem received with thanks.
Edward Wilson will oblige by replying to M. J. Hooton.
Leonard P. Rees. Problem received with thanks.
C. S. Bright. Solutions of Nos. 48, 49, and 50 correct.
Correct solution of No. 50 received from John Watson, Herbert Jacobs, and Squire.

NOTICES.

OFFICE: 74 & 75, GREAT QUEEN STREET, LONDON, W.C.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

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CONTENTS OF No. 45.

Science and Art Gossip.

THIS week, owing to pressure on our space from British Association matter, we omit the Weather Charts, Our Mathematical Column, and Whist. With regard to the first, we may note that many readers complain of the space occupied by these charts, "which tell us, after all," they write, "only of past bad weather." The charts were intended to form a collection of weather records, convenient in form, and useful for future reference. Their scale, indeed, is rather small; but no more space could be spared. For our own part, we should be only too glad to devote the space they occupy to other matter. We shall leave our readers to decide. If we find that far the larger portion would prefer that these charts should be omitted and other matter replace them, we shall attend to their wish. Only a certain amount of space, of course, can be spared (on the average) for weekly illustrations. If these charts disappear, other illustrations, probably more useful, will replace them. Of one thing our readers can be assured; we wish to meet their wishes, so far as is consistent with our scope and purport, to the utmost of our power. Our power is limited to some degree by our price; but we do not propose to increase it by any change in that direction. Still we must note that *some* of our readers ask us to do much more than could be afforded without such a change. We adhere as far as we can to our original plan and purpose. We warmly thank those who have helped to increase the circulation of KNOWLEDGE; but when many write saying that the new subscribers they have obtained want "more astronomy," say some, "more electricity," say others, more chemistry, biology, botany, entomology, metallurgy, geology, &c., &c., &c., and more illustrations, and when we find that a weekly as large as one of our monthly magazines would barely meet all these views—we find ourselves rather at a loss what to do for the best.

A JOKE fifteen months old has but now come to my knowledge. When I purchased from Messrs. Smith, Elder, & Co., their rights in my three books—"The Borderland of Science," "Science By-ways," and "The Poetry of Astronomy"—they sent me (September 2) their collection of the press criticisms of those books, mostly new to me. By the merest accident (for life is too short to read press criticism) in turning these over I came across the following odd illustration of the profundity of the *Saturday Review*, and the wide reading of the learned writers who "do" its criticisms. The *Saturday Review* for May 28, 1881, dealing with my "Poetry of Astronomy," questions whether I can be a judge of poetry, for this solitary and also singular reason—"Of the fineness of Mr. Proctor's ear, we may to some extent judge," it says, with fine irony, "from his selecting for quotation a specimen of rhyme so exquisite as—

> expanse of liquid, pure,
> Transparent elemental air."

It takes the *Saturday Review* to explain how badly Milton rhymed in the "Paradise Lost!" We can imagine a criticism of that work two centuries ago, if the *Saturday Review* had but existed then:—"We learn that the author is blind; he must be deaf, too; at any rate we may to some extent judge of the fineness of his ear from a specimen of rhyme so exquisite as

> Hail, holy light! Offspring of Heav'n first-born,
> Or of th' Eternal Coeternal beam."

But, unfortunately for Milton, there was no *Saturday Review* to teach him how to write poetry, as they have taught Browning and Tennyson.

IN the report of the Anthropometric Committee of the British Association (presented by Sir Rawson Rawson), it is stated that the greatest stature is found in Scotland and the North of England, and the shortest in Wales, the Welsh border counties, and the south-west of England. The counties inhabited by men of more purely Saxon descent are of medium stature. Allowing for the ethnological difference just mentioned, the inhabitants of elevated districts possess a greater stature than those of alluvial plains. The highest stature in the country is 70 inches, and the lowest 66. Sir Rawson Rawson added that the average stature of the Scotch people is 68·71, of the Irish 67·90, of the English 67·36, and of the Welsh 66·66 in. The average of the United Kingdom is according to this 67·66, or 5 ft. $7\frac{2}{3}$ in. From observations made by Dr. Baxter and others in America, it has been found that the average height of our transatlantic cousins is just about the same as ours. Generally, it might be said that not only in England, but in Europe, stature seems to diminish with the latitude of the race. Professor Roberts said he considered that the size and activity of the brain have much to do with physique; others suggested that the use of tobacco arrests growth; and Mr. Sclater-Booth remarked that climate, elevation, distance from sea, occupation, diet, and smoking modify growth.

"GREAT difference exists," said Professor Leoni Levi at the late meeting of the British Association, "in the classes of crimes and offences in England, Scotland, and Ireland respectively. Honour and property are safest in Ireland; the person is safest in Great Britain; drunkenness is worst in Ireland. Geographically crime is least in the north, midland, and south-eastern counties, and most in the north-western. The agricultural counties have less crime than the manufacturing and mineral. Crime following the density of population, the bulk of our criminals consist of persons having no occupation and common labourers, whose means are precarious; hence the relation of crime to savings and wealth is very intimate. The number of persons committed for trial in England and Wales in 1880 was 19 per [illegible] less than [illegible] Scotland, and 53 per cent. less than in [illegible] the amounts of deposits in the savings [illegible] per cent. more in England and Wales than it [illegible] Scotland, and 73 per cent. more than in Ireland. Prosperity moves hand in hand with virtue: misery with [illegible] and crime. The bulk of criminals are generally found to be illiterate, and drunkenness is both a direct and indirect cause of crime. Family dissensions are found to contribute a large quota to crime, and an ever active [illegible] the existence of the criminal classes."

In a letter to the *Times*, "Some of the Victims" write: "As many of your readers will now be visiting localities where valuable pebbles are said to abound, it is as well to [illegible] them before having them cut that much deception is [illegible]. We have been spending a month at a well-known watering place in Wales, and while there picked up stones on the beach, said by the principal lapidary in the town to be beautiful amethysts, topazes, and crystals. Some of those selected by him we had cut as specimens, others we had mounted. Upon showing the uncut pebbles to an eminent geologist he pronounced them to be pieces of quartz, and told us that the lapidaries substitute real stones imported from Germany in lieu of those they receive from the visitors. He says it is possible to find coloured crystals in the rocks of the neighbourhood and on the beach, but they would be quite transparent when divided, which was not the case with those we found."

An Eighty Pound Hailstone.—Considerable excitement was caused in our city last Tuesday evening by the announcement that a hailstone weighing eighty pounds had fallen six miles west of Salina, near the railroad track. An inquiry into the matter revealed the following facts:—A party of railroad section men were at work Tuesday afternoon several miles west of town, when the hailstorm came upon them. Mr Martin Ellwood, the foreman of the party, relates that near where they were at work hailstones of the weight of four or five pounds were falling, and that returning towards Salina the stones increased in size, until his party discovered a huge mass of ice weighing, as near as he could judge, in the neighbourhood of eighty pounds. At this place the party found the ground covered with hail as if a wintry storm had passed over the land. Besides securing the mammoth chunk of ice, Mr. Ellwood secured a hailstone something over a foot long, three or four inches in diameter, and shaped like a cigar. These "specimens" were placed upon a hand car and brought to Salina. Mr. W. J. Hagler, the North Santa Fé, merchant, became the possessor of the larger piece, and saved it from dissolving by packing it in sawdust at his store. Crowds of people went down to see it, and many were the theories concerning the mysterious visitor. At evening its dimensions were [illegible] 16 × 2 inches.—*Salina (Kansas) Journal.*

Hearing the Aurora by Telephone.—An observer of the recent aurora at Mont Clair, N. J., Aug. 4, writes that on connecting the two poles of his telephone, one with the water pipe leading to a cistern near his dwelling, and one with the gas pipe leading all over town, he heard the electrical crackle going on, substantially the same as is heard when the same connection is made during thunderstorms. He, however, reports that the auroral crackle was more [illegible] in its sound than the thunderstorm crackle, and that besides the crackle there were at intervals, of perhaps half a second each, separate short taps on the telephone diaphragm that gave a slight ringing sound.

Important Oriental Manuscripts.—The trustees of the British Museum have acquired a most important collection of Oriental manuscripts, consisting of 138 volumes, more or less fragmentary, containing (1) Arabic commentaries of the Bible, with the Hebrew text written by Karaite Jews; (2) liturgies and hymns both of the Karaites and the Rabbinic Jews; (3) Karaite polemical treatises; and (4) grammatical, lexicographical, and philosophical treatises. Among the commentaries with the Hebrew text are some of the highest importance. They rank among the oldest Arabic manuscripts hitherto known. Three are dated A.H. 348=A.D. 959, A.H. 395=A.D. 1004, and A.H. 437=A.D. 1045. The British Museum has hitherto possessed only one single manuscript of this kind, dated A.H. 398=A.D. 1007. Besides being of so early a date, these manuscripts show the cause of the law laid down in the Talmud, "that the sacred Scriptures must not be written in any than the square Hebrew characters." They demonstrate for the first time that the Jews were in the habit of writing the Scriptures in other characters. Another point of extreme interest to the Oriental student is the fact that, though the commentaries are written in Arabic, they contain large quotations from Anan's commentaries in Aramaic, thus proving beyond doubt that Anan, the founder of the Karaites, wrote in Aramaic—the language spoken in Palestine in the time of Christ.

Buried Cities in Greece.—Dr. Schliemann is carrying on new excavations at Hissarlik, with the assistance of two eminent German architects. No fewer than 150 workmen are daily employed in laying bare the foundation of the ancient cities. Two perfectly distinct cities have lately been discovered in the burnt stratum, the lower one resting on the large walls which have hitherto by mistake been attributed to the second city. Hissarlik now turns out to have been the Acropolis of this lower burnt city, this being proved by the walls and the pottery, as well as by two vast brick buildings, one of them 43 ft. broad by 100 ft. long, the other 23 ft. broad by less than 100 ft. long. These buildings seem to have been temples, a separate gateway, flanked by enormous towers, leading up to them. There are, besides, three or four large buildings, apparently dwelling-houses, but no smaller buildings. The city walls now stand out very imposing. They rest on a substructure of large blocks, 33 ft. high, afterwards superseded by great brick walls. All the treasures formerly found by Dr. Schliemann are now ascribed to the first burnt city. Dr. Schliemann has found in the temples copper nails of a very peculiar shape, weighing from 1,000 to 1,190 grammes. The second burnt city, being the third city from the rock, and hitherto identified with the Homeric Troy, turns out to have had but very small houses, and no lower town at all. Dr. Schliemann will continue his excavations till the beginning of August.

THE BRITISH ASSOCIATION.

By the Editor.

As I write the British Association meeting is drawing to a close. The final meeting of the General Committee has been held, mutual congratulations and laudations have been exchanged, and the sum of £1,286 raised on this occasion has been appropriated (all but a small balance for outside expenses) in grants "for scientific purposes." British Association science is disposed to rest and be satisfied (for the present); Southampton, if not altogether satisfied, has had quite enough of science, and is disposed to rest too. At the closing *soirée*, given by the Mayor and Corporation of the "good old town," as the former, with startling originality, calls Southampton, there was a crush, and finally a dance, in which somehow the dancers seemed to be shaking the dust of science from their feet.*

The next meeting is to be held at Southport, opening on September 19; and according to present plans, the meeting of 1884 is to be held in Canada! One of the greatest mathematicians living, Professor Cayley, of Cambridge, will be present at the meeting of 1883, which, had an Oxford man been appointed president, was to have been held at Oxford: as it is, the invitation of Oxford has been "postponed." *Tantæ*, &c.

GEOLOGY.

From the address of Mr. Etheridge, I extract the following passage, as of interest:—

"In Selsea I draw attention to a locality where historical evidence is based upon physical causes and changes that have long been, and still are going on, to modify the form, extent, and structure of the Sussex coast, from the mouth of Chichester Harbour to Littlehampton and Bognor. The peninsula of Selsea is celebrated in English history as one of the places where Christianity was first taught in this country. It was one of the most ancient Saxon establishments. This peninsula was granted by Edilwalch, King of the South Saxons, to Wilfred, the exiled Bishop of York, about the year 680. At that time it is stated to have contained 5,220 acres of land, with 85 families and 250 slaves. The parish now contains only 2,880 acres; 2,340 having been slowly denuded away by the action and encroachment of the sea. This encroachment and destruction during the past 800 years has been very extensive. The creek called Pagham Harbour, on the south-east side of the Bill or peninsula, was due to an irruption before the year 1345, when 2,700 acres of land were destroyed. The site of the ancient cathedral and episcopal palace of Selsea, believed to have been situated to the south-east of the present church of Pagham, is no longer to be determined, but there is no reason to doubt but that it stood nearly a mile out in what is now sea. We are led to believe that when Selsea became known to the English nation it was an island, and that in Bede's time the process of silting up the estuary must have commenced, and the completion of this process would seem to have been before the Conquest. The action of the tides on this coast carries the sand and shingle from west to east, therefore the gradual wasting which has taken place on the shore of Bracklesham Bay has served to supply a large portion of the material of which these marshes are formed. The ground on which Selsea, Bognor, Littlehampton, Worthing, and other places on the Sussex coast westward of Brighton are built, is of very recent formation, being composed of gravels, sands, and loam belonging to the post-pleiocene or pleistocene series."

BIOLOGY.

Professor Gamgee, in his opening address, gave a long, elaborate, and, to say the truth, rather wearisome account of scientific researches into the process of secretion. Our readers, except specialists (who, however, we trust, read KNOWLEDGE rather for simple accounts of matter outside their special department, than for such specialistic papers as would weary all other readers) would not thank us for more than the following brief summary:—

"Elaborate studies made by science into the process of secretion "have brought into greater prominence the dignity, if one may use the expression, of the individual cell. The process of secretion appears as the result of the combined work of a large number of these units. Each, after the manner of an independent organism, uses oxygen, forms CO_2, evolves heat, and derives its nutriment from the medium in which it lives, and performs chemical operations of which the results only are imperfectly known to us, and which depend upon peculiar endowments of the cell protoplasm, of which the causes are hidden from us. So long as the protoplasm is living, the gland cell retains its power of discharging its functions, and in many cases does so, so long as the intercellular liquid furnishes it with the materials required. In some cases, however, the gland cells are specially sensitive to a variation in the composition of the nutrient liquid, certain constituents of which appear to stimulate the protoplasm to increased activity. In the higher animals the cells, particularly in certain glands, are in relation to nerves which, when stimulated, affect in a remarkable manner the transformations of their protoplasm, leading to an increased consumption of oxygen, an increased production of carbonic acid, an increased evolution of heat, and an increased production of those matters which the cell eliminates, and which constitute its secretion."

ZOOLOGY.

Professor Lawson, in his address on Zoology, chiefly of a very technical character, made the following remarks on the work of the great naturalist we have lately lost:—

"Many now present would never forget the intense excitement which took place in the early days of the doctrine of evolution, and the manner in which Darwin's views were met at the meetings held at Oxford, Cambridge, Norwich, and Exeter. In those days whatever Darwin advanced was viewed with hatred and suspicion, and the popular mind only saw in his works that which tended to overthrow established beliefs in the existence of a Creator. But all the bitter attacks made upon him he met with silence, and never resorted to angry retort, for he could afford to disregard contumely and misrepresentation. The members of this department would also remember how, year by year, these attacks grew less frequent and bitter, and wholesale denunciation gave place to intelligent questioning, until at last Darwin's views were generally accepted by all scientists and inquiring minds as accurate, and a few months ago his coffin was followed, not only by scientists and laymen, but by clergymen of all denominations, many of whom, no doubt, thus sought to atone for the many unjust things which they themselves thought and said about him when they themselves were not really acquainted with the object of his labours. Darwin had the good fortune to live to see his doctrines promulgated, and almost universally accepted. All naturalists regarded him with an admiration and respect accorded to no naturalist since the days of Linnæus."

* In passing it may be noted that, had it been possible, some other place than the Hartley Institution should have been chosen for the *soirées*, as the Institute had to be closed for a whole day before each, and it is the only place in the "good old town" where there is anything like a library, with such works of reference as men of science value. "Closed for decorations," the janitor's answer to visitors at these times, led to the suggestion that the Institute was not primarily intended for *soirées*; though, indeed, there was nothing in the way of decorations which might not have been arranged by active assistants in an hour or two.

INTELLIGENCE IN ANIMALS.—An acquaintance placed his parrot on the lawn to watch the people. A large cat walked up to make its acquaintance. "Thwish, wish, go away!" Cat declines, goes closer. "Rough, Rough, come here!" (whistles). Rough comes, cat departs.—JOHN ALEX. OLLARD, F.R.M.S.

PROFESSOR BOYD DAWKINS ON RIVER DRIFT MAN.

THE following is an abstract of Professor Boyd Dawkins's address to the department of Anthropology, or at least of that portion of it which relates to our Pleistocene ancestor, River Drift Man—a term not meaning, by-the-way, as many (we fear) imagine, a being who passed the principal part of his time in drifting about rivers, but man in that stage of human development whereof the chief evidence we have is found in river drift.

The characteristics of the evolution of living forms may be summed up as follows:

I. Eocene—in which the placental mammals now on earth were represented by allied forms belonging to existing orders and families. Living orders and families appear: lemurs (*lemuridæ*) in Europe and North America. Evidence found in fresh-water and marine strata; lignites.

II. Miocene—in which the alliance between living and placental mammals is more close than before. Living genera appear: apes (*simiadæ*) in Europe and North America. Evidence—fresh-water and marine strata; volcanic *débris* (Auvergne); lignites.

III. Pliocene—in which living species of placental mammals appear. Living species appear; apes, *simiadæ*, in Southern Europe. Evidence found in fresh-water and marine strata; volcanic *débris* (Auvergne).

IV. Pleistocene—in which living species of placental mammals are more abundant than the extinct. Man appears; *anthropidæ*, the palæolithic hunter; living species abundant. Evidence—refuse-heaps, contents of caves, river deposits, sub-marine forests, boulder clay, moraines, marine sands, and shingle.

V.—Prehistoric—in which domestic animals and cultivated fruits appear. Man abundant, domestic animals, cultivated fruits, spinning, weaving, pottery making, mining, commerce; the neolithic, bronze, and iron stages of culture. Evidence camps, habitations, tombs, refuse heaps, surface accumulation, caves, alluvia, peat bogs, submarine forests, raised beaches.

VI. Historic—in which the events are recorded in history. Evidence—documents, refuse heaps, caves, tombs.

The orders, families, genera, and species in the above summary, when traced forward in time, fall into the shape of a genealogical tree, with its trunk hidden in the secondary period, and its branchlets (the living species) passing upwards from the Pliocene, a tree of life, with living mammalia for its fruits and foliage. Were the extinct species taken into account, it would be seen that they fill up the intervals separating one living form from another, and that they too grow more and more like the living forms as they approach nearer to the present day. It must be remembered that in the above definitions the fossil marsupials are purposely ignored, because they began their specialization in the secondary period, and had arrived in the Eocene at the stage which is marked by the presence of a living genus—the opossum (*Didelphys*).

It will be seen that our inquiry into the antiquity of man is limited to the last four of the divisions. The most specialised of all animals cannot be looked for until the higher mammalia by which he is now surrounded were alive. We cannot imagine him in the Eocene age, at a time when animal life was not sufficiently differentiated to present us with any living genera of placental mammals. Nor is there any probability of his having appeared on the earth in the Miocene, because of the absence of higher placental mammals belonging to living species. It is most unlikely that man should have belonged to a fauna in which no other living species of mammal was present. He belongs to a more advanced stage of evolution than the mid-Miocene of Thenay. Up to this time the evolution of the animal kingdom had advanced no further than the *Simiadæ* in the direction of man; and the apes then haunting the forests of Italy, France, and Germany represent the highest type of those on the earth.

We may also look at the question from another point of view. If man were upon the earth in the Miocene age, it is incredible that he should not have become something else in the long lapse of ages, and during the changes in the conditions of life, by which all the Miocene land mammalia have been so profoundly affected, that they have been either exterminated, or have assumed new forms. Nor in the succeeding Pliocene age can we expect to find man upon the earth, because of the very few living species of placental mammals then alive. It is not until we arrive at the succeeding stage, or the Pleistocene, when living species of mammalia begin to abound, that we meet with indisputable traces of the presence of man on the earth.* The rudely chipped implements of the River-drift hunter lie scattered through the late Pleistocene river deposits in Southern and Eastern England in enormous abundance, and as a rule in association with the remains of animals of Arctic and of warm habit, as well as some or other of the extinct species of reindeer and hippopotamus along with mammoth and woolly rhinoceros.

The geographical change in Northern Europe at the close of the Forest-bed age was very great. The forest of the North Sea sank beneath the waves, and Britain was depressed to a depth of no less than 2,300 ft. in the Welsh mountains, and was reduced to an archipelago of islands, composed of what are now the higher lands. The area of the English Channel also was depressed, and the "silver streak" was wider than it is now, as is proved by the raised beach at Brighton, at Bracklesham, and elsewhere, which marks the sea-line of the largest island of the Archipelago, the Southern Island, as it may be termed, the northern shores of which extended along a line passing from Bristol to London. The northern shore of the Continent at this time extended eastwards from Abbeville, north of the Erzgebirge, through Saxony and Poland, into the middle of Russia, Scandinavia being an island from which the glaciers descended into the sea. This geographical change was accompanied by a corresponding change in climate. Glaciers descended from the higher mountains to the sea level, and icebergs, melting as they passed southwards, deposited their burdens of clay, sand, and erratics, which occupy such a wide area in the portions then submerged of Britain and the Continent. This depression was followed by a re-elevation, by which the British Isles, a part of the Continent, and all the large tract of country within the 100 fathom line, again became the feeding-grounds of the late Pleistocene mammalia.

An appeal to the animals associated with the River-drift implements will not help us to fix the exact relation of man to these changes, because they were in Britain before as well as after the submergence, and were living throughout in those parts of Europe which were not submerged. It can only be done in areas where the submergence is clearly defined. At Salisbury, for instance, the River-

* The Pleistocene period is the equivalent of the Quaternary of the French, and the Post-pliocene of the older works of Lyell, and including all the phenomena known in latitudes outside the Arctic Circle, where ice no longer is to be found, under the name of glacial and inter-glacial.

drift hunter may have lived either before, during, or after the southern counties became an island. When, however, he hunted the woolly and leptorhine rhinoceros, the mammoth, and the horse, in the neighbourhood of Brighton, he looked down upon a broad expanse of sea, in the spring flecked with small icebergs such as those which dropped their burdens in Bracklesham Bay. At Abbeville, too, he hunted the mammoth, reindeer, and horse down to the mouth of the Somme on the shore of the glacial sea. The evidence is equally clear that the River-drift hunter followed the chase in Britain after it had emerged from beneath the waters of the glacial sea, from the fact that the river deposits in which his implements occur either rest upon the glacial clays, or are composed of fragments derived from them, as in the oft-quoted cases of Hoxne and Bedford. Further, it is very probable that he may have wandered close up to the edges of the glaciers then covering the higher hills of Wales and the Pennine chain. The severity of the climate in winter at this time in Britain is proved, not merely by the presence of the Arctic animals, but by the numerous ice-borne blocks in the river gravels dropped in the spring after the break-up of the frosts.

The River-drift man is proved, by the implements which he left behind, to have wandered over the whole of France, and to have hunted the same animals in the valley of the Loire and the Garonne, as in the valley of the Thames. In the Iberian peninsula he was a contemporary of the African elephant, the mammoth, and the straight-tusked elephant, and he occupied the neighbourhood both of Madrid and Lisbon. He also ranged over Italy, leaving traces of his presence in the Abruzzo, and in Greece he was a contemporary of the extinct pigmy hippopotamus (*H. Pentlandi*). South of the Mediterranean his implements have been met with in Oran, and near Kolea in Algeria, and in Egypt in several localities. At Luxor they have been discovered by General Pitt-Rivers in the breccia, out of which are hewn the tombs of the kings. In Palestine they have been obtained by the Abbé Richard between Mount Tabor and the sea of Tiberias, and by Mr. Stopes between Jerusalem and Bethlehem. Throughout this wide area the implements, for the most part of flint or of quartzite, are of the same rude types, and there is no difference to be noted between the *haches* found in the caves of Cresswell, in Derbyshire, and those of Thebes, or between those of the valley of the Somme and those of Palestine. The River-drift hunter ranged over the Indian peninsula from Madras as far north as the valley of the Nerbudda. Here we find him forming part of a fauna in which there are species now living in India, such as the Indian rhinoceros and the arnee, and extinct types of oxen and elephants. There were two extinct hippopotami in the rivers, and living gavials, turtles, and tortoises. It is plain, therefore, that at this time the fauna of India stood in the same relation to the present fauna as the European fauna of the late Pleistocene does to that now living in Europe. In both there was a familiar association of extinct and living forms, from both the genus *Hippopotamus* has disappeared in the lapse of time, and in both man forms the central figure.

We are led from the region of tropical India to the banks of the Delaware, in New Jersey, by the recent discoveries of Dr. C. C. Abbott. Here, too, living and extinct species are found side by side.

Thus in our survey of the group of animals surrounding man when he first appeared in Europe, India, and North America, we see that in all three regions, so widely removed from each other, the animal life was in the same stage of evolution, and "the old order" was yielding "place unto the new." The River-drift man is proved by his surroundings to belong to the Pleistocene age in all three. The evidence of Palæolithic man in South Africa seems to me unsatisfactory, because as yet the age of the deposits in which the implements are found has not been decided.

The identity of the implements of the River-drift hunter proves that he was in the same rude state of civilisation, if it can be called civilisation, in the old and new worlds, when the hands of the geological clock pointed to the same hour. It is not a little strange that his mode of life should have been the same in the forests to the north and south of the Mediterranean, in Palestine, in the tropical forests of India, and on the western shores of the Atlantic. The hunter of the reindeer in the valley of the Delaware was to all intents and purposes the same sort of savage as the hunter of the reindeer on the banks of the Wiley or of the Solent.

It does not, however, follow that this identity of implements implies that the same race of men were spread over this vast tract. It points rather to a primeval condition of savagery from which mankind has emerged in the long ages which separate it from our own time. It may further be inferred, from his widespread range, that the River-drift man (assuming that mankind sprang from one centre) must have inhabited the earth for a long time, and that his dispersal took place before the glacial submergence and the lowering of the temperature in Northern Europe, Asia, and America. It is not reasonable to suppose that the Straits of Behring would have offered a free passage, either to the River-drift man from Asia to America, or to American animals from America to Europe, or *vice versâ*, while there was a vast barrier of ice or of sea, or of both, in the high northern latitudes. I therefore feel inclined to view the River-drift man as having invaded Europe in pre-glacial time along with the other living species which then appeared. The evidence, as I have already pointed out, is conclusive that he was also glacial and post-glacial.

In all probability the birthplace of man was in a warm, if not a tropical, region of Asia—in "a garden of Eden:" and from this the River-drift man found his way into those regions where his implements occur. In India he was a member of a tropical fauna, and his distribution in Europe and along the shores of the Mediterranean prove him to have belonged either to the temperate or the southern fauna in those regions. It will naturally be asked, to what race can the River-drift man be referred? The question, in my opinion, cannot be answered in the present stage of the inquiry, because the few fragments of human bones discovered along with the implements are too imperfect to afford any clue. Nor can we measure the interval in terms of years which separates the River-drift man from the present day, either by assuming that the glacial period was due to astronomical causes, and then proceeding to calculate the time necessary for them to produce their result, or by an appeal to the erosion of valleys, or the retrocession of waterfalls. The interval must, however, have been very great to allow of the changes in geography and climate, and the distribution of animals which has taken place—the succession of races, and the development of civilisation before history began. Standing before the rock-hewn tombs of the kings at Luxor, we may realise the impossibility of fixing the time when the River-drift hunter lived in the site of the ancient Thebes, or of measuring the lapse of time between his days and the splendour of the civilisation of Egypt. In this inquiry I have purposely omitted all reference to the successor of the River-drift man in Europe—the Cave man, who was in a higher stage of the hunter civilisation. In the course of my remarks you will have seen that the story told by the rudely chipped implements found at our very door in this place (Southampton), forms a part of the wider story of the first appearance of man, and of his distribution on the earth.

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

By Miss Amelia B. Edwards.

VIII.—CONDITIONS OF PLACE AND DATE.

Whether the mounds of Tel-el-Maskhuta* do, or do not, cover the ruins of the city of "Raamses" is a question which can, perhaps, only be placed beyond dispute by the spade of the excavator; but, pending that final test (which I trust is not far distant), the evidence in its favour is undoubtedly very much stronger than any which can be adduced in favour of the other sites before mentioned. And, strong as it is, I scarcely think that every point in that evidence unless very cursorily by myself,† more than two years ago—has yet been fairly stated.

Before proceeding to examine that evidence, however, it will be well first to note the conditions which have to be fulfilled by any sites claiming to represent the "treasure-cities" of the Bible, and then to see how far these conditions agree with the sites advocated by Herr Brugsch, M. Chabas, and others; namely, Tanis, Pelusium, Heliopolis, Babloon, and Toossoom.

1. We have to look for two "treasure-cities," or Bekhennu, dating from the reign of Rameses II.; *new* cities, be it observed, "built for Pharaoh," like so many others during that reign.

2. We have to look for them (for the reasons already stated) in the land of Goshen; a district also known at and after the time of Moses as "the land of Rameses."

3. Being twin cities, the one sacred to Tum, the other sacred to Ra (in the divine person of Rameses), with, as it were, an inter-dependent worship, we may reasonably expect to find them somewhat near together.

Now, as regards the first condition, that of newness:—Tanis (Zoan), which Brugsch absolutely identifies with Raamses, must be at once rejected; for the sanctuary of the Great Temple was as old as the excessively remote period of the VIth dynasty; besides which, the mounds of Zoan are to this day strewn with remains dating from the XIIth and XIIIth dynasties, and with remains of the Hykshos period, all many centuries earlier than Rameses II. Furthermore we have the authority of the Bible (Numbers xiii., 22) for the fact that "Hebron was built seven years before Zoan in Egypt;" Hebron being a place as old as the time of Abraham. Of Pelusium we cannot speak positively, for the original Egyptian name and early history of this city are unknown; but Heliopolis was certainly older than Rameses II. by something like sixteen hundred years. The great temple of Heliopolis was, at all events, founded by Usertesen I., second Pharaoh of the XIIth dynasty. Babloon, a stout old fortress of the Roman period, built in genuine Roman fashion in courses of thin red bricks, is just as much too modern as Heliopolis is too old: and Toossoom, which consists of a few unimportant remains on a sandy height at the S.E. extremity of Lake Timsah, going from Ismailiah to Suez by the canal, is altogether inadmissible.

Our second condition is that Pa-Rameses and Pa-Tum shall be situate in the Land of Goshen. Again, therefore, Tanis must be rejected; for Tanis, the capital of the province known to the Greeks as the Nome Tanites (of which the Egyptian name was Khent-Abot) is certainly not in the Land of Goshen. Neither is Heracleopolis Parva, which Brugsch identifies with Pa-Tum (Pithom), and which is represented by a mound close upon the marshy shores of Lake Menzaleh, in a district of which the ancient provincial classification is unknown. Herr Brugsch, according to a proposed derivation which we will presently examine, believes this part of the sea-board of the Delta to form part of the ancient Sethroitic Nome; but the position of the Sethroitic Nome has yet to be determined. Pelusium, which M. Chabas identifies with "Raamses," and Etham, which he identifies with "Pithom," are neither of them in the Land of Goshen, but lie off upon the coasts near the Pelusiac mouth of the Nile, in that same district which Brugsch ascribes to the Sethroitic Nome. And as for Heliopolis, the capital of the Heliopolitan Nome, and Babloon, the Roman fortress already mentioned, so far from being situate in the Land of Goshen, the one is but five miles from Cairo, and the other is a part of Cairo, or rather of ancient Fostát, just outside Cairo.

Lastly, we may expect to find "Raamses" and "Pithom" not very far apart. Pelusium and Etham, Tanis, and the mound by Lake Menzaleh, are within a moderate distance of each other, and so fairly meet the requirements of the case. But Heliopolis and the rest stand alone; and even those who recognise Pa-Rameses in one or another of them, have no neighbouring mounds to propose for the companion site of Pa-Tum.

To sum up:—Pa-Rameses was a "treasure city" founded by Rameses II. in the land of Goshen. Neither Tanis, Heliopolis, nor Babloon were either founded by Rameses II. or situate in the land of Goshen. Of the foundation of Pelusium, and of its Egyptian name, we are ignorant; but it was not situate in the Land of Goshen. Of Toossoom we know nothing, save the insignificance of its remains, the improbability of its position, and the fact that it was in the Arabian Desert, and not in the Land of Goshen.

(*To be continued.*)

* [illegible] happens that the valley in which the British troops are now encamped between Ismailia and Zagazig is the precise scene of our present inquiry; and it was on Tel-el-Maskhuta, described by [illegible] as "a remarkable mound of [illegible]" that Sir Garnet Wolseley [illegible] the engagement of August 24 (see *The Times*, August 2[illegible]). Tel-el-Kebir, where Arabi's forces are [illegible], been proposed as the [illegible] site of [illegible], as will hereafter be shown, another [illegible] known as Tel Abu [illegible], has more evidence [illegible].—A. B. E.

† See my letter on "The Site of Raamses," *The Academy*, April 24, 1880.

THE SEAT OF WAR IN EGYPT.

By Miss Amelia B. Edwards.

In a letter to the *Times*, Miss Edwards remarks on the biblical and archæological interest which attaches to the valley through which the British forces are now fighting their way from Ismailiah to Zagazig:—

"The Freshwater Canal by which this valley is traversed follows the course, and in some places flows in the actual bed, of a canal constructed by Seti I., second Pharaoh of the XIXth Dynasty; which Canal, starting like the present work from the marsh lands near Bubastis (the modern Zagazig), was carried during the lifetime of Seti as far as the sheet of water now known as Lake Timsah. After his death, it was continued, probably as far as the Red Sea, by his son and successor, Rameses II. This valley anciently formed part of the Land of Goshen.

"According to De Rougé, Mariette, Lepsius, and the majority of Egyptologists, it was under Rameses II. that the Egyptians made the lives of the children of Israel 'bitter with hard bondage;' and in the opinion of the same high authorities (an opinion based upon evidence which I am at this present time examining in the columns of a contemporary publication)* the mound of Maskhuta, or Mahuta—the same 'remarkable mound of considerable height and great size' upon which your war correspondent tells us in his despatch of the 24th inst. that 'our feeble battery was placed' marks the site of the city of 'Raamses,' for the building of which the Hebrews were compelled to make bricks with stubble of their own gathering. These bricks, moulded of sun-dried clay mixed with chopped straw, and stamped, some with the cartouche of Rameses II., and some with the cartouche of his successor Menephtah, the Pharaoh of the Exodus, are to be found in any number in and about the mound.

"Two neighbouring mounds are claimed as the site of Pithom, the other 'treasure-city' of the Bible:—1. Tel-el-Kebir, where there is a village and station on the line, and whence, according to Sir G. Wolseley's official telegram in the *Times* of Saturday, August 26, the rebel army was reinforced by railway on the 24th inst.; 2. Tel-Abu-Sooleyman, a mound lying somewhat south of the mouth of the valley, in the direction of Belbeis.

Tel-el-Maskhuta is situate within a few hundred yards of the station marked 'Rameses.'"

SCIENCE IN ITS APPLICATION TO DOMESTIC LIFE.

By Percy Russell.

The adaptation of scientific discovery, in all its multifarious results, to the ordinary routine wants of humanity, must surely rank among the greatest practical triumphs of the age. It is not so very long since science—and, indeed, most matters to which the phrase technical could be rightly applied—were purely esoteric, and the mass of mankind was expected rather to express admiration for, than to participate in, the work of the foremost *savants* of the day. It has been aptly observed of Plato, for example, that, like Acestes, in Virgil, he aimed at the stars, but struck nothing; while Bacon, the father of experimental and practical philosophy, fixed his eye on a mark within the human range, and hit it in the centre. In a word, the former began and ended in mere metaphysics; but the latter, commencing in accurate observation, closed in a variety of arts, all of which have benefited mankind materially.

The second annual Exhibition of Domestic Labour-saving Appliances and Articles designed for the promotion of household thrift, opened at the Agricultural Hall, London, on Aug. 24, is in many ways a practical and highly suggestive commentary on the above view of the new relations, comparatively speaking, of science and normal contemporary life. Here we have palpably before us the tangible results of much patient philosophical thought, of profound chemical research, and especially of the higher mathematics whose practical use is so little understood by the majority. The season—and it had endured for centuries—of exclusiveness in science has finally vanished, and its greatest expositors now no longer deem it beneath their dignity to adapt the best results of even their profoundest inquiries to the abridgment of human labour, the prevention of disease, the multiplication of even mere material comforts, and, indeed, to very much that, some generations ago, was generally deemed beneath the dignity, and even outside the proper province, of our principal philosophers. One important outcome of this vast change has been to give a breadth to scientific inquiry which was often wanting before, and to infuse into it an accuracy which was sometimes absent when speculation took a merely metaphysical form. If, observes an able writer, a mathematician made a blunder in defining the properties of eight circles on a sphere, the world was none the worse, but if he made a mistake in estimating the centrifugal force in a wheel, he might indirectly wreck a factory.

The Domestic Exhibition comprehends, indeed, a variety of appliances and contrivances, many of which are founded on the most exact scientific principles, related to such homely, but, rightly viewed, all-important subjects as lighting, warming, and ventilating buildings, the more effective and wholesome preparation and cooking of food—a thing of equal moment to the *savant* and the ignoramus—the labours of the laundry, sundry purely hygienic matters, and, finally, to that admirable, healthy, and refining recreative utility—if the phrase may be used—gardening.

It will be readily perceived from this slight sketch that the various exhibits cover a very wide range indeed, and include much that is really of the highest importance to the material well-being of our household life, both in its outdoor and indoor aspects. In regard to the ventilation of buildings—a matter of the most vital consequence—I noticed an admirable self-acting air-pump ventilator, which is automatic in its working, and can be applied with equal facility to all kinds of buildings, great or small, and is, moreover, capable of being harmoniously blended with any style of architecture. This ventilator is constructed on accurate scientific lines, and ought to be carefully studied by all interested in the subject of ventilation. We noticed, *inter alia*, a very effective gas-engine, which has much to commend it where moderate motive-power is a desideratum. The engine is simple, safe, and economic. It occupies very little space, and may be placed in the upper storey of an ordinary house. There is no danger whatever of explosion, and as a substitute for manual power it is undoubtedly of comprehensive utility.

Another noteworthy labour-saver is that known as Griscom's electro-motor and automatic battery for sewing-machines, &c. The force required is obtained from a box of bichromate cells, and can, it is claimed, be regulated at the will of the operator.

There were also good examples of arrangements for warming buildings of all sizes; and, as might be expected, some excellent things in the way of gas-cooking stoves. The advantages of gas for cooking are certainly great, and the adaptation of some of the stoves shown to the purposes in view is in every way admirable.

The sanitary importance of pure water is now popularly appreciated, and it is generally understood that very much disease and premature death may be traced directly to the use of impure water. The battle of the filters is, therefore, a subject in which we are all of us interested, and I was certainly struck by a contrivance known as the "Filtre Rapide," which bids fair to come out of the competition a victorious champion. It is said to combine all the advantages, and to be destitute of all the disadvantages, of the best filter extant, while it has some valuable merits special to itself. These are great claims, but they appear justified by the facts. For one thing, the water during filtration is aërated thoroughly, while the filter can

* i.e. Knowledge.

be taken to pieces and properly cleaned at home by any person—an obvious advantage over some kinds in use.

With regard to constructional matters in respect to domestic architecture, &c., I saw some examples of improved glazing in one instance equally applicable to curved as to straight rafters; an excellent mechanical arrangement for opening fan-lights, sky-lights, &c. things causing extreme trouble in many houses; and above all, quite a new method of window ventilation, which is very simple, and yet ingenious: by merely lowering the top sash, which is made about a foot higher than the soffitt of the window opening, a free *vertical* current of air is introduced into the apartment between the glass of the top and bottom sashes, and yet to all appearance the windows are closed. Besides this the sashes are made to turn on centres end in line at any angle, and thus they can be cleaned from the inside only—a matter of no small importance. There are some other special advantages belonging to this invention, known as the Patent Imperial Window, which, by the-way, has already obtained two prize medals.

Economy in gas was not overlooked by exhibitors, as I observed a very good example of a burner regulator in action; some sectional hot-water coils, patent boilers, a portable heating apparatus, and several efficient hydraulic rams, self-acting, for raising water, were also among the features of the show.

Washing machines and laundry appliances in general were well represented, as were sewing-machines of many types, and other like matters, specially applicable to the ladies' section of the household.

Gardening requisites were in considerable force. I noticed some really striking exhibits in the way of wire arches, fencing, elegant trellis-work, garden furniture, and requisites of all kinds; aviaries, poultry-runs, and the like. Some of the designs in wire-work are really artistic, and these exhibits are equally useful and beautiful in the majority of cases. A very useful and truly economic appliance shown is a patent irrigator, which is well adapted for gardens of all sizes. Possessing, as it does, a horizontal and, at the same time, a revolving action, it can be furnished with such a variety of jets that natural rain may be simulated, from a mere mist to a heavy downpour. As a virtually self-acting apparatus, this irrigator is worthy the consideration of all who have gardens of any size.

Passing from outdoor to indoor requirements, a word must be said in praise of the Remington type writer, exhibited with an obvious improvement, inasmuch as lower case letters are now added, and thus it is no longer necessary to use exclusively capital letters. Some space is gained, and the appearance of the work produced is greatly enhanced. The merits of the type-writer are too well known to need further mention.

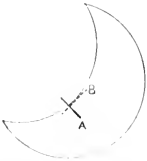
Viewed as a whole, this, the second exhibition of the [illegible] is a striking fact testimony to the benign efforts now generally made by our leading scientific men for the mitigation or amelioration of the ills and discomforts of human life, and for aiding in many practicable and truly beneficent ways the great cause of hygienic progress and domestic economy in these very [illegible]

HAS THE MOON AN ATMOSPHERE?

By Mr. Ranyard.

(Continued from page 215.)

Although Prof. Young had failed to find any trace of absorption caused by a lunar atmosphere, M. Thollon determined to repeat the observation. There were at Sohag two large bisulphide of carbon spectroscopes, one belonging to M. Trépied, the Director of the Observatory at Algiers, which had been made upon the model of M. Thollon's spectroscope, and the other M. Thollon's own instrument. The form of these spectroscopes does not permit the observer easily to turn the slit round. It was agreed, therefore, that they should be mounted so that the slit of one of them would be radial while the other was tangential at the part of the moon's limb where the last portion of the solar light would be visible. M. Trépied's slit was placed radially in the position marked by the thick line A



in the figure, while M. Thollon's slit was placed tangentially in the position indicated by the dotted line B. Their instruments were erected within a few feet of one another, in a building constructed of reeds and wood, some ten yards to the south of my tent observatory. It was arranged that during the partial phases of the eclipse I should visit their enclosure and observe with their instruments the spectrum close to the lunar limb. I cannot do better than give a translation of M. Thollon's account of his observation. It is taken from his report, which was presented to the French Academy, and is published in the "*Comptes Rendus*" for the 19th of June, 1882, page 1,633. He says:

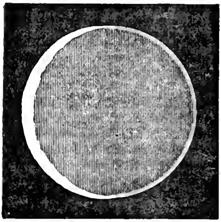
"My great apparatus performed marvellously, and had never given me more beautiful images. I passed in review with scrupulous attention all the telluric region of the spectrum, commencing at the red end. Between A and B I could not perceive any notable change. Arrived at B, I was quite surprised to see a decided reinforcement of the rays which compose this group. I hesitated to communicate this observation to M. Trépied, for fear of disturbing him, when he announced to me that he saw this reinforcement of the group B in a striking manner. It was of the highest importance to verify this fact; so, after some seconds of repose, I applied to it all the force of my attention. All the contour of the moon which was projected upon the sun was successively brought upon the slit, and, strange and inexplicable as it is to me, I did not succeed in reobserving the reinforcement as it had appeared to me in the first instance, nor even to see it in a manner I could be quite sure about. Mr. Ranyard and M. Puiseux, on being referred to, saw the phenomenon with the same certainty as M. Trépied in his apparatus, and with the same uncertainty as myself in mine. This difference was caused perhaps by the difference of the orientations. The slit of the spectroscope of M. Trépied being parallel to the line of centres, cut the limb of the moon perpendicularly, while my slit met the limb tangentially, or in a very oblique manner."

M. Trépied, in his report of observations of the eclipse published in the "*Comptes Rendus*," p. 1,639, says:—"I commenced in the red region; arrived at the B group, I observed a reinforcement of the dark lines close to the lunar limb. The group B, as one can see it in this instrument, is made up of a group of sixteen sharp lines, and then on the side towards A, of a series of double lines very regularly spaced. In this second part of the group it is always the least refrangible of the two rays which is the darkest; and it was the least refrangible ray of the pairs which was the most affected at the moon's limb. I tried to estimate to what distance from the limb of the moon the reinforcement extended. The part of each line which was darkened appeared to me to correspond to about 1-40th of the height of the spectrum. Since the length of the slit is 7 millimètres, and corresponds to an eighth part of the diameter of the solar image, it is easy to conclude that the absorbing layer, if it exists, which is capable of producing the observed reinforcement, does not extend to a height above 5″ above the moon's limb. The phenomenon was much less visible in the apparatus of M. Thollon, as Mr. Ranyard and M. André Puiseux bore witness. On the hypothesis that there is an absorbing layer about the moon, this difference of effect may be easily explained by the difference of the orientations; it will even be a necessary consequence. I ought to add that even in my apparatus the increase of intensity of the lines was incomparably more feeble during the last phases of the eclipse—very doubtful for Mr. Ranyard and nothing for MM. Thollon and André Puiseux."

I have given these observations at length, so that your readers may judge of the comparative certainty with which the observers principally concerned speak of the evidence they obtained as to the existence of absorption in the lunar atmosphere. My own examination of the spectrum before totality was very short, and in order to speak with certainty, I should have been glad of an opportunity of further examining the adjustments of M. Trépied's instrument. I can only speak with certainty as to the non-existence of absorption after totality when I examined the spectrum at greater leisure. Before totality, I did not notice the difference in the thickness of the double lines of the B group, though M. Trépied called my attention to the matter while I was looking through his instrument, and said that he had noticed such a difference. All the lines seemed to me to be slightly intensified near to the edge of the spectrum, where they were sharply cut off by the moon's limb.

I did not at the time make an estimate of the distance from the edge of the spectrum to which the slight thickening of the lines I thought I could detect extended, but the phenomena I observed (which may have been a mere physiological effect of contrast, or may have been due to a want of accurate focussing of the image of the solar crescent on the slit), extended to a distance of certainly more than 1-40th of the breadth of the spectrum. The next day, on talking the matter over, I thought that it must have extended to at least 1-10th of the breadth of the spectrum. A height of 5″ to which the darkening of the lines observed by M. Trépied extended would correspond to a height of nearly six miles above the moon's limb. In the terrestrial atmosphere absorption increases very rapidly as we approach the earth, and making all allowance for the difference between terrestrial and lunar gravity, it seems difficult to believe that phenomena of absorption could be traced to a height of twenty-four miles above the lunar limb.

It is quite possible that there might be a difference in the condition of the lunar atmosphere at the two limbs, for the limb of the moon which was examined before totality had just been exposed to the intense heat of the sun for a fortnight, while the limb which was seen upon the sun's disc after totality had been cooling during the long lunar night, and it is possible that absorbing vapours might arise under the solar heat which would again be deposited during the lunar night. Fortunately, it will not be necessary to wait for another total eclipse to repeat the observation. A partial solar eclipse is all that is required, and large spectroscopes in all parts of the world from which such an eclipse is visible may be simultaneously directed to the lunar limb.



In connection with this observation, I should like to direct the attention of naked-eye observers to the line of faint illumination which, at the time of new moon, is visible along the outer edge of the dark moon; that is, along the limb which has recently been exposed to the solar rays. Is this line of faint illumination due to dispersion of the sun's rays within an atmosphere which has been raised by the sun's heat? I think that it is pretty certain that the phenomenon is not due to an effect of contrast between the *lumière cendré* on the body of the dark moon and the background of sky: for I have held a circular diaphragm at a distance from the eye, so as just to exclude the light of the sky, and the band of faint illumination along the moon's limb was still visible; and my old friend, Mr. Webb, of Hardwick, has kindly repeated this observation for me, and confirms me as to the objective character of the phenomenon. It is difficult to see why, if the light is due to earthshine, the limb of the moon should be the brightest part. Such a band might possibly be caused by a phosphorescent light from the lunar surface, which slowly dies away as the lunar night advances. But if this were the case, there should not be a similar band of brightness seen along the dark limb of the morning moon, which has been in darkness for half a lunation. I should be glad to learn whether other observers see the band extending with equal brightness along the whole limb, or does it seem to them to be decidedly brighter in the region of the lunar equator? And do they see a similar band of brightness along the limb of the morning moon?

SCIENCE IN CANADA.

By the Editor.

A PROPOSAL has been made that a meeting of the British Association should be held in Canada, and in fact it has been decided, at least for awhile, that the meeting of 1884 should be held at Montreal. For my own part, I think the decision a mistake, and rather a serious one. Apart from objections raised with good reason by members of the British Association, the American Association for the Advancement of Science, which has much more life in it than the British, has been held this year at Montreal; and I rather imagine that if the British Association should meet there two years hence, there would be some degree of disappointment. I know what American tastes are in matters scientific, how much they prefer fresh to dried food in science, and I know that the kind of food purveyed, for example, at Southampton this year, would emphatically *not* suit American tastes, whether in the United States or in Canada.

But the *Times*, in an article which even in this silly season stands out conspicuous for combined silliness and insolence, finds a "more excellent" reason for disapproving the selection. This is what the *Times* (or some one who, having for the time the run of Jupiter's house, has found and put on an inappropriate lion-skin) tells us about Canadian science:—

"Canada is great in extent, but not great in science. Higher scientific views and less advanced thoughts than the British Association will bring with it would serve her as well for any instruction she will derive from them. Our scientific men must be well aware of this. They can have no serious purpose of holding a scientific meeting in Canada. Their wish must be to have an agreeable outing, to be looked up to with blank wonderment, to be pointed out wherever they go as the men who have done something or other which no other human beings have succeeded in doing, the magicians of the modern world, men skilful in strange, out-of-the-way arts. Their acquirements and their performances will be alike taken on faith. If they talk sense, they will be listened to. If they talk nonsense, they will be listened to all the same, and with the same degree of intelligent appreciation. We must not be surprised that our scientific men like the pose and the surroundings. They are mortal beings, of the same passions as the rest, and capable of being attracted in the same way as the rest. We do not at all grudge them the glory and the pleasure in store for them on their Canadian visit. Our only regret is that the gain of Canada will be our loss, and that in 1884, if the present design is carried out, we shall be deprived of the scientific lessons which the Association has given us during the last half-century. The invitation to Canada ought not, we think, to be accepted. A meeting of the Association in Canada can be in no sense the same thing as a meeting on English ground would be. But that the invitation should have been given, and should have been pressed, and that the way for its acceptance should have been as smooth as it could be, are very welcome signs of Canadian good feeling to the mother country. The wish of our colonists is that they should not be considered strangers to us. Their country is to be a part of our country. We are to be at home on their soil. The British Association is to be the common property of Great Britain and of Greater Britain. We are glad to be on these terms with Canada and with our other colonies. They are our rivals already in some things more congenial to their habit of life than scientific pursuits are. They have met us as oarsmen, and have beaten us so completely as to make us a little ashamed of ourselves. Special rules have had to be invented, in the interest of our pot-hunters, to prevent them from carrying away too many prizes at our regattas. In cricket we can hold our own, but even in cricket Australia runs us close." There is much more of this, but *quorsum hæc tam putida tendunt?* "Australian cricket has been a somewhat new revelation to us. We knew that they played cricket in Australia, but until they came over to this country and gave us proof what they could do, we had no notion that they played it so exceedingly well. Contests of this kind, on the river, or on the cricket field, or with the rifle, are healthy in every way. If they go against us we must accept our fate with the best grace we can, and must take comfort in the thought that we have been beaten by men of our own race and blood. But when the challenge is transferred to other ground, when we are asked to send our best scientific representatives to Canada, we may fairly ask for some proof that Canada is deserving of the compliment. Her hospitable intentions are beyond all doubt, but if her hospitality is accepted, it must be accepted on its own account, and not with any added notion that Canada is a fit place for a scientific gathering. We shall be sorry if the British Association is tempted away from its home duties for the sake of a run in Canada. With the movements of its members as individuals we have nothing to do, and surely Canada might be content to receive them as individuals, without insisting that they shall come as an associated host, and under a corporate name which has not been of their own creation, and which is not at their own disposal, but is common English property."

NEW VIEWS ON CRICKET.

SPEAKING of the cricket changes recently suggested in these columns, "A Lover of Cricket" makes the following remarks in the *Times* for September 1st:—"The suggested change is simply that while, as now, wicket after wicket should fall on either side till the tenth and last was taken, the fall of separate wickets should alternate between the two elevens, instead of the fall of all on one side alternating with the fall of all on the other. Thus, call the two sides A and B. Say side A, having won the toss, go to the wickets, the ground suiting them. After a while they lose a wicket; then side B go in, on ground very little changed, till, in turn, they lose a wicket. Side A go again to the wicket, sending in a man to replace the one whose wicket has fallen, precisely as in the game as usually played. After another wicket lost on side A, side B do likewise. And thus the sides alternate, wicket after wicket falling on either side, till the first innings is completed, the record of the innings appearing in precisely the same form as at present. Then a second innings is commenced, and, if possible, played out in the same way; if time does not allow this, the game is decided by the score when B's last wicket fell, at which time, of course, sides A and B have lost an equal number of wickets. If, on the other hand, the second innings is completed long before time is up (some time limit, as an hour or two hours, might be named in the laws), sides A and B would continue to send in man after man as before, till time expired.

"To illustrate this method, take the recent match between the Australians and England from the end of the first innings. The Australians, then in a minority of 38, would have sent in Massie and Bannerman, who (playing as they actually did) would have knocked off the deficiency and put 28 runs to the good before Massie's wicket fell. Then England would have sent in Hornby and Grace, who would have only knocked off 15 of the 28 before Hornby's wicket fell; so that when the Australians went in, with Bannerman and Bonnor, they would have been 13 to the good, increased to 17, when Bonnor's middle stump was knocked out of the ground. The loss of Barlow's wicket would have left England still 17 behind; and the loss of Bannerman's on the other side would have left the balance unchanged. Then Grace and Ulyett putting on 36 would have put England ahead by 19 runs. And so the game would have gone on with alternating positions (most interesting to spectators), till the end of the second innings, with England seven in arrears. But that would not have been the end of the game. All the remaining time on Tuesday and on Wednesday would have been occupied with a most interesting contest between the two elevens.

"It is claimed—and with obvious justice—for this method that, if it were followed, no game would ever end in a draw, none would fail to fill the whole time assigned to it, and in none would either side have any undue advantage from the state of the ground or weather. It may be added that matches played on this plan would be intensely interesting, and that neither side would be kept (as now often happens) waiting idly during a day, or even two days, of a long innings. But the three great advantages first named are such as to dwarf all others, and, I conceive, to make such few disadvantages as the system (properly arranged) might involve altogether as nothing by comparison.

"The system is worth trying. Once tried, I believe it would quickly replace the imperfect system at present in vogue, which in four cases out of five leads to most unsatisfactory results."

THE USE OF OPIUM.

At the quarterly general meeting of the British Medical Temperance Association, held recently in the rooms of the Medical Society of London, 11, Chandos-street, Cavendish-square, a paper was read by Dr. G. Shearer, of Liverpool, on "Recent Apologists for the Opium Trade." Dr. Norman Kerr presided. The attendance was small. The most powerful apologist, in his opinion, Dr. Shearer remarked, was the present Prime Minister. In 1870, during a debate in the House of Commons, in reply to Sir W. Lawson, Mr. Gladstone said, "I affirm that if we are to denounce the use of opium as something which is universally, essentially, and irretrievably bad, that must be done after it has been proved that the use of opium is to be broadly distinguished from the use of every other stimulant—a point which is not settled yet." But, argued Dr. Shearer, though there is a distinction to be drawn between opium and alcohol, and the common use of the former might vastly exceed in its baneful effects the common use of the latter, which there was an overwhelming weight of testimony to prove, still for the purpose of justice and fair dealing towards an injured people this was unnecessary. There was a preponderating weight of testimony as to the destructiveness of the vice. Among the Chinese people no advocates for the practice could be found; the nature of the commercial treaties between the Japanese and the Coreans and other nations, which were absolutely prohibitive of the trade in opium, and the action of the Indian Government in putting down the retail sale of the drug in Burmah, went as far in proof of the unmixed mischief caused by the use of opium, he should think, as Mr. Gladstone could desire. Against the views of Sir George Birdwood, Deputy Surgeon-General Moore, and Dr. Ayres, he set the evidence of many medical men, beginning with Dr. Kane, who had seen the results of the custom in his practice in the United States. Dr. Kane wrote that, "Viewed from any standpoint, the practice is filthy and disgusting; is a reef that is bound to sink morality; is a curse to the parent, the family, and the Government; is a fertile cause of crime, lying, insanity, debt, and suicide; is a poison to hope and ambition; a sunderer of family ties; a breeder of sensuality; a destroyer of bodily and mental function; and a thing to be viewed with abhorrence by every honest man and virtuous woman." The late Dr. Reid, of Hankow, stated that "Opium differed from alcoholic indulgence by the absolute necessity of having a daily quantity. A drunkard may abstain until means accumulate to enable him to purchase liquor, and may do his work efficiently in the intervals; but the opium-smoker must have his daily stimulant, or he breaks down." Dr. Myers, of Takow, Formosa, thought opium-smokers might be divided into two classes—first a minority who, being either officials or well-to-do persons, could afford to give vent to their passion and indulge to an extent which would in many cases justify the worst that had been said as to the effects and consequences of the vice; and, secondly, the majority, consisting of persons who were obliged to work hard for a living, and among whom moderation was the rule. Even among the former class there were some who had a remarkable power of self-regulation, taking just so much as they knew would abate the craving and remove the state of exhaustion, languor, and misery consequent on previous indulgence, and stopping short of all unmanageable or incapacitating indulgence. There was no doubt that many in this class retained sufficient self-control to continue the practice consistently with the discharge of their official duties or business, and with a fair measure of health and strength for many years. The tolerance of poisons by the human constitution was one of the most singular and least investigated of the processes of life. Having quoted the testimony of several observers, medical and official, as to the effects of opium-taking, Dr. Shearer spoke from his own experience, gained during a residence of over six years in China, which had led him to the conclusion that the Chinese did not enjoy even comparative immunity from consumption and diseases of the respiratory organs; that while the drug might be of value during the paroxysms of febrile disorders, it was not a prophylactic against fever, and that, considered merely as a stimulant and substitute for food, its usefulness had been overrated. The truth was, that many used the drug with apparent impunity for many years, and that many, but much the smaller number, were very seriously injured by the practice. Dr. C. R. Drysdale moved, and Dr. J. J. Ridge seconded the following resolution, which, after discussion, was unanimously adopted:—"That this meeting, having considered the evidence for and against the use of opium, condemns it as most injurious to health and happiness."

BUTTERFLIES AND MOTHS.

By W. J. H. Clarke.

THE PROMINENT MOTHS (*continued*).

In our last paper we gave a short sketch of the first six Prominent Moths, and this week we purpose finishing that family by giving desciptions of the remainder.

The last mentioned was the White Prominent (*Notodonta bicolor*), and next upon our list we find the Swallow Prominent (*Notodonta dictæa*). This is a very handsome species, the fore wings being of a greyish-brown tint in the centre, with the front edge darker, and a large purple-brown spot near the tip; the inner margin is of a fine brown, which shades off into the lighter colour of the centre. The hind wings are of a very pale hue, with a compound brown blotch at the anal angle; the body and thorax are brown. The caterpillar is green, with the usual yellow stripe down the side; it has also a black line on the twelfth segment. The leaves of the poplar and willow form its food, and the insect in all its stages should be looked for thereabouts.

Very similar to the last, and next in order comes the Lesser Swallow Prominent (*Notodonta dictæoides*). In colour it is precisely similar to *N. dictæa*, with the exception of the white mark on the anal angle of the fore wings, which is linear in *dictæa*, being wedge-shaped and more noticeable. This moth flies in June, and is not very abundant. The caterpillar is, we believe, green, with a yellow stripe similar to the last, but we have never had the good luck to capture one. It feeds on the birch.

The Iron Prominent (*Notodonta dromedarius*) next claims our attention. This moth should be sought for during the month of June, and though not common, it is to be found generally throughout the Midland and Southern counties of England. In colour the fore wings of this species are dull purplish brown, with a buff patch at the base of the front margin; the hind wings are greyish-brown. The caterpillar appears in August, and feeds on the birch and alder; it is yellowish green in colour, with a dull purple stripe down the back from the second to the fourth segments, and the remaining portion of the body is covered with small humps.

Next on our list of Prominents comes the Three-Humped Prominent (*Notodonta trilophus*). This very rare species is on the wing in May and August; the fore wings are dull yellowish brown, with two brown streaks, between which is a dull spot; the hind wings are white. The caterpillar may be sought for on the aspen, poplar, and birch during the month of July. It is dark-green in colour, with humps on several of the segments, and a reddish streak down the back, from the head to the fifth segment; along the spiracles is a broken, reddish streak.

The next species coming under notice is the Pebble Prominent (*Notodonta ziczac*). This, the commonest of the British Prominents, is one of the most handsome, and in the caterpillar state the most singular. The colour of the wings is yellowish brown, with a slight reddish tinge towards the upper margin; beyond the middle there is a large oval patch of purple and brown. The caterpillar is of a greyish colour, with three pale stripes on the sides, and is covered with humps in every direction; it feeds on the poplar, and is to be found towards the end of June, and in September and October. The perfect insect flies in May.

The last species of all is the Great Prominent (*Notodonta trepida*). It is the finest of its tribe, sometimes attaining the great size of two-and-a-half inches across the wings. The whole surface of the wings has a beautiful marbled appearance, the colour being smoky brown, with two streaks of a darker brown before the middle, and some brown spots on the hind margin. The perfect insect appears in May and June, and is rather rare. The caterpillar feeds upon [illegible] with two [illegible] down the back, and an [illegible] side of each segment. [illegible] September.

[illegible] we have endeavoured to point out the [illegible] species of this interesting family [illegible] appear to have taken as much [illegible] beautiful structure deserves, and we should [illegible] to thoroughly examine tree-trunks and [illegible] this and the next month, as many of the [illegible] be one more known by these means.

Our Paradox Corner.

[illegible]ROFESSOR SCHWEDOFF'S THEORY OF HAIL.

T[illegible] British Association supplies this year, and not for the first [illegible] a full-grown paradox, which students of science, who s[illegible] known better, have been ready to support.

[illegible] Section A, on Monday, Aug. 28, Prof. Sylvanus Thompson [illegible] occupied nearly an hour of the meeting's time with a most m[illegible] theory as to the origin of hail—a theory advanced origina[illegible] by Prof. Schwedoff, but adopted, or at least supported, by Prof. Thompson, despite its manifest absurdity. After describing [illegible] very large hailstones, including one (whose description was [illegible] by the meeting with irreverent laughter) as large as an [illegible] three days a-melting, Prof. Schwedoff contended in [illegible] that hail is not of atmospheric origin, generated from [illegible] not only in aerial storms, but comes from ultra-terrestrial [illegible]. In short, hailstones, according to this portentous theory, are [illegible] of cosmic origin.

Of course, with interplanetary space occupied, according to Dr. S[illegible] paradox, by aqueous vapour, nothing would be [illegible] than the formation of crystalline masses of water in extra-terrestrial space. These, wherever found, would be drawn [illegible] suppose; and the only way in which they [illegible] the earth would be when they were formed outside [illegible]. Then, if they were drawn towards the sun when it was [illegible] they would fall on that side of the earth which was [illegible] the sun—that is, where night was in progress. If [illegible] in the night, this would be a very ingenious theory [illegible] as a matter of fact, hail falls oftener in the [illegible].

S[illegible] rose to his feet, when his almost name[illegible] asked whether this meteoric theory of the [illegible] was put forward as a joke? He showed that meteoric [illegible] the atmosphere with planetary velocity would [illegible] 4,000 times as much work as would raise water one degree [illegible] rather thought would melt the hailstones. [illegible] little scenes which occasionally lighten [illegible] scientific talk-fights (the most utterly time-wasting [illegible] I know of). Lord Rayleigh slyly said he had [illegible] meteoric theory, which some said was advanced [illegible] as much as Schwedoff's—the theory that meteors, [illegible] burst planet, may have brought the germs of life [illegible] "The Kettle to the Pot objects," he seemed to [illegible] superfluous.") But Sir W. Thomson repudiated [illegible] in his notorious germ theory. He [illegible] he said, that life as it now exists [illegible] from meteoric visitants, fragments of a [illegible] millions of years before; but he maintained [illegible] to be impossible that some forms of life [illegible] a planet (wherefore Sir W. Thomson [illegible] imperfectly reported at Edinburgh). Neither [illegible] to be impossible that the moon is made of [illegible] to the meteoric germ theory the [illegible] theory of the verdant cavity of [illegible] the worse for either. Professor S[illegible] about the same footing. It is utterly [illegible] interplanetary space; still more [illegible] that such masses could reach the [illegible] reach the earth, they would not show, [illegible] preference for some regions and an utter [illegible] for example). Still, the theory is not [illegible] than Sir W. Thomson's germ theory, [illegible] myself in the days of my "scientific [illegible] whiteness (she being really more nearly [illegible] to snow on her plains, and slopes, and [illegible].

Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

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⁂ All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

ALCOHOL AND BRAIN WORK.

[536]—I think I can recognise the "learned friend" of whom you speak in your answer to the fiery denouncer of "fire-water," and perhaps a little more detailed information may be of use to you and others, from one who is as near as can be to a teetotaller from infancy, and yet may be said to be infinitely different from one, as the smallest known quantity is infinitely more than nothing. I am utterly indifferent to philosophy, whether alcohol is "poison," as milk is in excess, or "food," as castor oil is partially, or a constituent of the brain, as phosphorus is, or whatever anybody may choose to say that it is or is not.

I was four years at Cambridge, beginning nearly fifty years ago—a far more bibulous time than now—without ever drinking a glass of anything stronger than the college "swipes" given us at dinner, and occasionally a glass of the much better ale at a party, having been reared without even that, and disliking wine and spirits still more to this day. And I did much the same after I came to London, until I gave up even that small quantity of alcoholic drink—I forget for what reason; and I thought I did as well without it. But soon after I got into large practice at the Bar (without a scrap of notice, which I thought very unfair and unusual on the part of Nature), I became unable to sleep, often for several nights together, and never well except after some very bad nights. I guessed at the cause, and turned on my beer again, and gradually mended, but not completely for five years. After that I turned my beer into a daily half-pint of cider (in what the British merchant, the type of honesty all over the world, calls a pint bottle, with a false bottom which seems annually to increase), because I found beer tended to rheumatism and some kidney ailments, of which last, cider is a well-known preventive—at least to doctors in the cider counties, though to very few elsewhere, it seems.

That is my experience as a man working with my brains. My earlier experience as a worker with legs and hands was that alcohol is of no use whatever, and that seems to have been proved over and over again. I must add that I have known one man of considerable age able to go on doing hard work with his head on teetotalism, though I have known sundry, like myself, think they were doing very well on it for a time, and I have heard of a few others. Of course, that proves that some may while others cannot, and it may be worth everybody's while to try the experiment; but they had better watch it carefully, for fear Nature should play them the same trick as she did me, and come down upon them without notice. The cleverest doctor I ever knew, now dead, though the manager of a water-cure establishment, used to tell me the same, and particularly that he had annually to cure with a little disguised alcohol the leader of some teetotal society who used to come there annually for "water-cure," as he supposed.

YOUR "LEARNED FRIEND."

ALCOHOL AS A FOOD.

[537]—I have never in my life (not even when young and merry) known what it is to be intoxicated. I cannot find words to describe adequately the feelings of disgust, shame, and pity that a drunken man inspires me with. I dislike, and do not often visit, public places, but when for the sake of friendship I have to do so, the conventional small measure (one-eighth of a pint) of spirits dis-

comfits me very much, and it becomes a struggle for mastery (between myself and the unholy spirit). Yet I most emphatically declare that I consider alcohol a necessary "food" for me, "under the conditions in which I have to work and live."

These conditions are, "more or less," shared by many thousands of my fellow-creatures, from the artisan, trade professional, and literary classes, and differ very widely from the primeval condition of man described by Mr. W. Mattieu Williams in his letter (No. 514, p. 201). In such a condition, "all stimulants are unnecessary, and what is unnecessary must be injurious."

But even when man does not entirely spend his time in exhilarating pedestrian exercise, nor always breathe fresh mountain air and drink from the refreshing stream, he can (if he likes) dispense with stimulants, provided, first, he has the means, and secondly, the leisure, to secure for himself bodily comfort, fresh air, and exercise. These will supply the waste of energy by man's daily avocations in a far better manner than stimulants will do. But when man lives in what I may call the third condition (and which is my lot), then I say alcohol cannot be dispensed with.

My work is purely mental and literary. Of this I have about twelve hours daily. My meals occupy me about two hours, travelling to and fro about two hours, and I have eight hour's sleep, making in all the twenty-four hours of the day. I have two holidays in the year (Good Friday and Christmas Day). I am acquainted with the seaside from picture galleries; and with country rambles on bicycle or tricycle only from Mr. Browning's interesting articles in KNOWLEDGE.

To come to the point, I believe from my own experience stimulants have an injurious effect upon mental work. I dare not take the smallest quantity of it, in the middle of the day, without feeling hazy and giddy, and less able to see things clearly. But now I come to my chief assertion: "I take alcohol to overcome the fatigue of the body, caused by the labour of the mind, after the brain has done its daily work."

I draw particular attention that I used the term food for alcohol, and I maintain, in spite of a whole faculty, that there is a line below which alcohol (especially in its most natural combination, such as pure wine) is an ordinary food, above that line it is a stimulant, and above that "a poison."

I can neither afford to pay for, nor do I believe in the existence of, pure wines in this country. I therefore prefer good brandy, as being most agreeable and wholesome, and I will describe my method of taking it.

At night time, when tired and weary, a little brandy is sometimes necessary to enable me to fall into a good sleep, for after heavy mental work the mind will not easily rest of its own accord. I might therefore take for supper a cup of chocolate or coffee, with "one" (no more is necessary) small teaspoonful of brandy in it. If I take some light nourishment (I do not take heavy suppers), such as stewed fruit, rice, or some other farinaceous preparation, with milk, or milk and one raw egg mixed, then even half a teaspoonful of brandy will not only make these (mostly sweet) preparations agreeable to the palate, but also supply me with the necessary stimulative energy "to bridge over time intervening between cessation of work and the regaining of strength by natural means, such as rest or sleep." If by want of exercise I feel very low (and often bilious), then I do not take any food at all at night, but increase the quantity of brandy to two teaspoonfuls, taken in half a tumbler of soda.

I may also describe the consequences of not taking any brandy when feeling very low and fatigued. These begin about half-an-hour after repairing to bed, and consist in ceaseless energy of the brain, want of sleep, and gradual weakening of the action of the heart, which sometimes results in a distressing struggle for breath. Of course, a medical man would say—take more exercise! work less! go to the seaside! and buy a tricycle! But not being able to fill his behests, I must live (or die) my own way.

Let me finally add that, little as the quantity of alcohol is that I take, I wish it by no means to be inferred that I make a practice of it. I rather try to avoid taking it. When feeling strong enough, and well able to bear my daily task of labour, then sometimes weeks will pass without my taking a single drop of alcohol in any form whatever. MEPHISTO.

FAIRY RINGS.

"Where witches on kail runts did prance,
And whirling, led the merry dance."

[538]—I offer you a little contribution on the "Fairy Ring" puzzle, and trust that it may be suitable for the pages of KNOWLEDGE.

When a lad of ten years, I had occasion frequently to wander over a large old-land pasture field belonging to my father. It contained about 180 acres, and was sixty or seventy years' old grass, but had never been cut for hay. For forty-seven years I have kept up an intimate acquaintance with this large park, walking or riding over it almost every week in the year. My attention was very early called to the fairy rings, scattered all over the place. I had neither heard nor read of such rings, and many a time did I stand and wonder what produced them. I watched them from year to year, and saw them gradually widening the circle. Some of them I saw break on one side. The circle opened more and more, until it was shaped just like a D, thus), without the perpendicular stroke. Others I noticed broke up at two or three points of the circle, thus ◌, and thus ◌. My curiosity was aroused. I gave them more attention, and found some of the finest of the rings in a few years represented thus), and thus ;, all that remained of them.

About forty years ago (I am not sure to a year or two) we had a warm, damp, mothy summer. That year we had twenty horses grazing in the said park, and in the early autumn every horse-dropping produced a little plot of fungi. "Now," I said to myself, "I'll watch you;" for I had noticed that at a certain season of the year the same fungus grew on all the rings. These are my observations. The little plot of fungus of a foot in diameter of the first year was in the second autumn changed into a ring of three feet in diameter. When the fungus died off in the autumn, the grass springing up on the path of the fungus was dark blue, and what I believe to be a bad grass, as I never saw the stock eat it. On the little plot of a foot in diameter of the first year's fungi, there were no fungi in the second year, and the grass had assumed its natural colour in centre of the ring. The path of the fungus widened outwards, leaving yearly a larger inner circle of grass restored to its usual appearance. Some of these little plots which I knew forty years ago are now 180 feet in circumference. The most of the rings of forty years ago have become broken and scattered, and as good as lost to the ordinary observer. Rings are broken up by coming in contact with the path of contiguous rings, or old rings, or with spots of the land containing no food for fungus, and the remnants of them get into all shapes and sizes; but retain their bluish-green colour so long as any fungus grow. The spores of fungi permeate all soils, and only want proper food to develope them. The ring arises from the original manuring being applied in a circle, and the bed of fungi would take any other shape you wished, by laying on the dung in that shape. The fungi, once vigorously produced, will spread outwards on all sides for many years, but will not grow and thrive on the identical soil, without special manuring a second year. I don't think hay-tea will develope fungi, but I am not certain. The extremity of the tether of donkey, horse, or cow being the parent of a fairy ring is, I think, not a happy conjecture. I fear my letter is too long for KNOWLEDGE. Many thanks to Mr. Mattieu Williams for his fair and candid thoughts on this interesting subject. DAVID CARR.

[539]—When I was a lad, my father took me to see some very remarkable examples of these rings. They were of all sizes, from a foot in diameter to about fourteen feet; the colour light yellow, owing to the grass composing them having been killed. They were quite circular, and quite sharply-defined on the ground of green grass. The rim or body of these rings measured from two inches in the small ones to nearly a foot in the larger ones. They were all crowded together, and several of them intersected; but even then every part of each was sharply defined, and every one kept its own proper breadth and symmetry. These were the only examples I have come across where the grass composing them was killed. All the others I have seen were composed of grass much greener and of stronger growth than the rest of the lawn on which they appeared; for in every case which has come under my observation these rings appeared *on old, well-kept, frequently-mown lawns, and warm, very sheltered situations.*

To one like myself, who has lived all his days in the country, the idea of the rings, sometimes seen after haycocks have been removed, being mistaken for the true fairy rings, is amusing. It reminds me of a town cousin, who, the first time he saw haycocks, came to the conclusion that they had been put up to frighten the crows. JAMES PATERSON, Glasgow.

LEARNING TO SWIM.

[540] After reading your instructions on swimming, I thought you would not object to hear how I taught myself to swim. In the first place, I avoided the handbooks and bath-teachers, with their infernal belts, more than I would poison; in fact, the only thing I did, after watching how fellows swam and dived, was to dive myself. When in the water, I kept under as long as my oxygen lasted, struggling energetically the while in my endeavours to make

[illegible] water. [illegible] the surface, I kept on with [illegible] who watched my endeavours [illegible] that they never remembered [illegible].

[illegible] to be given to those boys who [illegible] in their compositions; [illegible] thought he would follow suit, and [illegible] water. This is what we saw: Two [illegible] touching the bottom; a head like- [illegible] about two feet from solid ground; a pair [illegible] visible above water. We thought this [illegible] movements of the arms and legs, [illegible], but one of our boys happily [illegible] kid was drowning, so we hauled him [illegible] would have ended his life. F. C. S.

[illegible] VEINS AND CYCLING—ARTISTIC PERCEPTION IN ANIMALS—ACCIDENT FROM LIGHTNING.

[illegible] that "Lacy Hillier" takes a somewhat [illegible] subject. I am not a medical man, but only [illegible] and from the information I have derived [illegible] I may say I have found more useful than that [illegible] the medical profession. Varicose veins [illegible] valves, whether double or single, no longer [illegible] stockings therefore being, as it were, to act [illegible] expansion and contraction as valves. An [illegible] the muscles in the leg into play is there- [illegible] provided the exercise is not carried to excess. [illegible] position, lying down [illegible] the best, [illegible] exercises, owing to the action of [illegible] veins of the thighs. Bicycling I have, [illegible] found the worst of all amusements, [illegible] varicose veins, as the actions of all the [illegible] brought evenly to bear on the veins. [illegible] worn after the veins have once [illegible] rest will cure the veins, for I [illegible] Walking and running are good for the veins; I [illegible] on foot, run trails, paper chases, &c., [illegible] not feel pain in the veins, whereas a [illegible] Having ridden a bicycle for over [illegible] a fair idea as to its influence on my [illegible] no cure for the veins, except extermina- [illegible] with the chances that fresh surface [illegible] others become varicosed under the [illegible] dangerous phase of the disease, I [illegible] with bad varicosers (as we call them) [illegible].

[illegible] Westwood Oliver's query at the end of [illegible] to say that, from experience, I find that [illegible] the cat looking at the mirror; i.e., [illegible] at once, others seem to do so and forget [illegible] fail to understand the deception [illegible] the reflection over and over again.

[illegible] from memory—it occurred some years ago [illegible] at the rectory of a clergyman. Please, [illegible] The house was struck three times in [illegible] on account of this I write) ac- [illegible] glass of one of the windows, leaving a clean [illegible] afterwards, which was fused evenly all round. [illegible] the drawing-room, and I believe ran down the [illegible] of the gas-piping in the basement. The [illegible] was considerable, as may be supposed.

F. C. S.

[illegible] VEINS AND CYCLING.

[512]—[illegible] cycling induces varicose veins. My [illegible] such effect. In many cases it seems [illegible] otherwise. For men who have been [illegible] and whose legs and feet, [illegible] and full, with a tendency to [illegible] removes this condition; [illegible] running or jumping. [illegible] I believe [illegible] provided [illegible] part of the dress con- [illegible]

A. Hartley, M.B.

[illegible] does not cause varicose [illegible] knee-breeches buckled, or tightly buttoned round the knees, does cause them. On learning to bicycle, about three years since, I had a narrow escape from having varicose veins, caused by the use of garters and knee-breeches as above. Since then I have always worn knickerbockers just large enough at the knee to allow the foot and leg to pass through (no elastic), and have a loop at the top of the stocking so as to pass a tape through it. The tape is fastened at the end of a piece of elastic, the top end of which is sewn on to the waistband of the knickerbockers. Braces must be worn to counteract the pull of the elastic.

E. F. B. Harston.

HERNIA AND TRICYCLING.

[514]—I am glad to see a letter in a recent issue of your valuable paper, a letter headed "Hernia and Tricycling." This is a subject I am interested in, as I suffer from that complaint, and am very fond of tricycling. Some of your readers may be glad to know my experience after having ridden some thousands of miles. I started by riding ten miles a day, and since then have increased it to seventy, and do not feel the slightest ill effects; on the contrary, my health is very much improved. I hope Dr. Richardson will still further investigate the matter, as I feel sure many people, suffering like myself, are denying themselves a most delightful and healthy pleasure through want of proper advice, which advice I consider can only be given by those who ride tricycles. Of course, there are some complicated cases of hernia where it would be most dangerous, but in the ordinary cases there can be no harm, providing persons are fitted with suitable trusses.

R. Sept. Alder.

TRICYCLES.

[515]—Having been an enthusiastic tricyclist for the last four years, and being the captain of a tricycle club, perhaps you will kindly allow me to say a few words upon the subject.

Mr. Browning overlooks two very important advantages gained by the front-steering machines.

1. In machines of the "Salvo" type, nearly the whole of the rider's weight is thrown upon the driving-wheels, sufficient weight only being thrown upon the steering-wheel to enable it to "bite." For this reason we have a dead weight on two of the wheels only, while in the case of a rear-steering machine, we always have a dead weight on three wheels, so in this respect the "Salvo" type of machine has an advantage almost equal to that of the "Otto," and, of course, when descending a hill with the feet on the rest, there is sufficient weight on the front steering-wheel to insure its answering its purpose without the fear of an accident.

2. Machines of the "Salvo" type can be so easily mounted from behind while in motion.

I drew attention to this important fact by a letter which appeared in the *Cyclist* some time ago. No time is lost in mounting or starting; the machine is mounted (as in the case of a bicycle) while you are running with it at full speed. The advantages of this are obvious; but they are not offered to us when riding a rear steering machine.

A great deal of the pleasure of tricycle riding is lost when sailing down hill on a machine of the "Meteor" type by the want of a comfortable foot-rest, as in the "Salvo," "Fleet," "Premier," &c., which enables one to stretch their legs for a while.

I think in the tricycle of the future it will not be so much a question of form as of a means for propelling machines by other than our legs as the motive power. Can the day be far distant when compressed air will be the chief mode of propulsion?

C. Carus-Wilson.

A WARNING.

[516]—Being desirous of obtaining the first three numbers of Knowledge, I advertised for the same in your "Sixpenny Sale Column." Among several answers I selected one and forwarded the amount by Post-office Order, but I have not received the papers nor heard anything further from the writer. I fortunately sent an Order payable ten days after date, which I have stopped. On the day I wrote to stop my previous order I received a post-card dating from a Post-office near Manchester. Thinking the writer was probably a clerk in the Post-office, I forwarded the amount, with the result that I have not received any papers or heard anything further about them. Thinking my experience of purchasing Knowledge may be of use to your readers, I venture to send this for insertion.

EXE.

ARE TOADS POISONOUS?

[517]—In reply to this query, I find the following in "Half-Hours in the Green Lanes." "All that is harmful about this poor beast (i.e. the toad) is the secretion of the skin, which is acid, and evidently protective. Many a young and playful puppy, that has

endeavoured to carry a toad in its mouth, has found out the properties of this secretion to its cost, and the foaming at its mouth has plainly indicated its disagreeable nature. . . . . This 'toad's envenom'd juice' has long been known to ancients as well as moderns."

W. Carling, Jun.

VEGETARIANISM AND FITS.

[548]—I have known two cases of epileptic fits cured by Vegetarian diet—one a man over forty, who lived and worked hard till past sixty; the other a young man still living. A vegetable diet is said to produce flatulence; it did the opposite with me—it cured it in about three months.

John Alex. Ollard, F.R.M.S.

THE CALEDONIANS.

[549]—Mr. Plaisher, in Knowledge of the 4th inst., asks, very naturally, as it has been so often said by those practically ignorant of the language, if the word Caledonii does not come from *coille-dhaoine*. Certainly not, as the usage of the language forbids it. We say *daoine-sith, daoine-uasal, daoine-Airghaelach*, &c., &c., but *not* the converse, *sith-dhaoine, uasal-dhaoine, Airghealach-dhaoine*. Such would be placing the cart before the horse, and quite inadmissible.

B. S.

STIMULANTS AND WORK.

[550]—I am heartily glad that you commented on the surprising dictum of Mr. W. Mattieu Williams, that the drinking of wine is a folly or a vice. There are many who are in the habit of taking wine every day of their lives, and who are yet neither foolish nor vicious. The man who enjoys a good dinner runs, I think, the same risk of being called foolish or vicious as the man who enjoys a glass of good wine. The folly begins, in my opinion, when a man exceeds and passes beyond moderation, either in eating or drinking. With the principle of total abstinence I disagree, because in its essence the principle is against nature.

Robert Macpherson, M.D.

ARTISTIC PERCEPTION OF ANIMALS.

[551]—I am not sure I quite understand the meaning of the last paragraph in your correspondent's letter. Does he wish to say that a cat, having seen its reflection in a mirror, becomes at once convinced of the true nature of the phenomenon, and therefore never cares to notice it again?

Having studied the habits of cats—animals in which I take a great interest—for many years, I am in a position to affirm that when a kitten sees itself in a looking-glass for the first time, it evidently imagines it has a stranger before it, and it is only after many experiments, such as touching the surface of the mirror, uttering certain sounds in cat-language (cats have a language), and, where possible, examining the back of the glass, that it at last becomes assured that what it sees is its *own* image.

M. W.

Answers to Correspondents.

∴ All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of Knowledge, *the increasing circulation of which compels us to go to press early in the week.*

Hints to Correspondents.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded, nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

Rev. J. J. Lambert will have to discontinue Knowledge unless the Amateur Electrician appears systematically, and there is more of it. Quite so; we must have weekly a page of electricity.—J. Hopkinson, L. Musgrave, R. S. Ripley, O. S. are very much disappointed that we have not more geology. Our geological contributor has disappointed us, but—yes we must have a weekly page of geology.—Telescopist, Mr. Patterson, John Baker, Young Astronomer (excuse me delaying reply to you for so long, but the questions and answers we are now dealing with we have been for some time collecting), M. S. Jellicoe, R. Watford, and others want regular astronomical papers with maps; this will occupy, say, two pages weekly.—Brevity says, "Please teach me the Greek alphabet: thanks in anticipation." Why, certainly. M. Tennant is well pleased with our papers on Moths and Butterflies, trusts they will appear regularly. Quite so: column and a half a week (this thing is getting monotonous.)—J. M. Petersen wants to know why we have discontinued Dr. Wilson's papers. We have not discontinued, but,—Let them appear regularly, one page a week. Next J. Leitsom knocks at our editorial door, "You have had very little lately of those charming writers, Mr. Grant Allen and Mr. Edward Clodd." We admit it, they are charming writers, and we have had little enough room for them lately. We must find two pages weekly for them.—J. Moss, Ignoramus No. 2, T. R., want more chemistry: a page a week.—J. Hargreave, R. T. P., M. Tillotson and others (come in), desire papers on metallurgy. Let us see if one page a week will do for this.—M. Compton and J. Bonney (*come* in), are good enough to say that they like the Editor's papers, and wish he would give more. Shall we give three pages weekly?—R. C. and S. D. P. (come in) want more Illusions.—R. Smith, X. Y. Z., L. Lucas, J. H. T., Q. Ellis, and others (come in! and leave the door open), want to know what place text-book matter on Electricity, Chemistry, etc., should have in a magazine which ought to be a sort of explanatory newspaper of science? What, indeed! we must at least have five pages of other matter for every page of the kind you object to.—For Ourselves, we remark that to oblige all and offend none is impossible; but to oblige all, without minding that some are offended, we want at least fifty pages of original matter besides ten or twenty pages for extracts of various sorts; in point of fact, we should provide a weekly shilling magazine for twopence. Fortunately, we have faith that the great majority of our readers are not quite so unreasonable as to expect this.—A Correspondent wishes to recommend a book by Mr. English, to those correspondents who wish to preserve flowers and fungi. Mr. English's book has already been mentioned in these columns.—A Derbyshire Subscriber. The monthly notices of the Astronomical Society are issued as their name implies, monthly, during the session of the society, or from November until June, with one supplementary number during the recess. They appear about five weeks after each meeting, and it is stated that they cannot appear earlier; but, somehow, when I edited them, I managed to make them come out three weeks earlier. They were formerly only to be obtained by Fellows; but when I was secretary of the society I brought in a motion changing this undesirable state of things, and they can now be obtained for a payment of 10s. annually—whether they are worth this, I will hardly venture to say. Looking back over the last year or two, I find that on the average about one-twentieth part of each volume contains matter of interest, and about nineteen-twentieths of that appears (generally rather earlier) elsewhere.—S. W. (answered by A. H. P.). Mix quicklime with water into a thick paste; spread on the wood, and leave for a few minutes until of the shade required.—Mr. Burton Fletcher (answered by John Browning). I beg to say that the machine ridden by Mr. Marriott in his wonderful ride through Wales was a "Humber" tricycle. At the time I wrote you the account of the ride, I was not aware what tricycle had been used, or I should certainly have given it. The address of the makers, which your correspondent may wish to know, is Humber, Marriott, & Cooper, Beeston, Nottinghamshire.

ENTOMOLOGY.

An Enthusiastic Subscriber. "British Entomology," by John Curtis, is the best book on the subject. It is published in eight volumes, by Lovell, Reeve, & Co., 5, Henrietta-street, Covent-garden. I do not know the price, but I think it might be bought second-hand, by advertising, for a moderate sum. If An Enthusiastic Subscriber will write to me, through the editor, stating what branches of entomology he wishes to study, I shall be pleased to recommend him the best manuals on the subject. Cloanthus. R. Maclachlan has written a very good catalogue of Neuroptera: it is published by the Entomological Society, I believe. The British Museum has also a catalogue, but written in Latin: I do not know if it can be procured by the general public. The first is the more recent.

Letters in Type. Artificial Stone, by Ernest L. R.; Highland Celts, by Charles Stewart; Brain Waves and Memory, and Brain Troubles, by Dr. Jope; A Luminous Sea, by H. P. Vacher; Ferguson's Mechanical Paradox, by F.R.A.S.; Size of Rising Moon, by G. E.; Local Weather Lore, by Michael Reardon; Singular Mental Illusion, by W. H. Perkins; A Glass of Wine, by W. H. Johnston, and H. F.; Drunkenness, by J. A. Ollard and W. Bevil Browne; Tarnished Daguerreotypes, by A Brothers; Physiological Experiment, by Z.; Skeleton Leaves, by E. C. N.; The Use of Drunkenness, by J. Ralph; Talking Canary, &c., by Charles L. Cane; Turkish Tobacco, by Tunbeko; Flint Jack, by J. E. Okill.

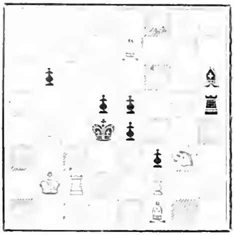
Our Chess Column.

By Mephisto.

PROBLEM No. 52

By H[illegible] J[illegible].

Black.



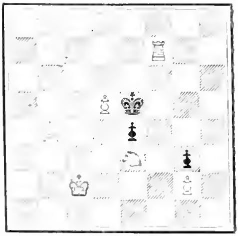
White.

White to play and mate in two moves.

PROBLEM No. 53.

By Leonard P. Rees.

BLACK.



WHITE.

White to play and mate in three moves.

The following is a brilliant specimen of a game at the odds of Pawn and two moves, played recently at Brighton.

Remove Black King's Bishop's Pawn.

White. Mr. ——	Black. Mr. F. Edmonds.	White. Mr. ——	Black. Mr. F. Edmonds.
1. [illegible]		12. P takes P	P to B4 (d)
2. P to Q4	P to K3	13. B to K3	Kt to Kt5
3. P to KB4 (a)	P to Q4	14. Q to B3 (e)	Kt takes B
4. P to K5	P to QB4	15. Q takes Kt	P takes P
5. P to B3	Kt to QB3	16. Kt takes P	B to B4
6. B to QKt5 (b)	Q to Kt3	17. R to Q sq	B to R3
7. [illegible] QB4	Kt to B3	18. P to QKt3 (f)	R tks P (g)
8. Kt to B3	Kt to K2	19. Q takes R	R to KB sq
9. Castles	Castles (c)	20. Q to K3 (h)	B takes Kt
10. B takes Kt	P takes B	21. Q takes B	Q tks Q (ch)
11. Q to QB2	P takes P	22. R takes Q	R to B8 mate

NOTES.

(a) No improvement on 3 B to Q3.

(b) [illegible] The [illegible] of the KBP ceases to [illegible] on the exposed side of the King by means of B to Q3 with a view to Q to R5. Besides, [illegible] this move.

(c) Black has soon got over his disadvantage, and White must now proceed on a very shallow current.

(d) Black seizes a favourable opportunity to attack the weak part in White's game, and the advance of this Pawn is the beginning of some very fine play.

(e) 14 B to B2 would not have a much better result, as Black would also proceed with Kt takes B, and P takes P, and B to B4, &c.

(f) White wanted to save this Pawn, whereby he lost valuable time. His position, however, was very weak, and it would have been of far more importance to him to abandon this Pawn and play Kt to R3, with a view of playing it to QB2.

(g) A very fine combination, which wins by force.

(h) This move facilitates victory. Had White played 20 Q to Kt3, then B takes Kt (ch), followed by B takes R, and Black would still win by being a piece ahead.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess-Editor.*

Leonard P. Rees.—6. Q takes KtP must result to White's advantage. 6. Kt takes BP would be more attacking, but less safe.

A. A. B. Best thanks for contribution.

Correct solutions of Problem No. 51 received from H. Seward, C. W. Croskey, H. V. T., E. J. G., Leonard P. Rees, C. J. Brown, Berrow, Geo. H. Bonner, Schmercke, T. Steele Sheldon, Tessir, H. B. Kingston, J. P.

W. H. G. Problem 47. If 1. Kt to Kt2, B to Ksq. 2. Kt to B4(ch), and Bishop mates.

A. Phelps Bennett.—Solution incorrect.

J. G. Dillon. In Problem No. 50, P to B8 for Black's second move is impossible.

A medal and prize, of the annual value of 20 guineas, has been founded by Charles William Siemens, D.C.L., F.R.S., "with the object of stimulating the Students of King's College, London, to a high standard of proficiency in metallurgical science." It is open to those who have, as matriculated students, studied in the Applied Science Department for two years, and who, either in their third year, or, if they remain in the Department for three years, in the succeeding year make metallurgy a special study. The first award will be made at the end of June, 1883, and will depend partly on an essay on some particular subject, partly on a written examination on the metallurgical lectures, and partly on actual work done in the laboratory. The subject for the essay for 1883 will be, "The Manufacture of Steel suitable for Ship and Boiler Plates." The essays are to be illustrated by freehand sketches and mechanical drawings to scale, and must be sent in to Professor Huntington on or before June 30.

NOTICES.

The Back Numbers of Knowledge, with the exception of Nos. 1 to 7, are in print, and can be obtained from all booksellers and newsagents, or direct from the Publishers. Should any difficulty arise in obtaining the paper, an application to the Publishers is respectfully requested.

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KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, SEPTEMBER 15, 1882.

CONTENTS OF No. 46.

Science and Art Gossip.

THE suggested cricket changes continue to form the subject of letters in the *Times*. "Old Harrovian" suggests a limitation of the first innings to one hundred runs, with corresponding limit to second innings if reached. Another writer mentions an excellent plan adopted at Philadelphia to decide games which otherwise would be drawn, viz., by taking the average runs per wicket taken, in unfinished games. He also notes how much time could be saved if cricketers would only play up, instead of lounging through the game as they often do. One writer (Old Kennington Club) thinks the new arrangement suggested in KNOWLEDGE would not do, because ten minutes, at least, would intervene between each wicket! He omits to notice how much time is lost, as it is, between each wicket. Of course, the plan proposed there might easily be modified, so that the changes would not occur too often. Twenty overs might be played before any change, and followed by as many as would be necessary to take as many wickets as had fallen during those overs. Other details could readily be altered. But it is little likely (as was pointed out in the first paper on this subject in KNOWLEDGE) that any change will be made by the M.C.C. Cricket is too agreeable a lounge to be altered by any arrangement that would ensure a real contest in every encounter. It is said that nine-tenths of our amateur players prefer drawn games.

THE Jews as yet do not seem to have gained that hold in the United States which they have obtained in most European countries. It appears by the census of 1880 that in that year there were only 230,984 Jews in the whole of the United States. But the emigration from Russia has added some 17,000 to the number, so that the total Jewish population of the country may be estimated at about 250,000. Out of this number New York claims 80,518; Pennsylvania, 20,000; Illinois, 12,625; California, 18,580; and Ohio, 12,581—these five States thus containing more than half the Jews of the entire country. There are 10,337 Jews in Maryland, 8,500 in Massachusetts, 7,538 in Louisiana, 7,380 in Missouri, 5,593 in New Jersey, and the rest are scattered over the country from Maine to Oregon. More than two-thirds of all the Jews of the country are congregated in the principal cities. New York has 60,000; San Francisco, 16,000; Brooklyn, 14,000; Philadelphia, 13,000; Chicago, 12,000; Baltimore, 10,000; Cincinnati, 8,000; Boston, 7,000; St. Louis, 6,500; New Orleans, 5,000; Cleveland, 3,500; and Newark, 3,500. This determination of the race to the centres of population is also a noticeable characteristic of the Jews in Europe.

As illustrating how the prospects of electric lighting are advancing, it may be noted that whereas, on the inquiry before the Select Commission, Dr. Siemens said that *it was impossible to supply electricity for domestic lighting, from one source, over a greater area than a square quarter of a mile*, at New York 5,000 lamps were lighted simultaneously over a district of one square mile, only one source of supply being provided, the electric light running through eighteen miles of mains. In the district there are 1,500 consumers of gas, of whom 1,100 have subscribed for the electric light.

THE statistics of the latest census of France, taken at the end of last year, show some singular results, although they cannot, says the *Times*, be said to be re-assuring to those who are interested in the future progress of the country [at least if we are to assume that the prosperity of a country is proportional to the population per square mile.—ED.]. The fact that the whole of France has experienced within five years only an increase of 766,260 inhabitants, is a disagreeable one to be faced, as representing practically an almost stationary condition of population; but it becomes still more unsatisfactory, when we find that this increase, small as it is, has to be credited almost entirely to five-sevenths of the larger towns, and that the rural population is distinctly retrograding. The census of 1876, which fixed the number of arrondissements at 362, of cantons at 2,868, and of communes at 36,056, showed the population to be 36,905,788. At the present time it stands at 37,672,048. Of the 87 departments, 34 (mostly agricultural) show a decrease, the 53 which figure as increasing containing more or less manufacturing or commercial centres, such as Nord, with its iron and coal works and textile factories, in which the increase is 83,674; Seine (containing Paris), 388,480; Rhône (Lyons), 36,339; Bouches-du-Rhône (Marseilles), 32,649; Aude (Carcassonne woollen factories), 27,077; Pas-de-Calais, 25,822; Alpes Maritimes (Nice and Mentone), 23,017. Some of the decreases of departments are very considerable, such as Vaucluse, with the manufacturing town of Avignon as its centre, which has declined to the amount of 11,554 out of a total population of 255,703 in 1876; Marche is still worse, for with its naval stations and ports of Cherbourg and Grenville, it has declined by 13,533, and Calvados, containing Caen, Bayeux, and Honfleur, by 10,390. In forty-seven of the principal towns, we find assembled one-sixth of the whole of the French population, which is not a favourable outlook for moral, sanitary, or physical reasons. Paris has now a population of 2,269,023, or an increase of 280,217; Marseilles numbers 360,099, with an increase of 41,231; Lyons 376,613, with an increase of 33,798; at the rate of about 10 per cent. for the last three mentioned. On the other hand, Bordeaux, with a population of 221,305, shows an increase of only 6,165, which is to be accounted for by the presence of the phylloxera. With the exception of Marseilles, the French ports have not increased much since 1876; Nantes, with a population of 124,319, having increased by only 2,072;

Dunkirk, with 37,328, increase 2,647; Boulogne, 44,812, increase 4,767; Havre, 105,867, increase 13,799. The naval stations have declined, showing a curtailment of outlay—viz., Cherbourg, 35,691, decrease 1,195; Toulon, 70,103, decrease 436; Brest, 66,110, decrease 718. As a rule, the textile centres, such as Rouen, Lille, and Roubaix, show the most satisfactory rates of increase.

A very large number of both men and women [among the patients at Hanwell] are the victims of alcohol. One poor woman, who, after being at Hanwell for several years, was sent out, four years ago, perfectly cured, was back at the institution within ten days, and her case is now considered hopeless. When discharged she went back to her old trade of bookbinding, at the back of Fleet street. Some of her old gin-drinking cronies enticed her into a tavern, and in less than a week she was a raging maniac. This is an old story. Scores of both sexes are confined at Hanwell whose lunacy is directly traceable to alcohol, but these by no means represent the number of its victims. Dr. Richards's estimate is that the lunacy of a full half of all his patients is the result of hereditary taint, and that a very considerable percentage of this may be credited to intoxicated parents.—*Weekly Times.*

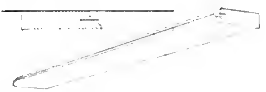
Sea Birds.—In a letter to the *Times*, "Femme du Monde" says: Sir, I beg of you to continue the campaign so well commenced in favour of the sea birds. The beauty they lend to the coast should alone suffice to protect them, without counting the value your correspondent justly claims for them as aids to the fishers and to the seamen. As it is quite certain that even good shots wound nineteen of these gulls to one that they kill, and lose very often even the rare few they do kill, it would be a million times better for all sea birds to be protected through all seasons. As it is for any birds the August days are far too early for the close time to cease. *Apropos*, I cannot forbear from urging at this moment upon all women the necessity of setting their faces against the employment of birds in costumes and in bonnets. I am myself accused of being too devoted to the art of dress, and I go to the great Paris *couturières* and *modistes*, to whom one cannot, as a rule, dictate. But I make it at all times clearly understood, even by these, that I will not have birds put upon anything that I wear, and, of course, none are ever sent to me. It would be so easy for all women of the world to do the same, and the use of birds in costumes would then be left to the vulgar, who would in turn abandon it. I see in reports from America and Africa that those exquisite creatures, the humming-birds, are rapidly becoming so scarce from the millions that are caught and killed, that their total extinction is to be dreaded. Yet, despite this grievous fact, one continues to see [illegible] trimmed with whole fringes of these fairy-like children of the sun. It is in these things that women, especially women of position, can do so much if they will only [illegible] exert themselves. The rough potting the [illegible] or the ocean gull, and the great [illegible] of humming-bird are at the extremes [illegible] they are on one level in coarseness [illegible] of a [illegible]

The Stinging Tree.—The "stinging tree" of Queensland, Australia, is a [illegible] shrub, pleasing to the eye, [illegible] to the touch. It grows from two or three [illegible] to ten or fifteen feet in height, and emits a disagreeable [illegible]. Says a traveller: "Sometimes, while [illegible] in the [illegible], I have entirely forgotten [illegible] stinging-tree till I was warned of its close proximity by its smell, and have often found myself in a little forest of them. I was only once stung, and that very lightly. Its effects are curious. It leaves no mark, but the pain is maddening, and for months afterwards the part, when touched, is tender in rainy weather, or when it gets wet in washing, &c. I have seen a man who treats ordinary pain lightly, roll on the ground in agony after being stung, and I have known a horse so completely mad after getting into a grove of the trees, that he rushed open-mouthed at every one who approached him, and had to be shot. Dogs, when stung, will rush about whining piteously, biting pieces from the affected part."

How to See the Attitudes of Animals in Motion. —A correspondent of the *Scientific American* writes as follows:—While experimenting in photography, I devised a kind of quick moving shutter, which I could operate with my fingers by moving a lever outside the tube. It occurred to me to look at animals in motion by merely putting the tube to my eye without any lens and operate the shutter. Immediately I had before me a series of instantaneous views without the costly appliances, and at will I could verify the strange attitudes set before us by the photographs of Muybridge. One who has not tried it will be surprised and pleased at the perfection and instantaneous character of the sights he will get of a moving object. It takes but a very short "exposure" to make the picture on our eye complete. The moving object is caught and shown to us just as it happens for the instant to be. Any device for opening the field of view quickly will answer, and in this way artists and scientific men can study the curious attitudes which any animal presents, and may reconsider, as Muybridge and others are doing, the conventional methods of representing a moving animal.

Benzine will answer much better to exterminate roaches, moths, &c., than anything else. It will not hurt furniture in the least, and can easily be applied.

Improved Ruler.—Mr. George L. Knox, Secretary of Colwell Lead Company, 63, Center-street, New York, has recently patented a ruler, by which the ink that may pass from the pen to the ruler is absorbed and effectually prevented from running down upon the paper to be ruled. This is an ordinary ruler having in one of its edges a deep groove extending its entire length, and in this groove is placed a folded plate of sheet metal. In the recess of the folded metal plate a strip of blotting paper or other absorbing



material is placed, the outer edge of which reaches to near the outer edge of the ruler, as shown in the annexed engraving. The metal of the folded plate has some elasticity, so that when removed from the groove the sides will open slightly to receive the absorbing strip, and when placed in the groove it acts as a spring against the walls for holding itself securely in place. The metal plate may be removed at pleasure for renewing the absorbing strip and for adjusting its edge at a proper distance from the edge of the ruler.

THE BRITISH ASSOCIATION.

By the Editor.

Many seem to consider that our remarks on the British Association (regarded generally and also with special reference to the recent meeting at Southampton) have been unduly critical. We are open to correction, and if any one can show that the work actually done by the Association during the fifty years of its existence has been worth the time and labour bestowed on the meetings, to say nothing of some £100,000 paid by members and associates, we shall be very glad, in the interests of science, to hear the evidence. For ourselves, we must confess we cannot see that the progress of science is in any way advanced by these gatherings, while the dignity of science certainly seems to be impaired when in one city after another, Science comes before the public saying, "*Now* you shall have something good," and retires presently from a wearied community, which has heard very little that has been intelligible and scarce anything worth remembering. It seems to us that, despite the utter silliness of the *Times'* article from which we quoted last week, that desire to pose before gaping thousands as men who have done something no one else has done, which the writer of that article seemed to recognise in the suggested visit to Canada, must have something to do with these annual gatherings. Nor does the idea seem altogether absent that what that insolent writer said of Americans may be true of the citizens of the "good old towns" visited by Science. Men of science seem to think that "if they talk sense, they will be listened to; if they talk nonsense, they will be listened to all the same, and with the same degree of intelligent appreciation." Of course, in the utterly offensive sense in which these words were applied to Canada (and by implication to America generally, which has sent its men of science to Canada this year) this is very far from being true; but it *is* perfectly true that men of science who talk, as nearly all did at Southampton this year, in jargon which is as a strange tongue to their hearers, may talk nonsense and be no more understood than when they talk sense, in the same jargon: for neither one nor the other would be understood at all. If Sir William Thomson, for example, had spoken of ecliptic tides, or of electric tides, his remarks would have been quite as well appreciated by ninety-nine hundredths of his hearers as when he spoke of elliptic tides (meaning really the monthly waxing and waning of the moon-raised tides, as the moon moves nearer to us or farther from us in her elliptic orbit). In Canada, or the United States, or in Australia, where audiences are most thoroughly competent to distinguish sense from nonsense, "ecliptic tides" would have done as well as "elliptic tides," because both expressions belong to scientific jargon, and jargon quite inexact and misleading, since what Sir W. Thomson called an elliptic tide is not properly speaking a tide at all, and is assuredly not elliptic. There is, probably, not a man, however, in an audience so perplexed, but would be able to perplex men of science equally by the jargon of his own trade or profession.

Of the benefit these gatherings do to science generally we may gain some inkling by noting that in all the daily papers *utter absurdities* were published professedly as reports of the meeting. We need not go beyond the case just referred to—Sir W. Thomson's Discourse on the Tides. The *Times'* report of that discourse, for instance, was altogether absurd. Passages absolutely essential to the sense were omitted by the reporters, in calm confidence that the nonsense thus produced would be read "with the same degree of intelligent appreciation as the rest." And the confidence was justified. The weekly journals (even some which, like the *English Mechanic*, claim a scientific character), as placidly quoted this egregious nonsense, as if it had been profound science. Handed to a leading-article manufacturer, the report became the basis of one of those "*Times* articles," in which the British public places such implicit reliance, wherein, on this occasion, ordinary cyclopædic information about tidal waves was associated with certain electric tides (an ingenious new reading for the ecliptic absurdity), of which Sir W. Thomson, with sly sarcasm, remarked that they were "not to be wondered at." Yet the sarcasm touches himself also; for if such nonsense as electric tides "need not be wondered at" in a *Times* leader, the fault resides nearly as much in the jargon of the scientist as in the ignorance and presumption of the article-monger. How is the world to be taught science if men of science will not even *try* to speak intelligibly!

Even, however, those papers which have united in raising the chorus of adulation, have been obliged to admit that the splendours of science which they laud have not been altogether appreciated. "We hear the meeting spoken of as tame," says the *Times*, in an article almost as silly, though not quite so offensive, as the other: "but we have not been able to detect any sign of greater tameness than usual" [which is very likely]. . . "The Southampton meeting is no unworthy successor of the York Jubilee. . . Southampton has not been treated to the mere leavings of that great feast! . . British science has suffered no collapse after the excitement of last year!" . . [As if science were likely to collapse because there was a scientific meeting a year ago.] "It is marvellous how, year after year, there should be such abundant evidence of continued and fresh work! . . We cannot detect any signs of falling-off this year in any respect. Workers seem as eager as ever to come forward and tell what they have been doing," &c., *usque ad nauseam.* The unscientific public, it should have been added, seem just as unwilling to listen to them, which also "is not to be wondered at," since most of them will not express themselves in clear and simple language.

SIR W. THOMSON ON THE TIDES.

Sir William Thomson's discourse upon the Tides at the Friday evening discourse, during the meeting of the British Association, was not, properly speaking, a lecture. A series of statements, scarcely connected at all, were poured upon the audience, to the manifest bewilderment of all except a few, who, having been acquainted with the subject and Sir W. Thomson's way of presenting it before, were entertained by his vivacity and by his obvious enjoyment of the effect he was producing. The real subject of the lecture was reached some five or ten minutes before the discourse came to a close.

Under these circumstances it is absolutely impossible to give either a full report or an abstract of the lecture, in such a form as would interest the majority of our readers. We propose, then, simply to select such statements from the lecture as are of intrinsic interest or importance, without attempting to do what the lecturer did not care to do—to present them, that is, as parts of a clear, consistent, and luminous discussion of the subject of the tides:—

From calculations by Mr. G. H. Darwin, the rigidity of the earth, as a whole, is about the same as that of a globe of homogeneous steel as large as the earth.

In some parts of the earth no lunar tides can be recognised, only a rise and fall occurring, either once or twice in a solar day. These may depend on meteorological causes, as on winds, or changes of temperature, due to solar [illegible] in this respect resemble the diurnal [illegible] presently shown by the barometer's [illegible] at about ten forenoon and evening, and [illegible] at [illegible] four morning and afternoon. We [illegible] explaining the annual solar tide, [illegible] due to the sun's varying distance, there [illegible] causes of variation. Thus there [illegible] and trade winds, changing with the [illegible]. These, however, are not tides. [One [illegible] part of Sir W. Thomson's discourse was [illegible] reported in the *Times*, thus: "The results [illegible] are utterly inexplicable on the theory of [illegible] a statement calculated to delight the hearts [illegible] Newton Crosland, Parallax, and the whole race, [illegible] of anti-gravitational paradoxers. It should hardly [illegible] necessary to say that Sir W. Thomson made no such [illegible]. What he really said was, that outside the [illegible] of water due to the attraction of the sun and [illegible] there are others not to be so explained. To some [illegible] reporters this would be quite the same thing, of [illegible] that the observed movements are quite [illegible] with the theory of gravitation. ED.]

[illegible] the weather change with the moon?" [illegible] digression, carefully reported, however, as a [illegible] the evidence relating to the tides.] Careful [illegible] with the barometer, thermometer, and anemo- [illegible] that is, careful observations of the varying density, [illegible] and movement of the air] have failed to esta- [illegible] relation whatever, and have proved, on the [illegible] that if there is any dependence of the weather [illegible] the phases of the moon, it is only to a degree quite im- [illegible] to ordinary observation. To myself, constantly [illegible] to say whether the moon influences the weather, and [illegible] in what way and in what degree, it is a comfort to [illegible] however unexpectedly a statement on this subject [illegible] Sir W. Thomson. Lunar and planetary influences, Mr. H. A. [illegible] tells me, are not duly considered by science, [illegible] doubts me when I say they receive all [illegible] they merit. Sir W. Thomson's statement is [illegible] this point, and will, therefore, be good for [illegible] of KNOWLEDGE (and especially, Mr. Bulley, [illegible]

[illegible] to the tides.

The [illegible] view is that the moon attracts the waters [illegible] herself, heaping them up on her side of the [illegible]. This would be the case if the earth and moon [illegible] on the two ends of a strong bar and put at [illegible] a state of things which does not actually [illegible]

[illegible] the moon fall to the earth, as according [illegible] theory it is always doing? Because it [illegible] perpendicular to the direction in which it [illegible] fall produces merely a continual [illegible]. That is the dynamical theory of what [illegible] centrifugal force." The parts of the moon [illegible] which tend to fall most rapidly, [illegible] which tend to fall less rapidly.*

[illegible]

Now as the moon moves round the earth, constantly falling towards her, so does the earth revolve round the moon, or, more correctly, each revolves round the common centre of gravity of the earth and moon. Each preserves a constant distance, or very nearly a constant distance, from the common centre of gravity of the two. The earth, as a whole, experiences an attraction depending on the average distance of its parts from the moon; but its parts nearer to the moon are more strongly attracted, and those farther from the moon less strongly attracted, than those at this average or mean distance. The result clearly is a tendency towards the moon and from the moon. Thus, in a necessarily imperfect manner, is explained how it is that the waters are (*not* heaped up on the side towards the moon, but) drawn up towards the moon and fall away from the moon, so as to tend to form an oval figure. [An explanation, however, which is altogether misleading, as no one could know better than Sir W. Thomson himself; only doubtless he felt that the true explanation was beyond the capacity of most of his audience. There *is* that tendency towards and from the moon; but the dynamical tendency is not at all to form the oval figure shown in textbooks, with the *longer* axis directed towards the moon, but to form an oval figure—the section of an ellipsoidal water surface—with its *shorter* axis directed moonwards. ED.]

As to the difference of the tendencies of matter towards the earth's surface, on account of lunar attraction, Sir W. Thomson stated that, when the moon is either overhead or directly under foot, the weight of a body at the earth's surface is diminished by a 6,000,000th part, as compared with the weight when the moon is ninety degrees from the vertical.* Or again, a plummet will be drawn aside by a 12,000,000th part of its length when the moon is [" off the vertical," says the *Times* report, complacently followed in many weekly papers] ninety degrees from the vertical.

The earth does not yield under the influence of these disturbing forces, because of her enormous rigidity regarded as a whole. Mr. G. H. Darwin's results, referred to above, conclusively dispose of the theory that the earth is a mere crust, forty or fifty miles thick, and full of molten lava.

There is a tide—really a tidal variation—depending on the moon's change of declination, which has, of course, a half-monthly period, the moon being on the equator twice in each lunar month. This may be termed the fortnightly or lunar declinational tide. [There is, in fact, as Sir W. Thomson subsequently explained, a slight heaping up of the water round the equator and lowering at the poles, once a fortnight, when the moon is crossing the equator, alternating with lowering round the equator, and heaping up at the poles when she attains her extreme north and south declination.] There is also a tidal variation which [if we want to confuse an audience] we may call a tide, due to the moon's varying distance in each lunar month. This tide, whose period is, of course, monthly, may be called the *elliptic tide*, because it depends on the ellipticity of the earth's orbit.

In a newspaper report it is bound, of course, to appear as the *eclyptic tide*, while in an amazing "leader" which adorned the pages of the *Times* for Monday, August 28, this tide appears as the *electric tide*, "an error little to be wondered at," writes Sir W. Thomson in the *Times* for Wednesday, August 30, a remark whose biting sarcasm seems to have escaped the attention of the editor (or who-

* [illegible]

* Here again, the *Times* report was utterly absurd, though here again it was followed by several scientific papers. It stated that the weight is diminished when the moon is overhead, and increased [illegible] degree when the moon is under foot, in each case by [illegible] 6,000,000th part [illegible] incorrect statement.

ever attends to such matters). [It is little when, in a report, an elliptic tide is called an ecliptic one, but really matters have reached a pleasing pass when Sir W. Thomson gravely tells the editor of the *Times* that it is not to be wondered at, if in a leading article which is even condescendingly explanatory, an electric tide appears upon the scene.—Ed.] The moon is alternately nearer to and farther from the earth by a difference of about 26,000 miles (13,000 miles on either side of her mean distance) a little more than one-tenth of her average distance, in [very nearly] the monthly period of her revolution in her elliptic orbit.

Lastly, Sir W. Thomson mentioned the experiments carried on by Messrs. G. and H. Darwin on a pendulum so delicately suspended as to be sensible to the smallest influences. They found incessant vibrations, which show that the earth's surface is constantly palpitating, so to speak, chiefly from local disturbances. These palpitations were in fact minute and unceasing earthquake tremors, completely masking the delicate regular periodical variations which their pendulum would have shown had the earth been worthy of its name—*terra firma.*

A STUDY OF MINUTE LIFE.

By Henry J. Slack, F.G.S., F.R.M.S.

POSTPONING for the present a further consideration of the microferments, the wants of young microscopists may be met by a dip in a waterbutt, or shallow pond in a sunny situation. Besides other creatures likely to reward the experiment, it is probable that the eggs, larvæ, and pupæ of the common gnat may be caught, and will amply reward careful examination. The female gnat lays eggs of long, conical shape, and glues a number of them together so as to form a floating raft. They are too small to be readily recognised by an unpractised eye, without a hand magnifier, but if any specimen of water contains larvæ and pupæ, small brown masses floating on the surface may prove to be eggs. When hatching-time arrives, they split lengthwise, and out comes a most curious creature, which grows pretty quickly, changing its skin by frequent moultings. A few ounces of water obtained as mentioned, will probably exhibit larvæ in various stages of growth. A two-ounce wide-mouthed bottle, just filled from a water-butt, contains scores of them, many about one-eighth of an inch long. Holding the bottle up to the light enables the naked eye to see them as wormy-looking things, with big heads and a many-jointed abdomen, curiously forked at the lower end. Many move about briskly by flicking what may be popularly called their tails; others are suspended upright, head downwards, and quiet, just keeping one of the forked ends out of the water; others are in a similar position, but completely immersed. The moving ones are violent in their jerks, which indicate great muscular power in proportion to their size. Closer examination with a magnification of about fifty times shows the internal structure through the transparent integument, and amongst other things it is seen that the creature is provided with the tracheal breathing tubes belonging to insects, and that the prong of the terminal fork, which is often thrust just through the surface of the water, can open a way for them to receive the air. Probably the four leaf-like expansions attached to the other fork may serve as gills. At any rate, the active creature can stay for some time under water, and when a swarm of them are watched in a bottle, they will be found at various depths, some at the bottom, and, as in the case before us, few caring to come often to the surface for a gulp of fresh air. When not jerking about, they either float head downwards, almost stationary, or slowly sink, and then with a kick dash the water behind them, and rise up again. Their motions are in all directions, and though scores are moving briskly in our bottle, which is less than two inches in diameter, collisions are rare.

After well examining their ways in the bottle with the naked eye and pocket lens, one or two should be transferred to a small shallow glass cell, and a power of about a one-inch objective employed. The great roundish head is thus seen to be broadest near the base, with two conspicuous black eye-spots, and to be furnished with two large antennæ, and numerous bristles. It is a fierce-looking object. At about one third from the tip, each feeler has a large tuft of bristles, a smaller one above it, and a terminal bunch. Next to the head, which is very movable, comes a wide thorax, followed by a ten-jointed abdomen, bristled ornamentally on both sides of each joint. If the light from the substage mirror of the microscope is thrown a little slantingly through the creature, two large vessels of a satiny aspect are seen to run one on each side of the thorax through the abdomen, and into a tube that springs from the eighth joint of the abdomen. From the thorax smaller objects of the same sort spring from the larger ones, and enter the head. These objects are the breathing-tubes (*tracheæ*), and their peculiar sheen in glancing light comes from the coils of wire-like material that keep them open. For collecting food, the mouth is furnished with two tufts of bristles, fan-like when expanded, and used, like the so-called wheels of rotifers, to lash the water into whirlpools, and bring floating particles into its gullet. Only very small objects are swallowed, but when they are massed together in the intestinal tube, they make a considerable show.

Besides the tracheal tubes and intestinal canal, a long vessel is seen rhythmically pulsating—acting like a heart.

After these objects have been well examined with an inch-power, a half-inch may be used with advantage. This enables the structure of the tracheal tubes to be more distinctly seen in their minute ramifications, taking air to all parts of the little animal. Many of the bristles will also be found elegantly feathered, and the muscular bands with which the vigorous motions are effected may be discerned.

What is called dark ground illumination gives these creatures a splendid appearance under a low power. They look self-luminous, and shine with brilliant pearly and opalescent tints. The principle of this illumination is that no light reaches the eye straight through the object, but only such rays as are refracted by it. With a little practice, it can be managed by a slanting action of the substage mirror, but a finer effect is obtained by a spot-lens, that is, a lens which has a patch upon it to stop the passage of light excepting through the margin which is left clear. This is placed at a suitable focus under the object, which is made to glow brilliantly upon a dark ground.

Besides the great larva, the pupa must be looked for, and if a lucky dip is made, it is sure to attract attention from its grotesque oddity, though no one not in the secret would imagine it had any connection with the larva, or would ultimately disclose a winged gnat. It is a queer, bigheaded thing, with two hornlike projections and a slender, tail like abdomen, sometimes curled close to the body, and then violently jerked to make it dart through the water. The breathing tubes of the larva terminate at the tail end, as we have seen; those of the pupa end in the two horns which it thrusts through the surface of the fluid [illegible] it wa[illegible] a supply of fresh air. A careful examination of this [illegible] the wings and other parts of the [illegible] gnat to be seen inside it, folded up neatly and [illegible]. The compound insect eye is also well seen by [illegible] light [illegible] it. The student keeping a supply of [illegible] hing them from time to time, is sure to be rewarded by seeing the little monster split open, and [illegible] the gnat to crawl forth and unfold its moist and glittering wings. If caught and mounted as a slide object, the fresh [illegible] with which wings and body are decorated [illegible] a beautiful display.

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

By Miss Amelia B. Edwards.

[illegible] THE LAND OF GOSHEN.

THE [illegible] familiar to us under its Biblical name, [illegible] the Land of Goshen, was anciently an Egyptian [illegible], or province, called "Kosem." The ancient geographical [illegible] sculptured on the walls of the temples of [illegible], &c., enumerate forty four of these [illegible] of which were in the Delta. Kosem was the [illegible] of the Lower Country. Its capital—or, [illegible] say, its county town—was named "Kos," [illegible] Pa Kos [illegible] Hebrew, "*Gessen*"; in our Bible translation, "Goshen." Under the Greek rule, Pa Kos became "Phacusa"; but as "*Kos*" it survived in the Coptic tongue, as long as the Coptic tongue* remained a living language. As "F. Koos" it survives to this day in the Arabic name of a miserable mud village, close to the Abu Kebeer station on the line between Zagazig and Salaheyeh. This village nestles at the foot of [illegible] mounds, beyond which lie undulating [illegible], covered in spring with waving corn-crops. [illegible] mark the site of that city of [illegible] Joseph (being in attendance upon the Pharaoh at Zoan) hastened in his chariot "to meet Israel his father," [illegible], by the way, that Jacob and his [illegible] Egypt from some point south east of Tanis.

The topographical limits of the land of Goshen (otherwise the nome Kosem) are not known; but the chief town, Goshen, [illegible] occupied a tolerably central position in the province. [illegible], at all events, to the east of the Nile, [illegible] south-east of Tanis, and to the west of Lakes Balah [illegible] Timsah. Southward, it is believed to have terminated [illegible] the Wady Toomilat, or Tumilat, now [illegible] by the line of railway which connects Zagazig [illegible] Ismailiah. A great wedge-shaped tract of desert [illegible] between Fa Koos and Wady Tumilat; but recent [illegible] connected with the modern Freshwater Canal [illegible] have shown that this is, at [illegible] encroachment. At the [illegible], the whole of this wedge [illegible] probably rich with pasture. It also [illegible] inundation; extensive beds [illegible] found near Tel-el-Maskhuta, in [illegible] of the Freshwater Canal Company.

These clay beds—which, if Tel-el-Maskhuta be really the "Raamses" of the Bible, furnished the Israelites with material for the bricks with which they built the treasure-city of Pharaoh—were largely used in building the new town of Ismailiah.

Part of the old Land of Goshen is, however, still flooded yearly by the Nile, is still carpeted with flowers in spring, and, where aided by artificial irrigation, still bears its double and triple crop per annum. Upon the calm surface of its backwaters and canals, the lotus still spreads its broad leaves and opens its cup-like blossoms to the sun; and the groves of acacia, sycamore-fig, pomegranate, orange, banana, and palm, which surround its scattered villages, are still each

"A populous Paradise of bees and birds."

By these yet fertile tracts—the mere fringes of the old province—we judge how the land of Goshen may once have been in truth "the best of the land."

Except in the geographical lists before-named, I am not aware that any mention of Goshen the province, or Goshen the city, has yet been found upon the monuments. The latter can never have been a place of political importance. It was a market-town; a county town; a local centre where justice was administered—such a place, in short, as the modern towns of Minieh, or Girgeh, or Keneh—not a place likely to be mentioned in religious or historical documents. As a territorial distinction, the name of "Kosem" would seem to have become obsolete under the XIXth Dynasty; surviving only as a legal archaism in the lists. We have, at all events, the evidence of the Book of Exodus, and the testimony of several Egyptian documents, to show that, from the time of Rameses II., when the new "treasure city" was built and Goshen city ceased to be the chief town of the province, the old name of the Nome fell into either partial or complete disuse, and the "land," or county, of Goshen came to be called after its new capital, "the land of Rameses."

That Wady Túmilat formed a part of the land of Goshen is a fact which has not been questioned even by those who dispute the identification of Tel-el-Maskhuta with the treasure-city of Pharaoh. It is a valley running almost due east and west between Zagazig and Ismailiah; the distance from Zagazig to Ismailiah being $47\frac{1}{2}$ miles, and the length of the valley about 28 or 30. Every traveller who journeyed by railway from the one terminus to the other before this war began, caught pleasant glimpses of that green and winding track, and of the heron-haunted canal, fringed with reeds and water-plants, which runs through it like a silver thread in the middle of a broad green ribbon. To the north of the railway line, all is grey desert. To the south, beyond the canal and the Wady, all is desert again. Here and there, (unseen from the railway-carriage windows) the scenery of the Wady is varied by scattered ruins and mounds of ancient towns—Tel*-Aboo-Sooleyman, Tel-el-Kebeer,† Tel-Retabah, and Tel-el-Maskhuta. The two former have by different authorities been suggested as the site of Pithom; while in 1845, when Lepsius visited the East of the Delta, the modern village situate at the foot of the mounds of Tel-el-Maskhuta was still called by the name of "Ramses." There is a station at this point, where, but the other day, the trains used to stop, while the Arab guard shouted "Ramsis! Ramsis!" Now, at the moment when I am writing these words, Rameses is the site of the

[illegible]

* "Tel" or "Kom" (Arabic) signifies a mound. "Tel" is chiefly in use in Lower and Middle Egypt; "Kom" in Upper Egypt.

† Spelt "Kebir" by the newspaper correspondents at the seat of war.

Guards' Camp, and a battery of English guns is planted on the mound of Maskhuta.

It has generally been supposed that the name of "Ramsés" was given to this place by the French constructors of the line; but at the time of Lepsius' visit in 1845 there was not yet a foot of railway laid down in Egypt. The name of "Ramsés," or "Ramsis," is, therefore, in all probability as old as the period of the Hebrew sojourn.

(*To be continued.*)

THE AMATEUR ELECTRICIAN.

ELECTRICAL MEASUREMENT.—III.

THE next point we have to consider is Conductivity, or "that property of matter in virtue of which an electric current is propagated through it." All matter is not equally endowed with this property—that is to say, electricity does not pass with equal readiness through all the various substances with which we are acquainted. For instance, iron does not conduct, transmit, or propagate electricity so readily as does either copper or silver; nor does mercury so readily as iron, nor water as mercury. There being, then, a wide divergence in the relative conducting properties of different bodies, it may naturally be asked—Is there any line of demarcation or any definite law governing the facilities offered for the passage of an electric current? If we limit our inquiry to different masses of the same material, our answer will be in the affirmative; but no one has yet explained why copper should conduct better than iron, zinc, tin, &c. Nor will we attempt to accomplish such a task.

Ohm, who first formulated the law which bears his name, declared electricity to be propagated in a manner closely akin to the way in which heat is transmitted, and that the best way to study the laws influencing the more subtle force is to investigate and apply the laws generally acknowledged as governing thermal transmission. Since that time experiments have demonstrated the truth of Ohm's deductions. So closely, in fact, are the forces of heat and electricity allied, that the tables of co-efficients are almost identical—that is to say, bodies which readily conduct heat as readily conduct electricity, and *vice versâ*: and the same relation which exists between the thermal conductivities of different bodies, exists also between their electrical conductivities. Conductivity is a property inherent in all substances, but in different degrees—that is to say, every substance conducts a greater or less amount of electricity. There is, however, as is well known, a vast difference between the best and poorest conductors. Thus, pure copper conducts 6,754 million times as well as distilled water, and 16 million times as well as sulphuric acid. Water, again, is an infinitely better conductor than air, ebonite, sulphur, and very many other substances. Practically, the conductivity of such bodies is *nil.* The almost total absence of this property in some forms of matter renders them of vital importance to the electrician. The converse of conductivity is resistance, or, in other words, bodies which conduct well offer but little resistance to the passage of a current of electricity, and bodies which conduct but poorly do so by virtue of the greater resistance which they offer to the passage of the current. Indeed, as every substance offers a greater or less resistance, we can with advantage start with this property of matter, and classify substances rather in the order of their resistances than of their conductivities. So, then, we measure the transmitting value of a medium, not by the amount of its conductivity, but of its resistance. And in measuring resistance, it will be seen that we at the same time measure the work which a current of electricity performs in overcoming that resistance. We require, however, a standard of measurement, and what this standard or unit shall be is a question which has caused many heart-burning contentions, and which is not yet quite settled. The unit which has long been in use in England, which has, on account of its eminently scientific origin, been almost universally accepted, and which will soon be stamped with the authority of an International Congress, is known as the Ohm, or B. A. unit. We will not attempt to define its origin or derivation, but say simply that an Ohm is the unit of resistance, and is equal to that offered by 18½ inches of copper wire, ·004 of an inch thick (about number 40 gauge).

Resistance varies as the length of the wire, and inversely as its section, that is to say, in the first place that if a mile of wire offers a resistance of 25 Ohms, ten miles of the same wire will offer ten times the resistance of 250 Ohms; and, in the second place, if we use a wire so much thicker or larger as to double its sectional area, we halve the resistance. For wires of uniform make, it is evident that with equal lengths the sectional area varies directly as the weight. The effect of temperature upon resistance is very important. With metals, the resistance increases with the temperature, so that a piece of platinum through which an electric current is passing increases in temperature and resistance, sympathetically, until, if the wire is not too thick, the heat overcomes the cohesion of the particles, and the wire breaks. With partial conductors the reverse is the case. This is especially noticeable in the carbon filaments of the various incandescent lamps. The Edison filament, which, when cold, offers a resistance of about 180 Ohms, offers only 100 Ohms when heated to its full illuminating power. Nor is this feature unimportant in its influence on practical telegraphy. The waters of the Indian Ocean are generally very warm, and in consequence of this, the insulating properties of the percha in the cables is very sensibly reduced, their efficiency for telegraphic purposes being necessarily reduced in proportion. There are in general use two methods of measuring resistance, viz., the "Bridge," and the "Differential." These it will be our duty to consider very soon.

THE TREE-TOAD.*

By Mary H. Hinckley.

A RECORD of several seasons gives the appearance of *Hyla versicolor* in the spring, in Milton, Massachusetts, from about the 1st to the 10th of May. Tadpoles of this species I have found most abundant in the water of small, still, shadowy ponds near large trees. The eggs are attached singly and in small groups for a distance of one or two yards along the grasses which grow up and rest on the water. Unless the grass is parted they are not readily seen. The gelatinous substance surrounding the eggs is exceedingly thin. When first laid they are of a drab colour on the upper surface, which becomes lighter after a few hours in the water. The under surface is white; the extent of this colour varies; in some cases only a spot of drab is seen on an otherwise white egg. The period of egg-laying, according to my observations, extends

* Abstract of a paper published in the "Proceedings of the Boston Society of Natural History," Vol. xxi, Nov. 17, 1880, from the *American Naturalist.*

from the first week in May to July. The development of the egg is rapid, being accomplished within forty-eight hours. When first hatched, the tadpole is about a quarter of an inch long, of a pale yellow colour, dotted with olive on the head and sides of the body. During the first week the external gills are developed and resorbed. At the same time the olive colour gradually increases and deepens till it extends over the upper surface of the tadpole. A fine dotting of gold colour also appears on both upper and under surfaces. In the water, however, they look black. The holders, at first so prominent, disappear within ten days. The head and body are short. The tail is broad and thick. The eyes are prominent, set widely apart, and of a brilliant flame colour: the iris in some specimens is quartered by dark lines. The lips are broad. The nostril openings and two perpendicular lines on the muzzle, also a line from before the eyes down each side to the tail, are gold coloured. Transverse bars of the same tint on the upper edge of the tail are sometimes seen.

The tadpoles are shy and quick in movement as young fishes, moving through the water with the least perceptible motion of the tail. They do not collect together, but where there is room enough, each tadpole goes its own way independently. They are hardy, and, probably owing in some degree to their quick movements, are more exempt from mutilation by water enemies than other species, rarely losing eyes or tail.

When about three weeks old the hind legs are in sight as small white buds in front of the base of the tail near the lower edge on each side. An iridescence of great brilliancy is seen on the white surface of the abdomen and sides of the body. The head and upper portion of the body show a bluish, metallic sheen, and the tail, which is more or less flecked with brown or black, becomes in some specimens a bright red colour. It would be difficult to exaggerate the beauty of colouring of these tadpoles: it exceeds in brilliancy and variety any species found in this locality.

As the legs become more fully developed, the colouring of the head and body tends from dark olive to a light, greyish-green. In the seventh week the body begins to lose its roundness, and the arms are seen to be moved under the skin, as if the tadpole were impatient to get them free. The head then appears disproportionately large. At this stage the tadpoles vary from grey to pea-green in colour. They are found in the shallow water near the shore, where many fall prey to various aquatic birds. During the eighth week they appear to take little food; the arms are thrown out, the tail is gradually resorbed, the mouth developed, and the frogs leave the water. While a few specimens retain the colour of grey up to this time, nearly all will be found of various shades of tender green on the upper surfaces, bordered with different tints of grey or salmon colour. The abdomen is white. Green asserts itself much earlier in some specimens than others; but I have never seen a tadpole of this species develope into the frog that did not sooner or later become green. The markings on the back also vary in time of appearance; but the colouring of black on the head, body, and limbs, the smooth, shiny patch below the eyes, the granulated appearance of the skin, and the yellow colouring in the folds of the legs, usually appear in the order of their mention, and after the frogs have left the water.

Last season a small pond in an open pasture, about fifteen rods from a wood, furnished a good opportunity for observing their movements on leaving the water. From the 19th to the 24th of July, numbers of the young frogs, with tails in different stages of resorption, were found on the ground, weeds, and grasses about the pond, which by this time had become reduced by evaporation to a shallow pool. They represented a variety of shades of green; a few were grey, and occasionally one was scarcely to be separated in colour from the mud on which it rested. I observed those on the ground frequently capture the small spiders which were numerous there. As soon as they left the water their object, evidently, was to reach the wood. Apparently aware of their danger in this exposed journey, they drew attention to themselves, when approached, by continually springing out of harm's way; but after the shrubbery was reached they rarely made any attempt to escape when discovered, trusting wholly, like the mature frogs, to their disguise of colouring for safety. I found

HINCKLEY, DEVELOPMENT OF HYLA VERSICOLOR.

several of them on a small apple-tree which was in the line of their journey. They were on the new growth which was overrun with Aphides, and the frogs had assumed a deep emerald-green, so like the leaf that it was difficult at first glance to distinguish them from it. After they reached the wood I could trace them no further. I think it probable that some observers have mistaken *H. versicolor* at this age for the adults of another species of Hyla.

My knowledge of the frogs from this stage till they reach maturity is confined chiefly to those reared in a fernery. For the first three months they retained the green colour, as a rule, with occasional changes of tints of brown and grey, matching the earth or branches to which they cling. After that time shades of grey become the rule and green the exception. The black markings on the head, body, and limbs did not change, excepting to vary in distinctness. Their food, which they never took unless alive, was Aphides at first, but soon flies formed their chief diet. During the day they commonly remained motionless, hidden behind the bark of the branches, with feet and hands, which are evidently extremely sensitive, compactly folded under the body, so that only their outer edges came in contact with the surface on which they were seated. Occasionally they would pat the discs against the sides of the body as if to moisten them. Their activity was reserved for the night, although rain, accompanied by a south wind, caused them to move about uneasily. About October 1 they left the branches and ferns and nestled away in the damp earth and moss, where they remained through the winter, unless exposed to a temperature above 60°. They took no food from the first week in October till the 14th of the following May, when I gave them their liberty. They were then placed on an oak tree, where, after climbing till a suitable crevice or hiding-place was found, they backed themselves into it, and became to all appearance like a part of the bark of the tree.

THE SEA-BATHING INFIRMARY AT MARGATE.

[In the following from the *Morning Post*, our readers will probably recognise the hand of one of the most esteemed contributors to KNOWLEDGE.—ED.]

On Monday, Aug. 28, without public announcement, ceremony, or parade of any kind, was accomplished one of those signal acts of private benevolence by which our country and our century are honourably distinguished. That is to say, at the annual anniversary meeting of the directors and committee of the Royal Sea-Bathing Infirmary, Margate, Sir Erasmus Wilson presented to the chairman the keys of the new wing, which, at a cost of nearly £30,000, he had munificently added to that old and deserving institution. This new wing, entirely designed by that accomplished architect and able *littérateur*, Mr. James Knowles, the well-known editor and proprietor of the *Nineteenth Century*, consists of four spacious wards, four nurses' rooms, two day-rooms, a large swimming bath-house, and a chapel. The four wards are constructed to hold sixty-four beds, and could well hold more if required. Two of these wards measure 63 ft. in length by 24 ft. in width, and the other two measure 56 ft. in length by 24 ft. in width, the height from floor to ceiling being 16 ft. throughout. The nurses' rooms measure 15 ft. by 12 ft. Attached to each ward is a bath-room measuring 10 ft. by 9 ft., and a lavatory measuring 9 ft. by 7 ft. 6 in. The swimming bath-house measures 60 ft. by 30 ft., and is roofed by a huge skylight 27 ft. above the level of the floor. It contains 35,000 gallons of water, is surrounded in the usual manner by a platform some 4 ft. to 5 ft. in width, and is furnished at the upper end with a row of dressing-closets, containing each a wooden seat and pegs for clothes. The whole of this bath and the walls of the bath-house are lined with white porcelain-faced bricks, picked out in delicate bands of buff and blue. The wards, nurses' rooms, day-rooms, bath-rooms, lavatories, &c., are entirely lined throughout, walls and ceilings, with the same porcelain-faced bricks, picked out with the same tints of buff and blue. The special needs of the patients in this hospital (all of whom are sufferers from scrofula and other diseases of the skin) being sea-air, sea-bathing, cleanliness, ventilation, and an even temperature, everything has been designed and carried out with strict regard to these curative conditions. The walls are built hollow; so guarding against excess of heat in summer or cold in winter. The doors are all of double thickness. The system of ventilation is so arranged as to admit cold air from under the floors through the warm-water coil-cases which stand in the centres of the various rooms and form part of the warming apparatus; while the *vitiated air is sucked out above through valves just below the level of the ceilings, whence it is carried off through continuous air-tight metal tubes running along the hollow walls in connection with the furnace chimney-shaft.* By these ingenious contrivances an uninterrupted sucking action is kept up, and an unchecked supply and renewal of fresh air is provided. Additional ventilation is also obtained through the windows, which can be opened entirely or only let down at the top, the upper part being shielded by screens of wire-gauze, to prevent downward draught. Furthermore, and with a special view to rendering all the surfaces proof against the adhesion of contamination, disease-germs, dust, &c., the floors are all laid down in the hardest teak planking: the walls and ceilings, *being porcelain-lined*, are capable of being washed in every part, and the *very sash-lines to the windows are made of wire-cording.* Nor is this all. The whole new wing—chapel and swimming-bath excepted—is constructed with a flat terraced roof, supported on *shallow brick arches, which arches (crossing the rooms transversely overhead, and lined, like the walls, with white porcelain tiles) are furnished with iron channels, or gutter-pipes, to receive any condensed vapour which may rise to the ceilings from the atmosphere breathed by the patients. Hence no foul droppings and no return of vitiated air in any form is possible.* The terrace on the roof measures 350 ft. in length by 32 ft. in width, and is designed to form a breezy and delicious promenade for the patients. It commands an immense view of sea and shore, town and country, and has all the advantages of a pier, without being actually in the sea. An engine-room, constructed in the basement of the northernmost ward, contains engines for pumping salt and fresh water—the former for the swimming bath, the latter for warming and washing purposes, the motive power being an Otto noiseless gas-engine.

We have dealt thus at length upon the sanitary features of Sir Erasmus Wilson's magnificent gift, for the reason that many of these arrangements are *as novel as they are scientifically ingenious; and because the building is designed, and we believe destined, to serve as a model construction for future imitation.* It is but just to Mr. Knowles to add that the whole of these admirable adaptations of means to an end are his own invention. A sanitary problem was proposed to him by Sir Erasmus Wilson, and it is thus that he has solved it, to his own lasting fame, and the no less lasting benefit of others.

THE POISONOUS LIZARD.

American naturalists declare the *gila* monster, known to science as *Heloderma suspecta* (Cope), or *horrida*, to be harmless, and are not satisfied with the evidence given by naturalists of the Zoological Gardens, in support of the theory that it is poisonous. "It is to be hoped," says the *Scientific American*, "that the matter will now be more fully investigated; it is barely possible that our American naturalists have prejudged the case." [Those who want to air their familiarity (real or assumed) with Greek, are not bound to speak here of naturalists, for they may say herpetologists—it sounds finer.]

With regard to the name of this animal, a writer,

C. C. H., in *[illegible]*, remarks:—"Heloderm is its name, *Heloderma horridum* scientifically. My only knowledge of the Greek language is that it is subservient to science, and zoologically defiant of gender and case, sometimes of spelling; therefore conjecturally *helo*, the first part of the generic name, may have reference to the pale yellowish or sunny colour of this creature, as certain flowers, helianthemum, heliotrope, and helianthus, are named from *helios*, the sun, as our botany books instruct us; and *derm* is certainly skin. Heloderm is of a pale ochre or maize colour, with a coarse reticulation of black marks all over it; and its specific *horridum*, deferentially inferring its terrible, dreadful qualities, is *not* given in slangy disgust, as is supposed to be the case with its neighbour, *Crotalus horridus*. 'Horrid rattlesnake!' exclaimed a lady visitor in my hearing. 'What's the use of calling *that* one 'horrid,' as if they are not all horrid!'"

The explanation of the name is erroneous. If the reference were to the colour of the sun, *helioderma* would have been the name. The reference doubtless is to the black marks on the skin, which were fancifully compared to nails (*helos*=a nail or stud): so that the name would be *nail-skin*. Why the adjective should be neuter, we fail to see. *Heloderma horridum* would imply that the skin is horrid, *horridum* agreeing with the neuter word *derma* (Gk.). But it is the animal, not the skin, which is horrid, and the animal is the *Lacerta*, of the species *heloderm*, or nail-skinned—a *Lacerta* called *horrida*, or *suspecta*, because of its real or suspected venomous qualities. Our contributor, Dr. Wilson, is certainly mistaken, by-the-way, in calling the animal *heloderma*.

FISHERMEN'S SUPERSTITIONS.

THE "Fisherman's Own Book" contains an interesting chapter [illegible] ve subject, from the pen of Capt. J. W. Collins, who [illegible] that fishermen seem to be more dependent upon [illegible] any other class of men, and that they are con[illegible] with events calculated to excite superstitions, may [illegible] some extent for their being credulous. Among the [illegible] superstitions of which he treats are—a belief in lucky [illegible] days; a belief in Jonahs; the superstitions [illegible] a hatch in the hold, breaking a looking-glass, [illegible]; and instances are cited where such [illegible] seem to have been well founded, and others in which [illegible] to have been without any foundation.

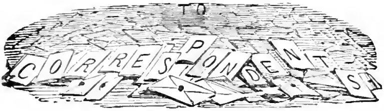
[illegible] his interesting report on the Greenland halibut [illegible] of the same subject. "The only difference [illegible] of the week," he says, "was that [illegible] on that day, for they said that would 'nail the [illegible] are a little curious. The old notion that any [illegible] on Friday would be unlucky has, in a great [illegible] of the fishermen having read in [illegible] great events that had happened on Friday. [illegible] was so strong that the [illegible] of the rigging from Sunday until [illegible]. There [illegible] superstition about which [illegible]. They will never leave a hatch up- [illegible] the fire, and had taken up the [illegible] which was kept in the bottom [illegible]. The hatch I had placed in [illegible] the cabin that, if it had fallen [illegible]. One of the fishermen, [illegible] seeing the hatch in [illegible] don't leave the hatch that [illegible] explained that if it should [illegible] would bring ill-luck upon [illegible] and knocked the hatch [illegible] remember of ever having [illegible] to turn the hatch [illegible] what the captain would say if [illegible] of the fishermen told of a captain he was with [illegible] him because he pushed a dory off from the [illegible] dory toward the sun. I found, however, [illegible] the men to acknowledge their belief in many superstitions, and I should not have found out those I have mentioned, had not the incidents spoken of called them into action. I think, as a whole, they were, for sea-going men, remarkably free from superstition."

UTILISING SMOKE FROM WOOD.

AT Elk Rapids, Michigan, is a blast furnace in which are manufactured fifty tons of charcoal iron per day. There are 25 charcoal pits, constructed of brick. Each pit is filled with 100 cords of hard wood, and then fired. The vast amount of smoke from these pits, which was formerly lost in the air, has now been utilised by Dr. Pierce, a chemist. Chemical works have been erected, which are thus described:—First, they have a circular tube made of wood, with pine staves 16 feet in length, bound together with heavy iron hoops. This tube is placed directly over the pits in a horizontal position, with an opening from each pit into the tube. At the end nearest the building there is a large drum containing a rotary fan propelled by machinery, the power of which is gas. That acts as a suction or draft for the smoke, which is conveyed into five stills filled with copper pipe 2½ inches in diameter. The boxes in which the pipes are situated are 20 feet square, 8 feet deep, made of heavy pine, and filled with cold water; these are all connected by copper pipes; they are connected with the main still 100 feet in length, 10 feet wide, 8 feet deep, filled with copper pipes 2½ inches in diameter in a horizontal position, surrounded with cold water, from this conveyed to a purifier, from which runs what is called pyroligneous acid, which is as clear as amber, with an unpleasant odour. From the acid is produced:—First, acetate lime; second, alcohol; third, tar; the fourth part produces gas, which is consumed under the boilers. Each cord of wood contains 28,000 cubic feet of smoke; 2,800,000 feet of smoke handled every 24 hours, producing 12,000 pounds acetate of lime, 200 gallons alcohol, 25 pounds tar. These articles have a commercial value in the manufacturing of various articles. The alcohol has been contracted to a firm in Buffalo, New York, for five years, they furnishing the packages and receiving it at the works at 80 cents. per gallon. The smoke from 10,000 cords of wood consumed per annum is thus made a source of much profit, as the works are nearly automatic.—*Boston Courier.*

THE application of dynamite to the breaking up of masses of iron too great to be broken by other means, was successfully tried near Chicago recently. A refractory chunk, "salamander," of twenty tons weight, was placed in a pit. A hole was drilled in the iron, and a charge of dynamite was inserted. Several bars of iron, weighing tons each, were placed over the pit in order to prevent small pieces of metal from flying heavenward. The cartridge was connected with a battery, stationed one hundred feet from the pit, and after the spectators had found secluded places, the word was given, and in an instant the twenty tons of iron that had previously stood all kinds of hammering, was reduced to fragments. The steel men were completely surprised, and admitted that a feat was performed that before was held impossible.—*Scientific American.*

ANOTHER EXPEDITION TO FRANZ-JOSEF LAND.—The *Dijmphna*, with the expedition of Lieutenant Hovgaard on board, sailed, as reported from Copenhagen, on July 18. It is the intention of Lieutenant Hovgaard to adhere to the programme originally announced, viz., to proceed first to Cape Chelyuskin and thence make for Franz-Josef Land, pushing for the north next spring in sledges. His ship of 150 tons burden has been strengthened for the ice both inside and out. He has provisions for twenty-seven months, and coals for fifty days, with full steam at six knots; besides which he has rigged the vessel as a three-mast schooner, with square sails on her foremast. He takes several sledges and nine dogs of a Newfoundland breed. The expedition consists, besides the commander, of Lieutenants Olsen and Pardo, of the Danish, and Lieutenant de Rensis, of the Italian Navy, Dr. Barch as surgeon and botanist, and Mr. Holm as zoologist, Mr. Litonius (Swede), engineer, and Mr. Ernest, mate, beside a crew of fifteen men, one of whom, the Norwegian Sivertsen, was in the Vega expedition. They are to ascertain whether Franz-Josef Land really extends to the neighbourhood of Cape Chelyuskin; whether the conditions of the current and ice are such that a basis for further exploration can be reached here without too great a risk; and whether the eastern coast of Franz-Josef Land trends to the northward at this point. They propose to winter near Cape Chelyuskin, or on the south coast of Franz-Josef Land, if it can be reached, and they hope to return within sixteen months. Observations will be taken throughout the winter in accordance with the programme of the international expeditions.



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of KNOWLEDGE; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

⁂ All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

TO MR. PROCTOR.

[552]—Paradoxers can become indignant when contradicted, as you know, having, like myself, received some epistles from that "polite letter-writer," John Hampden. What, then, must be the state of mind of a paradoxer when his chiefest, his dearest, his pettedest, his fundamental paradox is attributed to another? You have done me this wrong, and, therefore, when next we meet, &c.

In your "paradox corner," page 250, you place Dr. Siemens on my rightful pedestal. The "ingenious paradox" of supposing—aye, of even assuming—that interplanetary space is occupied by water is mine, and mine only. Grove and others have filled it with oxygen and nitrogen, Sterry and Hunt with carbonic acid; but "water, water everywhere" is my paradox, argued and stated as the fundamental basis of my essay on "The Fuel of the Sun," printed in 1869, and published 1870.

Hitherto none of the orthodox have attempted to refute this paradox by a discussion of the arguments upon which it is based. Until they do so, I shall not argue seriously with them, but merely refer to Chapter III. of the above, and quote the following from "A Simple Treatise on Heat," written ten years later:—

"The water of our ocean being equally capable of evaporation into the dense air immediately above it, or the lighter air above the clouds, or all the boundless space stretching between the orbs of heaven, be that space a vacuum or a plenum, must thus evaporate, or have evaporated, into all the interstellar space until that space be saturated according to its temperature, and such space must have *some temperature*, seeing that it receives all the radiations of all the countless suns. Therefore, the fact that our ocean is not dried up indicates the existence of 'water, water everywhere,' filling all the interstellar and interplanetary space of the universe, and having its density proportionate to its temperature" (*i.e.*, the temperature of space).

The above passage is corollary to any exposition of the general elementary facts of aqueous evaporation, more especially of the law that water is evaporated into the space surrounding it and *saturates that space*, be it vacuous or filled with much or little of air or other gases; or, "in other words, that the limit of evaporation of liquid water into surrounding space is simply a function of temperature, and not of the previous contents of that space."

I have heard of people who affirm that space has no temperature, and at the same time that our sun, and all the other suns of the universe, are dying out or cooling down. These orthodoxers then take another breath, and assert that heat is force, or a mode of motion, and that force and motion are indestructible. Then another breath, and further assert that heat is transmitted by the oscillations, gyrations, collisions, &c., of material particles; then another, and that there are no material particles between the sun and the earth.

As I refer to orthodoxers, and not to paradoxers, I must write courteously, otherwise I should say that they do this all in one breath. W. Mattieu Williams.

[Is it paradoxical to suggest that there may be aqueous vapour in interplanetary space? A very clever correspondent of the *English Mechanic* in former times (I forget how far back), Mr. E. L. Garbett, used to maintain that some comets are aggregations of the water of space—I think he even adopted Whiston's notion, that the Biblical flood was brought about by a big water comet. That, of course, was paradoxical. But the idea of aqueous vapour in space is reasonable enough. Paradox comes in when we try to get terrestial hailstorms out of it.—Ed.]

ARTIFICIAL STONE.

[553]—The utilisation of refuse opens up a large field for scientific investigation. Much has already been done, thousands of pounds have been saved annually, many manufacturers have arisen, and consequently work has been found for thousands of people, solely on account of discoveries made in this department of research.

A good example of making waste matter into a marketable product is afforded by the manufacture of artificial stone.

This stone can be used for a great variety of purposes, chief among them being for paving, edging for paths and gardens, but chiefly for building. It is easily worked, and can be made into any design, and at a short distance it cannot be distinguished from real stone. It has many advantages over real stone. It is much cheaper; it gets harder and harder for at least seven years; it does not break up in frosty weather; and lastly, it does not discolour when exposed to the atmosphere.

The larger kinds of stone-work are made in wooden moulds. A layer of plaster two inches thick, generally composed of one part of Portland cement and two parts of stone dust, is spread evenly over the bottom and sides of the mould; a mixture of brick rubble, broken up small, and coke breeze, both of which have been previously well washed, are worked up with Portland cement, and then put into the mould and rammed well in. Another layer of plaster is then put over this, and the whole left to dry for a week. The moulds and their contents must be kept under cover. This is specially needful in frosty weather, as if they are left out when freshly made for a single night the stones break all to pieces. But when once they are properly dry, they will stand any amount of cold.

The facing for paving stones, as they have to stand a good deal more wear, is made of a mixture of sand and Portland cement in equal proportions. Ernest L. R.

HIGHLAND CELTS.

[554]—In reply to A. H.:—(1.) Any person who reads and speaks Gaelic, or has a dictionary, knows that "donn" and "dubh" are in Gaelic as distinct as brown and black in English.

(2.) Tacitus, he says, uses a word meaning "unmitigated carrots." This word, however, also means golden and bright yellow, colours frequent amongst us Caledonians, but invariably tinged with brown. Tacitus himself shows that he means the latter, as he says it points to a German derivation of our race. That the Germans are a fair and not a red-haired race we all know, and A. H., not to go further, says so in his letter.

(3.) We have the astounding statement that Breadalbane lies south of the Grampians. I live in the centre of Breadalbane, with a range of the Grampians to the south. The battle of the Grampians was fought still further south.

(4.) A. H. says that but little Gaelic is spoken in our country parishes. To one living, as I do, near Killin, to put it mildly, this is nonsensical.

(5.) He says the Caledonians are described as a mixed race. I ask where? Certainly not in the ancient chronicles and ancient Gaelic poetry. Nor yet can it be found in unwritten tradition, usages, names of places and sculpture. In point of fact, Breadalbane (especially western) is the very acme of unmixed Caledonianism. All modern authorities I positively refuse to accept, as the bulk of them have no real knowledge of us, our language, poetry, usages, &c., and betray their ignorance at every turn, as "A. H." does.

Now for facts. On 27th instant there were present at Killin Public School 63 scholars, and of these 51 had brown hair and blue eyes; 11 brown hair and brown eyes; 1 red hair; and with black hair and black eyes, none. At Kenmore (eastern Breadalbane) Public School there are at present 100 scholars. Of these, 48 have brown hair and blue eyes; 43 brown hair and brown eyes; 6 red hair and blue eyes; 2 black hair and dark brown eyes; and one, a stranger, from London, black hair and black eyes. These are certified in writing by the respective teachers. Charles Stewart.

BRAIN WAVES AND MEMORY.

[555]—May I compare or connect Dr. Muirhead's theory (Mr. Knowles's) given in KNOWLEDGE, Aug. 4, with a theory as to memory?

1. Physical memory—*i.e.*, the memory by which bodily movements are performed. Here, the frequent renewal of the same impression on the nerve cells by efferent impulses, and connected

[illegible] will give rise to a certain number [illegible]. The cells tend to [illegible] at is (2), the mole- [illegible]. The motion at last [illegible] reflex; that is, an efferent im- [illegible] varied forms of efferent [illegible] to be associated with a [illegible]. Examples may be easily found of [illegible]

[illegible] connected with the acquisition of know- [illegible] R[illegible]ed feeling occupies the very same [illegible] manner, as the original feeling, and in no [illegible] manner that can be assigned. Again, he [illegible] the seat of an impression, becomes specially [illegible] ression, and for that only. I have not his book, [illegible] and cannot see the context at present; but this, [illegible] to the present fashion of explanation, seems to me to [illegible] the cell molecule, just as is believed to occur in [illegible] physical memory—that is, in memory, as a result [illegible] impression received, certain groups of brain cells have [illegible] tendency for their molecules to vibrate in one direction [illegible] another. When motion is communicated to these [illegible] be in that definite direction; it gives rise to cer- [illegible] changes (chemical), which form the recollection of the im- pression, and which may in some cases be referred outwards from the sensorium to the end organs. There are several ways in which recollections arise. We may again meet with an object which gives rise to an impression we have experienced before. The impression sets those cell molecules in motion with less effort than normal—we recollect the impressions. Again, recollection may arise volun- tarily. How does this occur? Again, involuntarily—impressions which we cannot trace to any sensory impression directly or by the association of ideas (i.e., the correlation of certain groups of nerve cells).

[illegible] recollection does not seem to admit of explanation so far. It is with [illegible] recollection that I would connect Dr. Muir- [illegible] theory of apparitions. The formation of an impression at [illegible] generates an ether wave. This, if it should return to the [illegible] cells, might affect them, causing the molecules [illegible] direction in which their motion has been deter- [illegible] return is to occur, I don't see. An impression [illegible] undergone by another brain would originate an [illegible] of the same nature, which, falling on brain-cells "duly [illegible] would, as above, give rise to the special impression [illegible] that ether wave. Two ether waves compounded [illegible] an idea by the action of molecules of about the [illegible] Mr. Knowles's friends, Damon and Pythias, may [illegible] brains of two persons, who had been accustomed [illegible] the influence of the same impressions, mental and p[illegible] thus, on the hypothesis given above, pass into [illegible] condition as far as the molecular structure of [illegible] concerned. I don't think it would be [illegible] the hypothesis given above, that such brains w[illegible] influence over one another. Please [illegible] paragraphs of the extract from Mr. Knowles [illegible] movements of inanimate objects [illegible] the recollection of those same [illegible]

[illegible] where angels fear to tread." May I ask, as to [illegible] Dr. Muirhead, whether any special organ is neces- [illegible] of these ethereal waves? The ether, [illegible] penetrating, passes also between the cells and [illegible] vertex. May not the waves of this ether [illegible] nerve molecules? As to how they act, even I am [illegible] to venture a theory just now. When [illegible] and such trifles, it is much pleasanter to [illegible] of "molecular action," "atomic [illegible] to confess our utter ignorance; but [illegible] the amount of satisfaction afforded [illegible]

[illegible] 1882. Dr. Jott[illegible].

DRUNKENNESS.

[55[illegible]]—M[illegible] live long, and do not die [illegible] the acts of their fathers, [illegible] to follow in the [illegible] and [illegible] our race [illegible]. Are we *all* [illegible] For in these artificial days [illegible] Mattieu Williams's theory [illegible] work now.

[illegible], F.R.M.S.

[557]—The question of temperance societies and pledges is being actively discussed in Knowledge just now, but there is one *raison d'être* for them which has not yet come up there. It is said to be a folly for a man who does not feel the craving for drink, to give up, save for example, his enjoyment in a glass which does him no harm. But surely, in the present state of society, many men are placed in positions where they are in constant danger, unless they exercise much thought and system (and how few have these at command!), of being led into habits of drinking. Men, I mean, who frequent clubs, messes, and such places where wine and spirits are always going, and "nips" constantly pressed upon them by hospitable friends. Workmen, again, who have to go from house to house, and get beer given them at each. Now, I think you would heartily commend such men for abstaining (if they found alcohol did them little good) from playing with such an edged tool, just as one commends a resolution to abstain altogether from gambling or betting. *Facilis descensus Averno* is true of alcohol above all, and surely it is wise for young men at least to keep off the slope. Temperance societies in both sections have, I believe, done far more good thus, by making men *think*, than by curing a few drunkards, but it is a work that can obviously never be gauged.

W. Bevil Browne.

[It appears to me that men placed in such positions as our corre- spondent mentions, should at least make the resolution never, under any circumstances, to drink in public under the conditions named; but that need not render it necessary for them to refrain from such moderate and regulated use of alcohol as they may find wholesome and readily controllable.—Ed.]

FERGUSON'S MECHANICAL PARADOX.

[558]—I have never seen the book entitled "Remarkable Men," to which "Cupidus Cognoscere" refers in letter 522 (p. 219), and am therefore ignorant in what way Ferguson's paradox is illustrated there. As a matter of fact, it affords an example of what is known in mechanics as an epicyclic train. As usually constructed, a heavy base standing on the table supports a fixed toothed wheel, on the axis carrying which, and beneath it, an arm goes round; on this arm are two axes, one near its extremity carrying the three wheels of which your correspondent speaks, while the other carries an "idle" Marlborough wheel to transmit the movement. Let us suppose that the fixed wheel has 60 teeth, the "idle wheel" any number that is convenient, and the three thin wheels 61, 60, and 59 teeth respectively. Then it is pretty evident that when the arm is made to revolve round the fixed wheel, the wheel with the 61 teeth will advance slowly in the same direction as the arm; that with 60 teeth will remain stationary, and the wheel with 59 teeth will go backwards. "C. C." will, of course, note that the intro- duction of the intermediate or "idle" wheel, in no sense affects the principle.

A Fellow of the Royal Astronomical Society.

SPOTS ON THE SUN.

[559]—The date at which Mr. A. Green's query arrived in June, and the very unfavourable weather which followed its reception, prevented us from having the sketch of the sun-spot made which

Group of Sun-spots, August 21, 1882 (10·45 a.m.).

he asked for. We, however, now append a careful drawing of the beautiful group which was upon the solar disc at the date of its execution, in hope that it may serve his purpose.

CONSUMPTION FROM STAYS.

[560]—In the reference to "taper waists" [431], in your issue of June 23, page 59, "F. W. Harberton" [Viscountess Harberton] seems to ignore statistics, and to be ignorant of established physiological facts. Dr. Ridge [432], in the same issue, shows that more males die from phthisis than females, although, as F. W. H. says, fully 90 per cent. of women are deformed by stays, and it is not probable that over 10 per cent. of the opposite sex "lace." It is impossible for stays to produce consumption if Koch's theory is correct. If it is not, tubercles do not begin to form at the lower end of the lungs, where they are compressed, but in the upper part, which the corset leaves free. Females breathe higher up than men (thoracic breathing), and the effect of lacing in the waist is to expand the chest and upper end of the lungs, and thus check the growth of tubercles. Pregnancy also interferes with free and full respiration quite as much as tight stays do, but, instead of causing consumption, it affords, at least, temporary relief. Carl Both has shown that a person has three times as much lungs as are required in health, and hence neglects to use them all; if a woman chooses to dispense with the lower portions for a few hours a day, she rarely suffers from it. That injury may result from very tight lacing no one can deny, but the anti-corset men injure their own cause when they make false charges against an article that every woman wears, and knows to be less injurious than they say it is. By pointing out the real dangers of tight-lacing (dyspepsia, sterility, &c.), and not the imaginary ones, much good can be done. "Total abstinence" has injured the temperance cause, and he who preaches moderation accomplishes far more good; so it is with stays. Another error of F. W. H. is in supposing that "taper waists" can only be attained at the expense of tight-lacing, while the fact is that, in many cases, moderate pressure, judiciously applied, will make what he calls a "taper waist" without any lacing at all.

I am afraid the editor will refuse to print this letter, because it does not follow the old rule of abusing stays at all times and in every manner; but a scientific journal should consent to present *all* the facts, even if they *seem* to contradict preconceived ideas.

E. H.

[E. H.'s letter is printed in full, even the last paragraph, in which he rather unjustly suspects me of disliking moderate views. It so happens that on quite a number of subjects about which extreme views are held, I have expressed moderate views. I have advocated, or at least defended, the moderate use of stimulants, where many readers have urged me to Blue-Ribbonise KNOWLEDGE. I have held a middle course on the Vivisection question, opposing equally the brutalities of some vivisectionists and the colder form of cruelty which some anti-vivisectionists display. So far as I know, I have no extreme views on any subject. Even in dealing with the Endowment of Research, supposed by many to be a subject on which I am rather earnest, I have advocated reasonable State support in the very papers in which I have most strongly denounced scientific mendicity and Micawberism. I have acted on the rule, *Medio tutissimus ibis* (which a spiritualist friend translates, "You may very safely visit a medium")—or, rather, my idiosyncrasies tend that way. E. H's fears were ill-founded.—R. P.]

FLINT JACK.

[561]—It may be rather late, but as no one has satisfactorily answered A. Britland's question, I think the best he could do would be to write to the Curator of the Wilts and Devon Museum, Salisbury, where there is a large collection of forgeries, and a portrait of Flint Jack, *alias* Flint Willie, Shirtless, Bones, &c.

J. E. OKILL.

LETTERS IN TYPE.—Brain Troubles, by Dr. Jope; A Luminous Sea, by H. P. Vacher; Size of Rising Moon, by G. E.; Local Weather Lore, by Michael Rearden; Singular Mental Illusion, by W. H. Perkins; A Glass of Wine, by W. H. Johnston, and H. F.; Tarnished Daguerreotypes, by A. Brothers; Physiological Experiment, by Z.; Skeleton Leaves, by E. C. N.; The Use of Drunkenness, by J. Ralph; Talking Canary, &c., by Charles L. Cane; Turkish Tobacco, by Tunbeki; New Method of Preserving Organic Bodies, by W. Mattieu Williams; Defects of Bicycles, by John Browning and H. T. Round; Hot and Cold Drinks, by M. D.; Jordan-Glycerine Barometer, by C. J. W.; A Poisonous Lizard, by Solanum; Botanical Repulsion and Attraction, by Beccabunga; Singular Rainbow, by William Ackroyd; Mechanical Paradox, by C. T. M.

Answers to Correspondents.

⁂ All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded, nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

EGYPTIAN CHRONOLOGY.

HALLYARDS.—With regard to your note, for which I am much obliged, I can only say that I do not profess to be a chronologist, or to reconcile Bible statements which differ from each other. Believing the clear, straightforward, unvarnished tale of Exodus to be the original version, and the later variations mere departures from the original, I have preferred to accept the statements in Exodus, and to abide by them. I believe Abraham, for instance, to have been laid in the Cave of Macphelah, and not in Sychem, and I believe the sojourn to have been, *most likely*, 430 years in duration. But, as a fact, I doubt *all* chronological statements before the time of Shishak and the fall of Jerusalem. Up to that time I regard all chronology as merely approximate. We know how the most ordinary statements of events happening in our own day, when we have printing-presses and telegraphs, get garbled, magnified, and turned upside down by mere verbal repetition. And how much more must statements regarding lapses of time have become garbled, and magnified, and altered, when repeated from mouth to mouth, and from generation to generation, in ages when there was no press, no sifting of evidence, and no means of comparison? It must be observed that I have scrupulously avoided *fixing a date* for any of the events relating to Joseph, the Exodus, Rameses, &c. I have again and again insisted on the fact that I use figures and dates only for *convenience*, and that my dates are merely approximate, and may be shifted "up or down the scale of ages" to almost any extent.

A. B. E.

JAS. DEANE. Many thanks for Mr. Russell's paper. He certainly presents the meteoric theory of the cold snaps in a much more effective form than any in which it has yet been advanced. I propose to present his theory presently in a paper which I will write on the subject. In passing, however, let me note that in the extract you send me a mistaken idea is advanced (without being corrected, as it should have been) that the August meteor system lies between the earth and the sun in February. This is certainly not the case.—F. W. wishes to know *how*, also (which is harder) *why* the teeth of cows differ from those of other quadrupeds.—HUNTINGFORD wishes to know how best to learn Latin without teacher.—J. F. SIMPSON. I am much obliged to you for sketch of R. W., but fear it will be long before space can be found. British Association pushes aside so much. Electricity in atmosphere in type. It is rather technical.—P. T. LETCHFORD. Letter about tricycles forwarded to Mr. Browning, who will note it. We are getting weekly more into arrears with letters, or would insert it.—J. PARRY. Probably what you saw was an August meteor, so near the radiant that its path was almost without apparent length,—in other words it was moving almost directly towards you. Saying that it appeared to you "about the size of a hen's egg, relatively," does not convey a clear idea of its apparent size. You should have mentioned how far off an egg would be to appear about as large as your meteor. Then again, what sort of hen?—M. TESTER. We have asked "Natator," and he tells us he thinks those india-rubber collars may be used without harm; they certainly help some learners; but you should only use them so as to learn as quickly as possible to do without them.—T. R. ALLINSON. Every one knows what a "caul" is; but if any one wants to sell a caul, and thinks some one may want to buy one, what is it to us?—W. G. S. notes that the stone objects referred to by W. M. probably do not exist in "flint," as it is doubtful whether there is true flint in South Africa. He refers readers to "Journal of Anthropological Institute," vol. xi., p. 129.—ALG. BRAY. You are quite right. The chance that the letters of the sentence "Up, Guards, and at them," will be drawn in their right order from an urn containing seventeen alphabets, or 442 letters, is not what I said in the number for July 31, but

$$\frac{17^{12} \times 16^{4} \cdot 15}{442 \cdot 441 \ldots\ldots 427 \cdot 426}$$

I hope G. A. D. will notice the correction, and excuse my mistake which I cannot explain. My answer implied that because there were 2 *u*'s in the sentence, there were 34, not 17, *u*'s in the urn, and so forth; but *why* I should have imagined this at the moment, [illegible] C. L. [illegible] Your letter sent to printers. [illegible] pages of letters waiting. [illegible] W[illegible] is there to explain? It is pretty [illegible] 30 oranges at two for a 1d., and 30 [illegible] you pay 25d., while if you sell the lot [illegible] 24d., or lose 1d. If you mean [illegible] neither loss nor gain, I would [illegible] taking 10 sets of 20 oranges from the [illegible] with 10 sets of 3 made up out of the [illegible] 10 sets of 5, for each of which you [illegible] 10 oranges of the first lot, for which you [illegible] for 1d., you are antecedently likely [illegible] transaction. If there had been 20 at 2 a [illegible] 30 at 3 [illegible] the 50 might have been sold at 5 a [illegible] loss nor gain. Such proportions should always [illegible] —Tunbeki. Pray excuse long [illegible] of Persian tobacco. I wanted [illegible] A writer with hieroglyphic sig[illegible] which are such as only advanced [illegible] interest in, and they would know [illegible] this question, "Is there any [illegible] by logarithms?" Why, certainly. [illegible] 2 from 7. Double the logarithms [illegible] 7 [illegible] the results thus obtained are the [illegible] of these numbers by the sum of 7 and 2 [illegible] you want. Some prefer to subtract 2 [illegible] 7 [illegible] will soon be a Durham B.A., wishes to [illegible] a surgeon in the least possible time. [illegible] at Owen's College, Manchester. [illegible] insert your interesting letter if not [illegible] the good effect of exercise you [illegible] to the circulation. Quite agree [illegible] effect of a single glass of wine when [illegible] Beware, however; it is a deadly [illegible] once or twice a week, is absolutely [illegible] century.—M. M. Williamson. W[illegible] but fear it was not pre[illegible]

ASTRONOMICAL.

[illegible] promises us to look at 2 Cancri [illegible] 175 [illegible] Castor as soon as they come into [illegible] Just now it is between 3 and [illegible] high.

CHEMICAL.

[illegible] Advanced Stage in Inorganic Chemistry, Science and Art [illegible] the following works may be studied. [illegible] "Elementary Chemistry," for Practical [illegible] Chemistry," published by Longmans & [illegible] considerable portion of the theoretical [illegible] two other querists were inserted [illegible] "Cuco." [illegible] The flame [illegible] is mixed with the gas than [illegible] the more intimate [illegible] with the coal gas [illegible] produces a much more [illegible]

BOTANICAL.

[illegible] explanation of the difference [illegible] a little too condensed. A [illegible] the spur being com[illegible] The best way to under[illegible] or Indian [illegible] touches the [illegible] and you have [illegible] There are always [illegible] at the base of these [illegible] "small deep [illegible] as far [illegible] If you cut [illegible] can readily [illegible] will show you [illegible] by the [illegible] Observe [illegible] [illegible]

slight cut on your fingers, some of the poisonous juice might easily have got into your blood. The plant derives its very misleading name from the fact that its capsules slightly resemble capers; but many people have been more or less poisoned by rashly concluding that they could pickle and eat them with impunity.

GEOLOGICAL.

Flint-Jack. I notice that no reply has yet been given to the query as to the time and place of the death (if he be dead?) of the celebrated fabricator of stone implements and other spurious antiquities, whose great misfortune it was to be born about five thousand years too late. When I became Curator of the Leicester Museum, in 1872, I found that the institution possessed several specimens of his handiwork; but a knowledge of his abilities had by this time become widely disseminated, and it is a fact that he was only able to sell some really good examples of neolithic flints by offering them as his own workmanship! During the next two or three years he was frequently an inmate of the Leicester workhouse. About this time I carefully watched his mode of chipping flint, and certainly his dexterity in manipulating that refractory substance was very great. After breaking a flint nodule in half with a heavy hammer, he would select a portion, and by smart blows delivered from the elbow, detach long, knife-like flakes, guiding and lengthening the fracture by the pressure of his fingers. The flakes so obtained he would fashion into knives, saws, &c., by rapid up and down blows of a thin iron rod, bent at one end. I often tried to induce him to attempt the imitation of some of the wonderful Danish daggers or spear-heads, made out of flint, yet not much thicker than card-board, and having surfaces rippled in the most beautiful manner. Over these he always shook his head and repeated again and again, "'tis a *barbarous* art, lost to mankind!" One day, I think it was the autumn of 1875, he came to the Museum in unwonted alarm, and announced his intention of making an early departure, for "they were dying off like flies at the workhouse, and he would sooner die in a ditch." This was the last I saw of Edward Simpson; irreclaimable scamp and true tramp though he was, I cannot help a kindly feeling for him, and I should be glad to learn, with your querist, where and how his wanderings were ended.—W. Jerome Harrison.

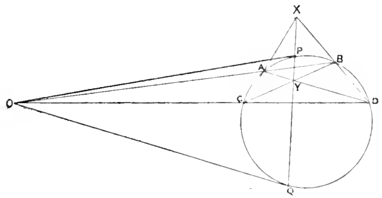
TRICYCLING.

Mr. Litchford.—I had had my attention drawn to the mistake in my article. It was by a slip of the pen that I described the "Humber" as a rear-steerer—of course it steers in a similar manner to a bicycle, by the movement of the front wheels. The truth is that I had in my mind the title of my article on the *form* of the tricycle, and your correspondent will see that in the case of the "Humber" there are two large wheels in the front and one small wheel behind. Possibly rear-steering machines may not prove well fitted for riding at the very highest or, in other words, racing speed. But I doubt if this would materially affect their sale. When, as Mr. Litchford states, the rear-steerer was found unsteady, both himself and his fellow-competitor were probably going at between twelve and fifteen miles an hour. Very few tricyclists care to ride faster than from eight to ten miles an hour, and at this rate of speed most of the rear steerers I have tried have been fairly steady, though they might have been improved in this respect by having the pedals brought underneath the rider, and the backbone lengthened in the manner I have indicated in my previous article. I think it quite possible that the greater number of tricycles will, for the future, be made of the front steering type. For intending riders, who purchase a machine and wish to ride at once without any practice, a front steerer will be best, but I cannot admit that the rear-steering machine need necessarily be unsafe. My principal object in writing my article was to point out that the bad reputation this class of machine has acquired has been due to errors in construction. Last year I had an ugly accident myself while riding a "Salvo," which I believe to be the safest of all front-steering machines. In this experience I am not alone. A well-known and excellent rider turned more than one somersault, when running down hill on a "Salvo" a few weeks since. This year I have ridden only rear-steerers, without any approach to an accident. Of course, I have ridden carefully when descending steep or very rough hills. Your correspondent is mistaken in supposing that the hill-climbing power of the "Monarch" is due entirely to the small size of the wheels and long cranks. In my "Monarch" the cranks have but $4\frac{1}{2}$ in. throw, while the "Premier" I have has cranks with nearly $6\frac{1}{2}$ in. throw. Many riders besides myself will be sorry if manufacturers generally give up making rear-steering tricycles. I am looking forward to the "Sterling," with its novel application of back-pedalling, being made one of the best machines of the day.—John Browning, L.T.C.

Our Mathematical Column.

I SEND you two questions which I would be glad of a reply to. The first was intended to be given at examination for licensed surveyors in this colony (New Zealand). Your papers on probabilities suggested No. 2.—Toowoomba.

Prob. 1.—*Prove the following method of drawing tangents to a circle from a point* O.



Draw any two chords OAB, *and* OCD. *Let* AD *and* BC *meet in* Y, *and* CA *and* DB *in* X. *Let* XY *meet the circle in* P *and* Q, *then* OP *and* OQ *are the tangents required.*

This property is true if ABDC is any conic section, and is most simply proved as follows:—OAB and OCD being chords from a point O, CA and DB intersect on the polar of O, and so also do AD, BC. Therefore XY is the polar of O, and P, Q, in which XY cuts the conic, are the points in which tangents from O meets the conic.

But Toowoomba's letter suggests that the solution of the problem might probably have been required to be independent of the theory of polars.

Try then the following.—

Take OB, OD as axes of y and x, and let OC $=\alpha$; OD $=\alpha'$; OA $=\beta$; and OB $=\beta'$.

Then the equations to CA, BD, CB, and AD, are respectively—

$$\frac{x}{\alpha}+\frac{y}{\beta}=1; \qquad \frac{x}{\alpha'}+\frac{y}{\beta'}=1;$$

$$\frac{x}{\alpha}+\frac{y}{\beta'}=1; \text{ and } \quad \frac{x}{\alpha'}+\frac{y}{\beta}=1;$$

Hence the equation to XY will be of both the forms

$$\frac{x}{\alpha}+\frac{y}{\beta}-1+m\left(\frac{x}{\alpha'}+\frac{y}{\beta'}-1\right)=0 \qquad \text{(i)},$$

$$\text{and} \quad \frac{x}{\alpha}+\frac{y}{\beta'}-1+n\left(\frac{x}{\alpha'}+\frac{y}{\beta}-1\right)=0 \qquad \text{(ii)};$$

since (i) is the equation of a line passing through X, and (ii) is the equation of a line passing through Y. Obviously the only equation which is of both these forms, and therefore the equation to XY, is obtained by putting $m=n=1$. Hence equation to XY is

$$\frac{x}{\alpha}+\frac{x}{\alpha'}+\frac{y}{\beta}+\frac{y}{\beta'}-2=0 \qquad \text{(iii)}.$$

Now let the equation to the conic ABDC be

$$ax^2+bxy+cy^2+dx+ey+f=0 \qquad \text{(iv)}$$

Put $y=0$, and divide by x^2, giving

$$\frac{f}{x^2}+\frac{d}{x}+a=0$$

The two values of $\frac{1}{x}$ obtained by solving this quadratic are, of course, $\frac{1}{OC}$ and $\frac{1}{OD}$ or $\frac{1}{\alpha}$ and $\frac{1}{\alpha'}$; and we know that this sum $=-d$. Thus,

$$\frac{1}{\alpha}+\frac{1}{\alpha'}=-d, \text{ and similarly } \frac{1}{\beta}+\frac{1}{\beta'}=-e.$$

Hence, equation (iii) may be written

$$dx+ey+2f=0 \qquad \text{(v)}$$

Now let x', y' be the co-ordinates of P, and x'', y'' those of Q, the points in which tangents from O meet the curves ABDC. Then we know that the equations to the tangents at P and Q may be written

$$(2ax'+by'+d)x+(2cy'+bx'+e)y+dx'+ey'+2f=0$$
$$(2ax''+by''+d)x+(2cy''+bx''+e)y+dx''+ey''+2f=0.$$

Since these both pass through the origin, they must be satisfied when $x=0$ and $y=0$; that is, we must have

$$dx'+ey'+2f=0 \qquad \text{and } dx''+ey''+2f=0;$$

Or both the points P $(x'y')$ and Q (x'', y'') lie on (v), that is on the straight line XY. Q. E. D.

[I have given the proof more fully than is necessary. For equation (v) is known to be the equation to the chord through the points in which the tangents from the origin meet the conic (iv).]

Problem 2.—*Having won the first game at whist, it is usual to lay the odds, 5 to 2 on winning the rubber. How are these odds calculated?*

The odds are incorrect. Independently of the deal, it is an equal chance that the second game is lost, and also an equal chance that the third game is lost; so that the chance is $\frac{1}{2}\times\frac{1}{2}$ or $\frac{1}{4}$ that the rubber is lost by the winners of the first game. The odds are, therefore, 3 to 1 in favour of their winning. With the deal they are rather more than 3 to 1; without the deal the odds are rather less than 3 to 1.—Ed.

Our Chess Column.

By Mephisto.

SOME GENERAL REMARKS UPON THE STRATEGY OF THE GAME.

The First Move.

MANY of our readers who know the rudiments of Chess play, cannot follow the analysis of an ordinary game without feeling somewhat disappointed. Such a game will present to them many unintelligible points, which they cannot explain themselves. They wish to know the precise reason for every move. We will endeavour this time to satisfy—and, let us hope, improve—this weaker class of our Chess patrons.

1. P to K4.

We have a lively recollection of the despair of a young man who, when playing with a young lady, was, with great perseverance, asked why people always played 1. P to K4, and why not any other move. The only answer he could give was, everybody begins with that move. This, however, did not satisfy the inquirer at all, who wanted reasons. In our opinion there are various reasons, based on the theoretical foundation of the game. Firstly, the Pawn occupies as nearly as possible the centre of the board, and is intended to form the nucleus of a force which, being centrally posted, has the greatest command over the enemy's camp, both to the right and left. A good position is the first step towards the attack which leads to victory. Secondly, P to K4 liberates two very important pieces, namely, the Queen and the King's Bishop. The more squares your pieces command, the more you limit your opponent's possible moves, and as the game proceeds, if you succeed in concentrating the commanding action of your pieces on one of your opponent's pieces, you will cut off the defence or retreat of such a piece, and capture it; and a Mate is nothing but the successful posting of your pieces in such a commanding position as to cut off the defence or retreat of the hostile King. Like every other potent fact, this proof can also be mathematically demonstrated. By moving 1. P to K4, your Bishop has the command over five squares and the Queen over four—viz., B to R6 and Q to R5. This gives nine moves, and it is impossible by any other first move on the board to obtain the command over nine squares by the pieces liberated. 1. P to Q4 only gives the command over seven squares by the Queen and the Queen's Bishop. This undoubted mathematical inferiority is, however, counterbalanced by the fact that in reply to P to Q4 your opponent cannot reply with the superior move of P to K4, as then the Pawn could be captured, which necessitates P to Q4 in reply to 1. P to Q4. Thirdly, the King's Bishop's Pawn is the weakest point in an opponent's camp, it being only protected by the King, and 1. P to K4 enables B to B4 to follow, also Kt to KB3. Both these pieces indirectly threaten the Pawn on KB7, the Bishop from B4, and the Knight from Kt5, where it might be played to, or the Queen from R5, where it also might be played prior to or after moving the Knight. Of course, Black has a ready defence, but while he is defending, White develops his forces, and is enabled soon to bring his King into safety by Castling.

1. P to K4.

For the student this is, no doubt, the best reply, although one [illegible] however, can only be ventured on [illegible] strategy of the [illegible] being at once to make [illegible] in connection with the com[illegible] P to K3 also leaves Black [illegible] P to K4, the Pawn is not attacked by [illegible] Kt3. P to K3 may be followed up by [illegible] equal development of forces. The [illegible] reply of P to K3 is called the French [illegible] moves are possible for Black, such as [illegible] defence, and 1. P to QKt3, the fianchetto; [illegible] state P to K3 sooner or later, and there[illegible] category.

[illegible] dwelt upon the general principles that [illegible] we will now proceed more briefly with a game

1. P to K4 | 1. P to K4
2. P to KB4

[illegible] abandoning a Pawn, but on Black taking this Pawn, [illegible] partly compensated by obtaining a strong centre by [illegible] to play P to Q4 later on, which, likewise, threatens [illegible] Pawn on B5, the defence of which is difficult, and gives [illegible] opportunity for attack.

2. P takes P

[illegible] Black ought to be able to maintain this Pawn, but [illegible] difficult. Should the second player elect not [illegible] the attack, he can reply either with 2. P to Q4, [illegible] which yield a fair defence.

3. B to B4

[illegible] Bishop's Gambit, in distinction from the King's [illegible] brought about by 3. Kt to KB3.

3. Q to R5 (ch)

[illegible] acknowledged that before giving this check it [illegible] 3. P to Q4 first, thereby voluntarily giving up [illegible] the Queen's Bishop, and relying upon the [illegible] the White King, which ought to tell in the End [illegible]

[illegible] K to Bsq
[illegible] move

4. P to QKt4

[illegible] of diverting the Bishop from his commanding [illegible]

5. B takes KtP | 5. Kt to KB3
[illegible] Kt to KB3

[illegible] Queen from her present position; for instance, by [illegible] Kt5 Black would threaten Mate by Q to B7, and also [illegible] Pawn on R2. Had White played 6. P to K5, Black [illegible] with Kt to K5, threatening the same Mate, and [illegible] change by Kt to Kt6(ch).

6. Q to R3

7. P to Q3 | 7. Kt to R4

[illegible] Kt to Kt6(ch), retiring the Knight from where it [illegible] by P to K5, and also serving to defend the [illegible]

8. Kt to R4

[illegible] Kt6(ch), and with a view to an attack by [illegible]

8. Q to Kt4

[illegible] to escape the menacing move of Kt to B5 by [illegible] Bishop and the Knight.

9. Kt to B5 | 9. P to QB3

[illegible] P to KKt3 looks better, as it threatens to win a [illegible] the Kt to Q4 by Black playing B to Kt2. [illegible] P to KKt3, White would have played P to KR4, [illegible] Queen retiring to KB3, it is clear Black cannot [illegible] would leave his own Knight unprotected, [illegible] White Queen with a good game.

[illegible]

[illegible] force of which will be seen as the attack, [illegible]

10. P takes B
11. [illegible] | 11. Kt to KB3
12. [illegible] | 12. Q to Kt3
[illegible]

[illegible] more apparent, he [illegible]

13. Q to Kt4

[illegible]

[illegible] move of Bishop takes Pawn, which [illegible]

14. Kt to Ktsq

[illegible]

15. [illegible] | 15. Q to B3
[illegible] B3

Further strengthening his attack by threatening Kt to Q5, or Kt takes QKtP.

16. B to B4

17. Kt to Q5 | 17. Q takes P

Black had nothing better. This is the only move which guards his KKtP against Kt takes P(ch).

18. B to Q6

A most wonderful power of perception. It further embarrasses Black's game. He cannot take that Bishop on pain of mate in four moves as follows. 18. B takes B. 19. Kt takes B(ch), K to Qsq, 20. Kt takes P(ch), K to Ksq. 21. Kt to Q6(ch), K to Qsq. 22. Q to B8 mate. White disregards the loss of his Rooks for the sake of attack.

18. Q takes R(ch)

19. K to K 2

White's object in giving up this second Rook is to be enabled to play Kt takes KtP(ch); it would, therefore, have been better for Black not to take the Rook, but play his Queen to Kt7, so as to defend his Pawn on KKt2 as long as possible.

19. B takes R

20. P to K5

White now threatens mate in two by Kt takes KtP(ch), K to Qsq, and B to B7 mate.

20. Kt to QR3

Black's intention was of course to prevent the check with the B on B7 after Kt takes P(ch) and K to Ksq, but B to R3 would have been better for that purpose, as it would have provided a retreat for the King on QBsq and QKt2. White now effects a mate in three moves in a highly ingenious manner.

21. Kt takes P(ch) | 21. K to Qsq
22. Q to B6ch

Now of course the Knight must take, which enables White to play.

23. B to K7 mate.

We have purposely selected this game, which by some is considered the finest game ever played, and is known as the immortal game in which White was played by the late Professor Andersen and Black by L. Kieseritzky. We hope its perusal will give our readers a good insight into the strategy and combination of Chess.

ANSWERS TO CORRESPONDENTS.

**** Please address Chess-Editor.*

Herbert Jacobs.—Problem will receive attention.

H. B. Kimpton wishes to play a game by correspondence.

Leonard P. Rees. 1. K to Q2 does it.

Mebsuta.—Pray learn the English notation; the King cannot give mate.

J. G.—Problem 19. If B to Bsq, then P takes B, becomes a Queen, and mates.

Correct solutions received of Problem No. 51 by Aryce (etc.), C. S. Bright, T. Wilson Morris, A. Wahltuch, J. K. Milne, Squire, Charles Hartley, John Watson, Sydney Herbert, and Herbert Jacobs. Problem No. 52 Geo. H. Bonner, Schmucke, J. K. Milne, H. Seward, Leonard P. Rees, and Berrow.

Problem No. 53. W. C. Thomas, Berrow, H. Seward, J. K. Milne, Schmucke, Sydney Herbert, Geo. H. Bonner, and Herbert Jacobs.

Incorrect solutions of No. 50, H. G. Watson. No. 51, J. G., A. J. H., F. J. C., and Th. L. Jones. No. 52, W. C. Thomas and Sydney Herbert.

NOTICES.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, SEPTEMBER 22, 1882.

CONTENTS OF No. 47.

Science and Art Gossip.

DISCOVERY OF A COMET.—A circular from Lord Crawford's Observatory at Dunecht says:—"Monsieur Cruls telegraphs from Rio Janeiro, by the Science Observer Code, the discovery of a comet on September 11·718 M. T. (Rio?) in R. A. 9h. 48min; Decl. – 2° 1′. M. Cruls says that it is visible to the naked eye, and is probably the expected Comet Pons of 1812."

MR. A. AINSLIE, of the Common, Ealing, says the *Times*, telegraphed to us yesterday:—"This morning, at 10.45, I found a magnificent comet west of the sun about 6 min. and about 1·3° south. It is approaching the sun rapidly, and is, no doubt, the comet referred to in the Earl of Crawford's Circular, No. 54." [For Mr. A. Ainslie, of the Common, Ealing, read Mr. A. Ainslie Common, Ealing.—ED.]

THE USE OF BALLOONS IN WAR.—The objection to the use of balloons in war time always has been the possibility of the enemy firing at and disabling them, to the certain death of the unfortunate occupant. Mr. A. Cooper Key writes to a daily paper suggesting a plan by which this risk could be obviated. He proposes that a small captive balloon, from which four cameras fixed to a square frame are suspended, should ascend to a given height—say half or three-quarters of a mile; the four lenses, previously focussed, must be towards the earth, and closed with instantaneous shutters, capable of being moved by galvanic battery, the wires from which could be carried by the rope which tethers the balloon, and the frame in which cameras are fixed should have facing plates at an angle of 45°, and be prominently painted in different coloured symbols which could be clearly read off from the field of observation. The officer in charge should be provided with a field-glass, mariner's compass, and a sheet of paper with symbols painted to correspond with those on the camera frame, so as to note the position of balloon the instant contact is made by means of the battery. Thus, when the balloon is brought to earth, the exact situation in which the photograph was taken can be ascertained.

EDISON *v.* MAXIM.—A suit has been brought by the Edison Company against H. E. Maxim for infringing Edison's incandescent lamp patents. The trial will probably take place in Paris in November next.—*Electrician.*

THE *Engineer* says:—The unsanitary condition of certain towns in the United States has drawn attention to the fact that wooden houses, and especially wooden foundations, are liable after a certain time to cause malarial symptoms. So many malarious attacks have been experienced of late years in San Francisco that the medical men began to suspect the buildings, especially as the structures themselves, which are nearly all built on wooden foundations, began to show disturbances, cracks appearing in the walls, and the floors settling. Scientific investigation into the causes of these troubles points to the fact that the wood used in the foundations becomes decayed by contact with the sand, which destroys its fibre and leaves it porous and brittle. The next stage in the process is the formation of a fungus growth from the edge of the wood, composed of infinitesimal insect life, which burrows the remaining wood until its vitality is gone, and the insect itself dies. Physicians attribute many of the unpleasant smells and the bad health that hang about the inhabitants of these dwellings to this malarial condition, which to a great extent disappears as soon as proper foundations are substituted for those of wood. There are doubtless many old houses in this country which, without being actually dangerous to health, have constantly hanging about them a damp odour of decay, giving rise to *malaise*, and it is most probable that the woodwork will in many cases be found to be permeated by insect life.

ANCIENT WORKS IN FLORIDA.—The *Travers Herald* describes the finding of an ancient work in digging a canal between Lakes Eustis and Dora, to open up the more southern lakes of the great lake region of Florida. The first excavations revealed the existence of a clearly-defined wall lying in a line toward the south-west, from where it was first struck. The wall was composed of a dark brown sandstone, very much crumbled in places, but more distinct, more clearly defined, and the stone more solid, as the digging increased in depth. The wall was evidently the eastern side of an ancient home or fortification, as the slope of the outer wall was to the west. About eight feet from the slope of the eastern wall a mound of sand was struck, embedded in the muck formation above and around it. This sand mound was dug into only a few inches, as the depth of the water demanded but a slight increased depth of the channel at that point; but enough was discovered to warrant the belief that here on the north-western shore of Lake Dora is submerged a city or town or fortification older by centuries than anything yet discovered in this portion of Florida. Small, curiously shaped blocks of sandstone, some of them showing traces of fire, pieces of pottery, and utensils made of a mottled flint were thrown out by the men while working waist deep in water. One spear-head of mottled flint, five and a-half inches long by one and a-quarter inches wide, nicely finished, was taken from the top of the sand mound, and about four feet below the water level of the lake.

THE TELEPHONE IN THE DIVING-BELL.—The *Newcastle Chronicle* says the telephone has been applied as a means of signalling between the workmen in the River Wear Commissioners' diving-bell and the workmen in charge of the crane and air pump for governing the bell, in the craft employed for submarine work. A successful trial was made recently at the entrance to the South Dock, Sunderland. The signalling between the diving-bell at the bottom of the river and the machinery in the craft at the surface was all that could be desired. In fact, everything that proceeds within the bell can be heard above, every stroke of the hammer or whisper of the men. It is worthy of remark that in this application of the telephone, which will be exhibited at the forthcoming North-East Coast Marine Exhibition, to be held at the Tynemouth Aquarium, the workmen in the bell have no necessity whatever to speak into the telephone. So long as the telephone is within the bell it records all that is passing. This is not the first occasion on which the telephone has been applied to the diving bell. In March, 1880, an experiment similar to the above was made at the Earl Grey Dock, Dundee.

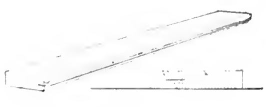
The Four Great Ports.—Liverpool ranks as the most important port in the world, with an annual tonnage of 2,647,372; London stands second, with a tonnage of 2,330,688; Glasgow third, with 1,432,364; New York fourth, with a tonnage of 1,153,676. As a manufacturing city New York leads the world.

A Coloured Reaction of Atropine and Daturine. —If a specimen of either of these alkaloids or of their salts is covered with a little fuming nitric acid, let dry upon the water-bath, and when cold moistened with a drop of potassa dissolved in absolute alcohol, a violet colour is instantly produced, and soon passes into a fine red. Only the violet colour is characteristic, as strychnine also gives a beautiful red colour if similarly treated. According to the author, 0·000001 grm. of atropine sulphate can thus be detected. None of the other important alkaloids give a similar reaction.—*D. Vitali.*

Mr. Joseph M. Collingham writes as follows in the *Times* about dogs barking at horses:—Allow me, as an old dog fancier and one who has had most kinds of sporting dogs, and who has broken and trained various kinds, to say that not one in a hundred dogs ever shows the annoying fault of barking at horses, but that when one does contract this fault it is all but an impossibility ever to break him of it. The offender will disregard all rating or scolding, and soon becomes crafty enough to keep out of the way of the whip. He becomes a dangerous brute from this habit of barking in front of, or at the heels of, any passing horse, and is deservedly looked upon by any equestrian or driver as an ill-conditioned cur, which only a dose of poison or a charge of shot will cure. My observation leads me to say that collies or shepherd dogs and retrievers are the most frequent offenders, and the former are sometimes dangerously savage.

A Berthon Boat in a Gale. We made reference to this boat a few months ago, when referring to the Naval and Submarine Exhibition at the Agricultural Hall. What we then said is fully borne out by the following extract from *The Engineer*. "It has been believed by many that the remarkable collapsible boats invented by Rev. E. L. Berthon, and now coming into general use, though good for some purposes, could never stand the test of a gale of wind or compete with other boats in sailing power. To prove the fallacy of this opinion, Captain Frederick Harvey, R.N., and Captain Whalley Nicholson, ventured to take an ocean trip in a 28ft. boat of this kind, built at Romsey for the Union Company. With four seamen they embarked in the s.s. *Esquibo*, by the permission of the Royal Mail Company, on Friday, the 11th inst. On Monday the 14th, the boat and its crew were put overboard about 400 miles west of the Scilly Isles. There was a very strong wind and high sea. Owing to the thick weather and constant rain, the boat's crew got no observations, and when they ascertained their whereabouts by hailing a ship, they found themselves about sixty miles west of Cape Finisterre; they then bore away more to the north, and reached the Scilly Isles on Saturday at 3 a.m. Here they stayed till Sunday, the 20th, at 4 p.m., when in more than half a gale of wind they started again for Southampton, and made the wonderful run of 240 miles to the Needles in thirty-five hours. We believe this is quite unprecedented for a ship's boat. Sometimes they logged more than ten knots an hour. That an open canvas boat should live in such a stormy sea as would have swamped any other is remarkable enough; but that she should have been able to carry sail through it all, and at such tremendous speed, is quite astonishing. The courage and skill of Captain Harvey and his able coadjutor, Captain Nicholson, an officer in the army, were admirably displayed in starting again from Truro after encountering such a gale of wind as they had in skirting the Bay of Biscay from south to north. One member of the crew—who were all volunteers—was the boatswain of the unfortunate *Teuton*, wrecked at the Cape last year. This man expressed his wish to join the party in order to prove that it was no fault of the Berthon boat on board the Teuton that it did not save the passengers. His testimony on this point concurs with that of all the other survivors, that the said boat was never lowered nor opened at all, but, like others of the boats, went down with the ship. The total distance run on this occasion could not have been much less than 800 miles, and when it is considered that the whole time she bore the brunt of the gale which raged here in the beginning of last week, we have abundant proof that Berthon boats are not exceeded in seaworthiness and speed by any others in the world. The boat is now afloat in the inner dock at Southampton, and has not suffered in the smallest degree. She has been visited by a great many members of the British Association. The dimensions of the boat are as follows:—Length, 28 ft. 4 in.; breadth, 8 ft. 6 in.; depth, 3 ft. 9 in. When shut against the bulwarks of a ship her width is 22 in. with all her gear stowed in her, such as masts, sails, oars, water-beakers, and anchors. The time required to open, set up, and lower such a boat is less than one minute. It was done before 160 members of the British Association on Saturday last in forty-five seconds. It is an interesting question whether the great elasticity of these boats has not something to do with their unusual speed."

The woodcut intended to illustrate the "Improved Ruler," recently patented by Mr. G. L. Knox, of New



York, was accidentally printed upside down in a portion of our last issue. We now append it in its correct form.

ANTIQUITY OF MAN IN WESTERN EUROPE.

By Edward Clodd.

CONCLUSION.

THE general character of the deposits in Kent's Hole resembles so closely that of the accumulations in bone caverns of the Continent, that reference to these would be needless but for the presence in them of certain relics of palæolithic art which are rare in English caves and, so far as is known, altogether absent from Neolithic deposits, as the "kitchen-middens" of the Baltic shores and the lake-villages of Switzerland. The exploration of rock-shelters in the Dordogne by Lartet and Christy brought to light a series of scratched or etched fragments of bone and stone remarkable for their graphic sketches of animals of the reindeer period, and for their witness to the advance which Cave-man had attained over his predecessor of the Drift. That such work as this was done, implies not only the existence of the germs of art, but also leisure for their cultivation, and places man of the Ancient Stone Age on a level of culture not inferior to that of savages yet extant.

On pieces of ivory, horn, schist, &c., we find rude, but spirited, pictures in outline, sometimes lightly shaded, of the ox, the horse, the cave-bear, man, and, as evidence of his wanderings to the coast, of the whale and seal. The attitude of the animal is often ingeniously adapted to the shape of the material, as in one specimen where the pre-historic, certainly pre-Raphælite, artist, working on a fragment of reindeer's horn, has doubled up the fore-legs under the belly and stretched out the hind-legs along the blade of the poignard into which the horn was converted. But among the many specimens unearthed, the most striking—if we except that of a reindeer feeding, which was found in the Kesslerloch cavern, near Schaffhausen—is that of a mammoth, or woolly-haired elephant, on a fragment of ivory, the long hair and curved tusks being faithfully drawn, while the feet are hidden, as it were, in the long grass through which the creature waded. That we are enabled to say the sketch is faithful is owing to the discovery of frozen carcasses of the mammoth in Siberia, with solidified blood and flesh—in fact, in such perfect condition that even microscopical sections of some of the delicate internal tissues have been made from them. But the mammoth and the grave that thus preserved him deserve a chapter to themselves, for which, perhaps, space may hereafter be accorded in Knowledge.

With the materials from the bone-caves, we are able to compose a fairly distinct picture of the rude tribes which roamed over Europe at a period subsequent to the savages of the Drift, yet enormously remote from the earliest immigrants of the Newer Stone Age. Leading the wandering life of tribes dependent for food on the chase, they camped-out by the river-side, under trees, or huts built of branches, resorting, as need arose, to the surer protection of the cavern and the rock-shelter. With the barbed spears and arrows, so common among their relics, they caught the fish and shot the fowl; trapping, stalking (as a sketch from the Duruthy case shows), or killing with ponderous weapon of stone bigger game, as the reindeer, bison, horse, sometimes the mammoth, rhinoceros, and cave-bear. The flesh, cut into pieces with flint-knives, was cooked in vessels of wood or skin (for no traces of pottery occur), into which were dropped hot stones as "pot boilers." The bones were split for the marrow. The skins, scraped with flints and sewn with bone needles threaded with sinew, were welcome covering under the cold conditions of the Reindeer period—albeit, man was a more hairy creature than now, and, as portraits from the Pyrenees caves show, he protected his hands with long gloves. Reference has been made already to indications of the use of "rouge" by palæolithic ladies in the red oxide of iron found in English and Continental caves, and to this may be added the discovery of necklaces of skulls and teeth, some of these last of the lion and the bear. They were, perhaps, given as proofs of their daring by the "braves" of the period!

Absolutely ignorant as we are of the whence and whither of Drift-man, we are in like case respecting Cave-man, although able to fix with more precision the limits of his range. That he has no representatives among the races of Europe is certain, but from evidence based on kindred habits of life, artistic feeling and physical features inferred from relics, as, for example, the smallness of hand from the size of weapons and implements, some authorities regard the Eskimo as his lineal descendants, "banished now, like the musk-sheep, to the inclement regions of North America, and isolated from all other peoples." Similarities such as the above are, however, no sufficient proof of ethnical relationship, and no definite opinion for or against the connection between Cave-man and the Eskimo can be given.

Such clue to deterioration of race as the remains of Palæolithic man themselves would furnish is unhappily missing. The exceeding scarcity of human bones, both in the drift and in caverns, does not, however, affect the conclusions respecting man's high antiquity and primitive savagery drawn from relics of undoubted human origin imbedded in ancient deposits, and there are many reasons which explain that scarcity. A sufficing cause is at hand in the changes, vast in their cumulative effect, wrought upon the earth's surface by rain, frost, torrent, and chemical agents. Nature, so careful of the type, "so careless of the single life," is still less careful to preserve its dead framework; and when we remember that all her energies work for its conversion to uses of the living, we cease to wonder at the imperfection of the geological record and at the small proportion of fossil remains of organisms, even of the giant reptilians of Secondary times and the huge mammalians of Tertiary times. The numerical inferiority of man to the animals surrounding him, especially hyænas, which would spare none of his bones, further explains their absence, as does the fact cited by Sir John Lubbock, that in the gravel beds of St. Acheul, "no trace has ever been found of any animal as small as man. The larger and more solid bones of the elephant and rhinoceros, the ox, horse, and stag, remain, but every vestige of the smaller bones has perished." Coming to our own time, when the Lake of Haarlem, on which there had been many wrecks and naval engagements, was drained, only scanty fragments of Spanish and other vessels were found in it, and not a single human bone.

When we contrast man's fragile body with the imperishable nature of his earliest implements, the sparseness and fitfulness of his presence with their countless numbers and continuous use over an enormous range of time, the scantiness of the one and the abundance of the other banish our surprise while not lessening our regret.

In the cave deposits, of which only a general account has been given in these papers, we touch the last traces of man's presence in the Palæolithic Age. As already set forth, the great gulf of altogether different physical and climatal conditions separates him from the Neolithic races, between whom and the European peoples of to-day some trace of continuity may be faintly discerned. Yet the connection between the two is not to be severed, and the testimony yielded by the chipped flints of the one and the polished axes of the other points in the same direction: that is, that the primitive state of mankind was one of savagery, that the farther back inquiry is pushed in every habitable quarter of the globe, such culture as exists is found to have been preceded by barbarism; and that the savage races of to-day represent, not the degradation to which, as many assert, man has sunk, but the condition out of which all races above the savage have emerged.

The adherents of the development theory do not overlook the fact that civilisation has been arrested and overthrown occasionally and locally, for both hemispheres have witnesses sad enough of that; neither do they forget that knowledge has been here and there used as an instrument hurtful to culture. But these do not militate against the general result—a progress in which none of us see, or, if healthily constituted, desire to see, finality.

Note.—Since giving Mr. Wallace's estimate of the antiquity of man, as based on the rate of accumulation of stalagmite in Kent's Cavern, I find that this estimate rests on a misunderstanding, the accretion being reckoned by him at one eighth of an inch, instead of one-twentieth of an inch, in 250 years. The estimate, however, remains sufficiently high to support the main argument.

VENUS NEARING TRANSIT.

By the Editor.

THE planet Venus is not only interesting just now because of the approaching transit of the planet across the face of the sun, but also as the ruling star of eve. Her movements at present are such that she appears to be gradually increasing her distance from the sun, attaining her greatest elongation (east) from him on September 26, at one in the afternoon, at which time she will be separated about 46° 31′, or 1° 31′ more than half a right angle from him. But after that time she will draw gradually nearer and nearer to him on the heavens (it must be clearly understood when we speak of the distance of Venus from the sun increasing and diminishing, that we are not referring to actual distance, but to apparent distance in the sky). During the first five weeks or so of this approach, Venus, which has been growing brighter and brighter since she has been an evening star, will still continue to increase in brightness, until on November 1 she will attain her greatest brilliancy, after which, during five more weeks, she will grow less and less bright, as she draws nearer and nearer to the sun in the heavens, until on December 6 she reaches him, and passes across his face towards the west to become a morning star.

Before considering the transit of Venus specially, it may be well, as Venus is the planet of the evening at present, to consider her as she presents herself at each passage through her various phases of appearance.

For rather more than eight months Venus is seen as an evening star, getting brighter and brighter slowly, for the first seven months, and then getting fainter much more quickly, until at last she is lost to sight. In about a fortnight she is seen as a morning star, getting brighter and brighter quickly during rather more than a month, and then getting slowly fainter and fainter during seven months, after which she can no more be seen. So that Venus shines about eight months as a morning star; after this remains out of sight for about two months, and is then seen as an evening star; and so she goes on changing from a morning to an evening star, and from an evening star to a morning star continually, and always changing in brightness in the way just described.

Venus was called of old the Planet of Love; and when it was thought that the stars rule our fortunes, the rays of Venus were supposed to do a great deal of good to those who were born when she was shining brightly. But in our time, men of sense reject the notion that because a star looks beautiful, like Venus, it brings good luck; or that because a star looks dim and yellow, like Saturn, it brings bad fortune. They know that Venus is a globe like our own earth, going round the sun just as the earth does. Our earth seen from Venus looks like a star, just as Venus looks like a star to us. And if there are any creatures living on Venus who can study the stars as we do, they have quite as much reason for thinking that the globe on which we live brings them good luck, as we have for thinking that *their* globe brings *us* good luck.

Of all the stars we see, Venus is the only one which is in reality like the earth in size. All the others are either very much smaller or very much larger. Most of them—in fact all the stars properly so called—are globes of fire like our sun, and are thousands of times larger than the globe we live on. A few others are like Venus and the earth, in not being true stars but bodies travelling round the sun and owing all their light to him. But it so happens that not one even of these is nearly of the same size as the earth; they are all either very much larger or very much smaller. Venus is the only sister-world the earth has, among all the orbs which travel round the sun. There may be others in the far off depths of space, travelling round some one or other of those suns which we call "stars," but if so, we can never know that such sister-worlds exist, for no telescope could ever be made which would show them to us.

And as Venus is the earth's sister-world, so is she her nearest neighbour, except the moon, which is the earth's constant companion. The globes which form the sun's family, go round him in paths which lie nearly in the same level. Venus is the second in order of distance, our earth

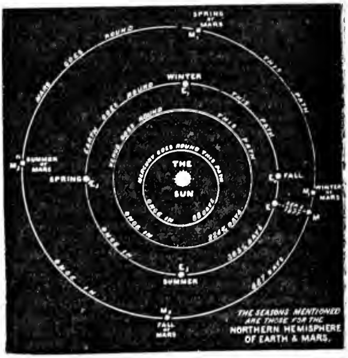


Fig. 1. The Paths of Mars, the Earth, Venus, and Mercury.

the third, and Mars the fourth (Fig. 1). So that Mars is our next neighbour on the outside, and Venus our next neighbour on the inside; but the path of Venus lies nearer to ours than that of Mars, the four planets which travel nearest to the sun.

But it will be convenient for us to consider at present only the paths of our earth and Venus.

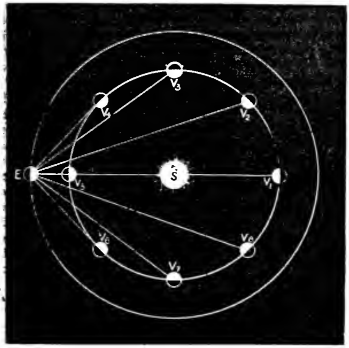


Fig. 2.—The paths of Venus and the Earth around the Sun.
(On the scale of this figure the Sun's diameter would be little more than the thickness of the circles, representing the orbits of Venus and the Earth. Venus and the Earth would be scarcely discernible points.)

Fig. 2 shows the shape and size of the paths of Venus and the earth, S being the sun, the inside circle (with eight little globes shown upon it) being the path of Venus, and the outside circle the path of the earth. The earth takes a year going round her path, while Venus goes round hers in about seven months and a half, so that just as the two hands of a clock going round at different rates come together at regular intervals, so Venus and the earth come at regular intervals on a line with the sun, as shown at E and V_5 in Fig. 2. But it will be easier to see what changes must happen in the appearance of Venus, if we suppose the earth to stay still as at E, and Venus to go round from the position V_1 to all the other places V_2, V_3, &c., shown in the figure. It takes her about nineteen months to get through all these changes. When she is at V_1 she is very far away, as the figure shows. Her bright face—that is, the face the sun shines on—is turned towards the earth full front, and the face she shows is therefore like 1 in Fig. 3. She goes on to V_2, drawing nearer, and turning a small part of her dark half towards the earth; so she looks as 2, Fig. 3. At V_3 she is still nearer, and turns still more of her dark half towards the earth; looking like 3, Fig. 3. At V_4 she turns rather more than half her dark side towards the earth, and looks like 4. At this time she looks much brighter than when she was on any part of the path from V_1 to V_3. But now she draws up to the place V_5 where her dark side is turned fully towards the earth. Her face is like the horned moon during this part of her course, but grows larger and larger, until when she is at V_5 it would be as large as 5 in Fig. 3, if it could be seen. But at this time it is out of sight, just as the moon is before she shows as a new moon. Afterwards Venus goes through the same changes, but in the reverse order, getting smaller and smaller, but turning more and more of her bright face towards us, as shown at 6, 7, 8 and 1, Fig. 3. Remembering that Venus takes nineteen months in passing through all these changes, we see how it is that for about seven months she gets brighter and brighter as an evening star (this is while she is moving from near V_1 to V_4). She then continues about a month more as an evening star, but growing fainter (while she is moving from V_4 to near V_5). After this she becomes a morning star, growing brighter for a month or so (while she is moving from near V_5 to V_6). And lastly, for eight months more, remaining a morning star, she gets gradually fainter (while she is moving from V_6 to V_1).

When Venus is observed without a telescope, she always looks like a bright point of light, because she is so far from us. But with a telescope, even a small one, the changes of shape and size shown in Fig. 3 can be easily seen. They were first seen by Galileo, the great Italian astronomer, in

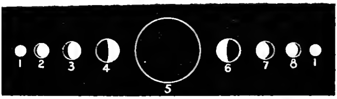


Fig. 3.—Showing the Phases of Venus.

the year 1610. If we could only see Venus's bright face instead of her dark one, when she is nearest to us, we could learn more about her; but as it is, Venus cannot be seen at all when nearest, and the more of her bright face she turns towards us the farther away she gets. Yet we have learned many interesting facts about her, and a few which no one ever could have thought we should learn.

Venus looks very beautiful to us, but our earth must look far more beautiful to creatures living on Venus. For, as is seen from Fig. 2, when Venus is nearest to the earth, and turns her dark side towards us, the earth turns her bright face to Venus. If Venus looks so bright as she does when only turning towards us a small half-face like 4 or 6 (Fig. 3), and when shining on a bright sky, how glorious must the earth appear when turning a bright disc as large as 5 (Fig. 2), toward Venus, and shining on a black sky? For observe: when Venus is at V_5, Fig. 1, the earth E is on that side of her which is just opposite the sun. The earth is therefore seen at midnight. So that, beautiful as our sister-world looks to us, our own world looks still more beautiful to Venus. It shines at midnight in her sky as a star far brighter than our star of morning and evening, and close by it the moon must be quite clearly seen, now on one side, now on the other. One cannot but wonder whether there are creatures on Venus who admire this beautiful sight in their skies, or try to find out if that distant world, our own earth, is the abode of living creatures.

(To be continued.)

ELECTRICAL ENGINEERING.

THE unusual activity which has of late pervaded electrical circles has, as might naturally be expected, opened the eyes of many fathers to the fact that a field promises soon to open, if it be not already opened, in which there will be free scope for those who devote their energies to it with a view of making it remunerative. With so many over-crowded professions before him, an electrician's prospects are certainly not the poorest among the many that may present themselves. Under these circumstances it is not to be wondered at that when *bonâ fide* efforts are made to guide young men in paths electrical, there should be a ready response to an appeal for pupils. Until recently telegraphy was the only really practical application of electricity, and as the Post-office engineering staff is recruited from other branches of the service, the field was almost limited to the cable companies and the manufacturers. Very great impetus has, however, been given to electrical industries by the invention of the telephone and the secondary battery, and the introduction of electric lighting into the domain of our domestic economy. In our issue of the 2nd instant we announced the re-opening of the School of Telegraphy and Electrical Engineering. As this is the largest, and the only general, electrical engineering school, it can scarcely be said to be invidious if we make a few general remarks upon the institution and its work. Established in 1868, it is now in its fourteenth year, and the progress it has made is remarkable. Intended originally as a school wherein to prepare telegraph engineers and skilled cable operators, it has developed into an institution of such ambitious dimensions, as to declare its ability to send forth capable men in every practical application of electricity. Submarine telegraphy, nevertheless, still holds a very prominent position in the school, and the apparatus in use is one of the most complete collections in existence. What may be called a *uniquity* is the artificial cable, consisting of a collection of resistance coils and condensers, so arranged as to exhibit all the phenomena and all the practical difficulties presented by a real oceanic cable. With good teaching capacity, this piece of apparatus is a host in itself, inasmuch as all kinds of imperfections can be readily and correctly imitated in almost any part of the circuit. Greater interest, perhaps, may be attached to the apparatus for showing the retardation a current experiences in traversing a long cable. This apparatus consists of a series of resistance coils and condensers, having small receiving instruments at ten different points in the circuit, representing as many stations on the line from England to Australia. The receiving instruments are similar to the mirror portion of Thomson's Mirror Galvanometer, in which a ray of light falls upon a very small and almost imponderable mirror attached to a small magnet capable of rotating around a vertical axis when acted upon by a current circulating in a coil of wire. It is very interesting and eminently instructive to notice these magnets with the mirrors attached moving one after the other, and so indicating the time taken in charging the whole length of wire.

In telephony, the arrangements appear good, and every effort is apparently made to keep pace with the rapid strides recently made in this branch of the science. Electric lighting promises to afford a very large field, and the managers of the school have done well in securing a 6 H.P. gas engine, of an improved make, which they use to drive dynamo machines of the Gramme, Siemens, and Brush types. Arc lamps of several forms are at the disposal of the students, and in the upper rooms they may be seen busy at work making Fitzgerald incandescent lamps, in which the filament is made from Swedish paper treated with chloride of zinc. The paper is placed in the hands of the pupils, and they have to carry it through every process until the lamp is finished. A number of the lamps are fixed up in a show room on the ground floor, and the uniformity and brilliancy of the light emitted by them is evidence, to say the least, of careful training. Having said thus far of the work of this institution, we think we may fairly indulge in a little criticism. The prospectus says that six months suffices to turn out good men. Of course, we must allow the managers to be better judges than ourselves, but our experience teaches us that an electrician is not so easily made, and that twelve or eighteen months' assiduous labour would not be by any means too much. Electricity occupies a very wide and ever widening field, embracing also a great deal of what may be called speculative science, and a man, however studious and gifted, requires to be possessed of a good groundwork before he can hope to achieve much in general electrical engineering in the brief period of six months. If there is any fault to find with the school itself, it is that it is too electrical, and not sufficiently mechanical. We should much have liked to see these embryo engineers doing a little real engineering, making, repairing, and improving all kinds of apparatus, from the magnetic needle upwards. Nevertheless, an electrician who entered his profession a decade or so since must, on viewing such a building, regard his young competitors with a feeling something akin to envy, for then no such advantages were offered to the most ardent student; and our hope is that those who go to the School of Telegraphy and Electrical Engineering to get an insight into a new profession, will appreciate the very advantageous ground they occupy in starting.

BUTTERFLIES AND MOTHS.

By W. J. H. Clark.

We have now arrived at a slack time for entomologists, as the number of butterflies and moths which gladdened our eyes during last month and the preceding ones has sadly diminished, and very few, comparatively speaking, are now to be found on the wing. Many are dead, and some have found a comfortable home where they can spend the winter and return to our sight as soon as the warm sun of spring has peeped out.

The wet weather we have been having lately has also been greatly against the entomologist, but if it is more favourable during the ensuing weeks, we may expect to find flitting about among the lanes the Small White (*Pieris rapæ*), the Brimstone (*Gonopteryx rhamni*), the Clouded Yellow (*Colias edusa*), and the Pale Clouded Yellow (*Colias Hyale*), the Comma (*Vanessa C.-Album*), the Peacock (*Vanessa Io*), the Red Admiral (*Vanessa Atalanta*), and the Brown Hairstreak (*Thecla Betulæ*).

Among the Sphingidæ, the Humming Bird Hawk (*Macroglossa Stellatarum*) and the rare Convolvulus Hawk (*Sphinx Convolvuli*) will be on the wing.

Very few Geometræ are to be seen now, but probably the September Thorn (*Ennomos erosaria*), August Thorn (*Ennomos angularia*), the Vestal (*Sterrha sacraria*), Autumnal Moth (*Oporabia filigrammaria*), Many Lined (*Phibalapteryx conjunctaria*), Treble-bar (*Anaitis plagiata*), and the Streak (*Chesias spartiata*), will be taken during the course of the month.

We may also expect to have the good luck to find the Figure of Eight (*Diloba cæruleocephala*), Pale Oak Eggar (*Trichiura Cratægi*), Autumnal Rustic (*Noctua glareosa*), Merveil du Jour (*Agriopis Aprilina*), Flounced Chestnut (*Agriopis pistacina*), Lunar Underwing (*Agriopis lunosa*), Green Brindled Crescent), *Miselia Oxyacanthæ*), Red Line Quaker (*Orthosia lota*), Black Rustic (*Epunda nigra*), Centre Barred Sallow (*Cirrhædia xerampelina*), Sallow (*Xanthia cerago*), Pink Barred Sallow (*Xanthia silago*), Orange Sallow (*Xeranthia citrago*), Dusky Lemon Sallow (*Xanthia gilvago,*) the Brick (*Xanthia ferruginea*), Lesser Lute String (*Cymatophora diluta*), Rosy Rustic

(*Hydræcia micacea*), the Bullrush (*Nonagria typhæ*), and the Silver Y (*Plusia gamma*).

Now is the time to begin pupæ digging, as a very large proportion of our British insects have retired into the pupal state for the winter, and a great part of them take up their quarters under the earth. The operation consists in digging round the roots of trees with a trowel, or a small spade, preferably the latter, to the depth of about six inches, and thoroughly examining the earth as it is turned up. The *modus operandi* is first to turn up a spadeful, and after breaking it into small pieces with the hands, and tearing all roots asunder, in case any pupæ of the BOMBYCIDÆ should be present, to carefully scrutinise every inch of it, and if any chrysalides are found, to pick them out, box, and bring them home. This requires more practice than any other branch of insect collecting, as the pupæ are so very often of the same or a similar colour to the earth by which they are surrounded, that a very particular examination is necessary to find every chrysalis contained in the earth just lifted up.

The Reverend Joseph Greene, one of the most careful and painstaking pupa-diggers ever known, says that "parks and meadows with scattered timber trees" are the most likely spots to yield a good harvest, whilst "those trees from which the surrounding grass has been worn away by the feet of cattle (in such a manner as to leave a ring round the trunk, for if the cattle come too close they do harm) and those situated on the borders or banks of streams, dykes, &c., when the soil is dry and friable, will be found most remunerative."

The best trees are the oak, ash, beech, and elm, whilst the poplar, willow, birch, and hawthorn, though not so good, will often prove very productive.

The following is a short list of the pupæ to be found at the roots of the first-mentioned trees :—

OAK.—Oak Beauty (*Amphydasis prodromaria*), Great Prominent (*Notodonta trepida*), Lunar Marbled Brown (*Notodonta chaonia*), Marbled Brown (*Notodonta dodonea*), &c.

ASH.—December moth (*Pæcilocampa populi*), Coronet (*Acromycta ligustri*), &c.

BEECH. — Coxcomb Prominent (*Notodonta camelina*), Square Spot (*Tephrosia consonaria*), Nut-tree Tussock (*Demas coryli*), Red-necked Footman (*Lithosia rubricollis*), &c.

ELM.—Lime Hawk moth (*Smerinthus siliæ*), Scarce Umber ((*Hybernia aurankaria*), Spring Usher (*Hybernia leucophearia*), March moth (*Anisopteryx æscularia*), Sprawler (*Petasia cassinea*), White Spotted Pinion (*Cosmia diffinis*), Grey Shoulder-Knot (*Xylina rhizolitha*), &c.

There are numerous other methods for obtaining pupæ besides digging, and in next paper we will describe the most generally employed, as space forbids this week.

ARE TOADS POISONOUS?

SIR,—In answer to this query, propounded by Mr. Herbert Brown in a recent No. of KNOWLEDGE, a decided affirmative may be returned. The toad *is* venomous, though not in the way that is implied by the general acceptation of that term, as is commonly believed. Nothing can be more harmless than the bite of the common toad—if it can be said to bite, for it has no teeth. But the glands contained in the papillæ and rugosities of the skin covering the back, and especially those which can be plainly seen in the form of two bean-like eminences just behind the head, secrete a milky, highly-acrid fluid, which is exuded profusely on irritation. Indeed, if it were not for this poisonous secretion, the poor toad would fall an easy victim to many enemies, having neither the agility of the frog or lizard to enable it to make its escape, nor the teeth and claws of other reptiles wherewith to defend itself. Cats, which are eager hunters of frogs for food, spit and foam at the mouth when they pick up the wrong batrachian by mistake, and are often affected in a similar manner to Mr. Brown's St. Bernard; frog-eating snakes, too, detect the difference, and will not take toads, as a rule. When a snake, greatly pressed by hunger, swallows one, it usually rejects it again immediately afterwards, and not unfrequently dies. Those frogs which prey upon their own kind (as most frogs do) despise their ugly relative from an alimentary point of view; and, curiously enough, certain toads which devour frogs share the same antipathy to their race. Except with very small animals, the poison appears to act rather as a local irritant than a toxæmic agent; it has no effect upon the sound skin, but will cause any abraded surface to inflame to extensive ulceration, while great pain results from its application to the conjunctiva or internal mucous membranes. Any one who can overcome his repugnance to the creature sufficiently to put his lips or tongue against the skin of an angry toad will experience an intensely acrid taste; he should shut his eyes in making such an experiment, as the post-occipital glands sometimes emit their secretion in a jet. Mr. Frank Buckland quotes a case which occurred in Oxfordshire, where a drunken brute bit a toad's head off. Happily, his teeth went right through these glands, and his mouth and throat immediately became swollen and inflamed to such an extent, that his life was in jeopardy for some hours. These characteristics are much more strongly marked in many of the tropical Bufonidæ. My giant toads (*Bufo agua*) used to swelter venom when they were taken in the hands in such abundance that it would pour off their backs and drip from them, before they became tame; and I was thus enabled to collect a large amount. This species feeds on rats, and it is possible that this copious exudation may serve to prevent their prey from biting them when seized by the leg, or otherwise awkwardly caught. I once put a "cribo" snake (*Dromicus fugitivus*) into a box with three of these toads for a single night, for lack of other accommodation: it was a fine active specimen, five or six feet long, and its movements during the night so disturbed them, that in the morning I found the floor of the box all awash with fluid. The snake was lying on its back, apparently dead: and, though it recovered somewhat on being plunged into a bath, it survived only a few days.

ARTHUR STRADLING, C.M.Z.S.

CURIOUS WAY OF UTILIZING ANTS.—Some interesting facts are contributed to a scientific journal in a little paper sent by Dr. C. J. Macgowan from Han Chow, Province of Hainan, China, on the "Utilization of Ants as Insect Destroyers in China." It seems that in many parts of the province of Canton the orange trees are injured by certain worms, and to rid themselves from these pests, the inhabitants import ants from the neighbouring hills. The hill people throughout the summer and winter find the nests of two species of ants, red and yellow, suspended from the branches of various trees. The "orange ant breeders" are provided with pig or goat bladders baited inside with lard. The orifices of these they apply to the entrance of the bag-like nests, when the ants enter the bladders, and, as Dr. Macgowan expresses it, "become a marketable commodity at the orangeries." The trees are colonized by placing the ants on their upper branches, and bamboo rods are stretched between the different trees, so as to give the ants easy access to the whole orchard. This remedy has been in constant use at least since 1640, and probably dates from a much earlier period.—*Frank Leslie's Magazine.*

CLOUDS IN THE AIR.

By the Editor.

(Continued from page 209.)

IN our last we considered only how a horizontal layer of mist laden air would appear, showing how the line of sight towards the horizon would pass through a much longer range of such a layer than a line towards the point overhead. The effect in making the sky near the horizon misty is great in that case, but there is a much more marked effect in the case of a sky over which cumulus clouds are scattered.

There is a picture familiar to my memory, but I cannot at the moment "place" it (I think, however, it is in "Kaemtz' Meteorology," a book I have not seen for many years), in which the effect of foreshortening in bringing rounded clouds apparently closer together is very simply shown.

Suppose AZ (Fig. 1) to be a layer of cumulus clouds at

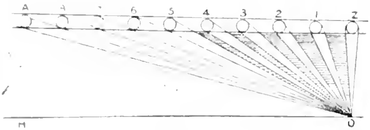


Fig. 1.

equal distances from each other, the cloud at Z being overhead for the observer at O, OH his horizon. Then if lines are drawn from O to touch the sides of the clouds shown at Z, 1, 2, 3, 4, 5, 6, &c., we see how the space included by the two lines touching any cloud bears a constantly increasing proportion to the space left between two clouds, until at last (as at 5, 6, 7, 8) this latter space disappears altogether, and the clouds to the left of this spot, though really as far apart as those near Z, appear to form a continuous layer. This layer, though really formed by the under surfaces of the horizontal layer of clouds, appears to the observer at O to rise vertically, or nearly so, from the horizon.

There is a rather pretty way (which I have not yet seen described) of showing how the sky whitens, in such a case, towards the horizon, assuming the clouds to be roughly spherical, and strewn in reality with a certain general uniformity throughout the layer which they form. It depends on the geometrical property that if a sphere be

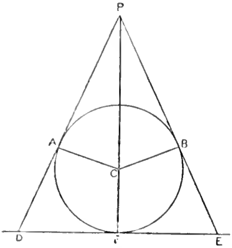
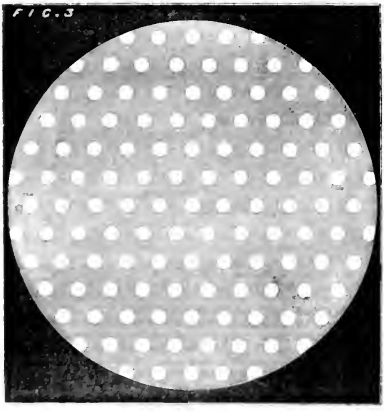
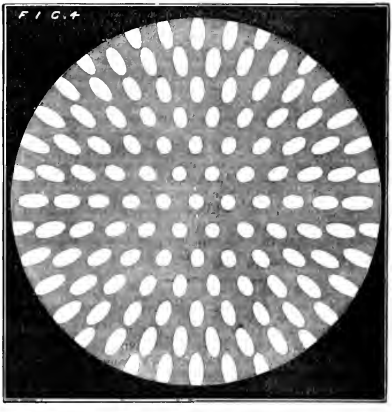


Fig. 2.

placed on a plane, and a fixed point on the same side of the plane is supposed to be luminous, the shadow of the sphere is an ellipse of unvarying minor axis wherever the sphere may be set on the plane. This can be proved analytically in a number of pleasant ways; but there is also a simple proof which I devised when I was an undergraduate at Cambridge (somewhat to the disgust of the lecturer on plane co-ordinate geometry, who wanted an analytical proof):—Suppose DE (Fig. 2) to be the plane





turned edgewise to the eye; P the fixed luminous point at a given distance PF from the plane; ABF the sphere so situated that its centre C is seen projected on the perpendicular PF; PBE, PAD planes touching the sphere, their line of intersection being a straight line through P parallel to the plane DE, and seen as a point at P. Then, obviously, DE is the breadth of the shadow of the sphere ABF, and as obviously DE is constant. For

$$FE^2 : CB^2 :: PF^2 : PB^2 :: PF^2 : PC^2 - CB^2$$

and CB, PF, and PC are given constants. Thus, the breadth or lesser axis of the elliptical shadow of the sphere is constant wherever the sphere may be.

We may regard the spherical clouds in Fig. 1 as equal spheres, all touching the horizontal plane AZ; for the luminous point we may set an eye at O; and we have learned that the apparent projection of any of the clouds on the plane AZ is an ellipse whose shorter axis is constant, while its longer axis, of course, becomes greater and greater the farther the spherical cloud is from Z.

Now, if a blue plane AZ were occupied by a number of equidistant white *circles*, an eye at O would recognise the same proportion of whiteness in all directions, for the white circles and the blue spaces between would all be foreshortened and reduced in equal degree towards 6, 7, 8, or A. But since the spherical clouds are not projected into circles all of the same size on the blue blackground, but into ellipses all of equal breadth, and longer and longer the further they are from the centre, there is a proportionate increase of white sky with increase of distance from the point overhead.

Thus, if we suppose a horizontal layer, as in Fig. 1, really covered with clouds arranged as in Fig. 3, the projection of these on the horizontal plane AZ, would be as shown in Fig. 4. But, as seen by the eye, the proportions of this projection would all be so reduced radially outwards that all the ellipses would become circular (for in whatever way we look at a sphere it always looks perfectly round), and we should have the arrangement shown in Fig. 5, where the relative whiteness of the general surface is the same for each part as for corresponding parts of Fig. 4.

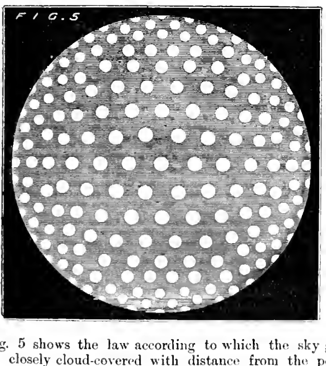


Fig. 5 shows the law according to which the sky gets more closely cloud-covered with distance from the point overhead, though the individual stars get smaller. It shows the sky to a distance of about 5 deg. from the zenith, that is, half way down to the horizon.

(*To be continued.*)

COMPOUND NEST.

By Daniel C. Beard (in the *Scientific American*).

Almost every one whose business or occupation has introduced him to an intimate acquaintance with the salt marshes that line our eastern coasts is familiar with the odd, chattering notes of the marsh wren. This little bird finds its board and lodging among the reeds and rank grasses of the damp, salt meadows. Morning and evening its song, if such vocal efforts can be so called, may be heard, but especially does it delight to sing at night. Often after a long sail, when belated and overtaken by night, the writer has welcomed the harsh, but not unpleasant, notes of the long-billed marsh wren (*Cistothorus palustris*) as a signal from shore and home.

Not long since a boating party caught in a dense fog only discovered their dangerous proximity to the shore from the warning notes of one of these little coastguards.

Compound Nest of the *C. Palustris* and the *A. Phœniceus*.

Other birds find refuge and sustenance among the salty sedges inhabited by the marsh wrens. Among them may be seen the brilliantly-decorated *Agelaius phœniceus*, commonly known as the red wing or swamp blackbird. The lustrous black plumage of the male bird shines in the sun, giving out greenish metallic reflections. Its shoulders and lesser wing coverts are ornamented with crimson epaulets, giving it a very martial and rich appearance, in strong contrast with the modest brown plumage of its friend and neighbour, the marsh wren.

Some time ago the writer published an article and illustration of a fish-hawk's nest, the interstices of which were filled in with the nests of the cow blackbird (*Quiscalus purpureus*), making a sort of compound nest, or tenement house, of the structure. Following the above-mentioned article was a second, illustrating and describing the strange two-story nest the summer yellow-bird builds to cover the eggs which that tramp, the cow blackbird, delights to surreptitiously deposit in the nests of smaller birds.

The same young collector that secured the writer the yellowbird's double nest, discovered and brought to him another two-story nest. This time both nests bore unmistakable evidence of being inhabited. The lower compartment, from its peculiar spherical form and the reeds and cat-tail cotton of which it is composed, would be at once recognised as the nest of the marsh wren, even if it did not contain the little chocolate-coloured eggs of that bird. The upper nest is cup-shaped, three inches inside depth and diameter. The outside is made of coarse straw and fibres, and the inside lined with fine grass. A single glance suffices to prove it to be the nest of a swamp blackbird.

Two bluish-green eggs, with strange hieroglyphic markings on the end, occupy the upper floor, and three little brown eggs are hidden in the lower nest. The blackbirds must have commenced the upper nest about as soon as the wrens finished the lower one.

In both the upper and lower stories of this seaside tenement house the eggs were warm when discovered, which proves that the mother birds had been off the nests but a few moments. The writer knows of no other recorded instance of a compound nest occupied by the red-winged blackbird and the little marsh wren.

The sketch on page 279, made from nature, shows the construction and difference in style of architecture of the nests, as well as the difference in the size and appearance of the birds themselves. It is a fact worth noting that in all three instances of compound nests the blackbird plays the part of a parasite in a greater or less degree.

Edison's Lamps.—The Edison Electric Light Company, of 71, Coleman-street, E.C., announce that the price of their lamps is now reduced to 4s. each for quantities of 1[illegible] and upwards, and 4s. 6d. each for smaller quantities. These lamps are now being very extensively used in all parts of the globe, and there is little doubt but that the company will, before long, earn a rich harvest, thanks, however, as we pointed out some months since, to the quality of the labour employed. Even in America, where electricians are, we believe, somewhat plentiful, Mr. Edison has found "he had a greater demand for light than he could supply, owing to the lack of experienced men to put up the wires." He also says, referring to the colossal installation in New York, that the loss of current or leakage in [illegible] miles of conductors is equal to only ·351 of the current necessary to supply one lamp. Several thousand lamps are in the circuit. The supply of current is always at hand, and the price being uniform with that charged for gas (which, however, is dear in New York), many consumers "have ordered out their gas meters." The Edison light which has been fitted in one of the wings of the Central Telegraph Office in London, is said to be giving unbounded satisfaction.

CARBONIC ACID IN THE AIR.*

By M. Dumas.

Of all the gases that the atmosphere contains, there is one which offers a special interest, as well on account of the part ascribed to it in the mutual interchange going on between the two organic kingdoms, as on account of the relation that it has been observed to occupy between earth, air, and water; this gas is carbonic acid.

Ever since the fact has been established that animals consume oxygen and give out carbonic acid as the product of respiration, while plants consume carbonic acid and give out oxygen, the question has often been asked whether the quantity of carbonic acid contained in the air did not represent a sort of sustaining reservoir, which was being continually drawn on by the plants and resupplied by animals, so that it has doubtless remained unchanged owing to this double action.

On the other hand, Boussingault has long since shown that volcanic regions give out through crevices and fumaroles enormous quantities of carbonic acid. The deposition of carbonate of lime that is continually taking place on the sea-bottom is, on the other hand, fixing carbonic acid in quantities which we may accurately estimate from the strata of limestone seen on the surface of the earth. We might imagine, that in comparison with the huge volumes of carbonic acid sent forth in volcanic districts, even in the oldest one, and the mass of carbonate of lime deposited on the sea-bottom, the results attributed to the life of plants and animals would be of no consequence either for increasing or diminishing the physiological carbonic acid in the air comparable with those which are accomplished by the purely geological exchange.

Schloesing has recently succeeded, by a happy application of the principle of dissociation, in showing that the amount of carbonic acid in the air bears a direct relation to the quantity of bicarbonate of lime dissolved in sea water. If the quantity of carbonic acid diminishes, the bicarbonate of the water is decomposed, half of its carbonic acid escapes into the atmosphere, and the neutral carbonate of lime is precipitated. The aqueous vapour condensed from the air dissolves part of the carbonic acid contained therein, and carries it along, when it falls as rain upon the earth, and takes up there enough lime to form the bicarbonate, which is thus carried back to the sea.

The physiological role of carbonic acid, its geognostic influence, and its relations to most ordinary meteorological phenomena on the earth's surface—all these contribute to give special weight to studies concerned in the estimation of the normal quantity of carbonic acid in the air.

Nevertheless, this estimation is attended with great difficulty. Not every one is able to take up such questions, and not all processes are adapted to it. The first thought which would naturally arise would be to enclose a known volume of air in a given vessel, and then determine its carbonic acid by measuring or weighing it. In this way we should obtain the exact relation between a volume of air and the volume of carbonic acid in it, for any given moment, and in any given place. If, however, this be done with a ten-litre flask, for example, it would only hold 3 c. c. of carbonic acid, weighing 6 milligrammes; and, whether it is weighed or measured, the error may easily equal 10 per cent. of the real value, hence no deductions could be drawn from the observed facts.

For this reason larger volumes of air were taken, and a current of air, whose volume could be accurately measured by known methods, was passed through condensers capable of retaining the carbonic acid. But in this case the air must pass very slowly through it, so that the process may last several hours; and since the air is continually in motion, owing to vertical and horizontal currents, the experiment may be begun with the air of one place, and concluded with air from a far distant spot. For example, if an experiment lasting twenty-four hours was made in Paris when the air moved but four mètres per second (nine or ten miles per hour), it might be begun with air from the Department of the Seine, and end with air from the Department of the Rhone, or the Belgian frontier, according to the direction of the wind.

So long as we had no analytical methods of sufficient delicacy to estimate with certainty the hundredth, or at least the tenth of a milligramme of carbonic acid, it was very difficult to determine the quantity in the air at a given time and place. It is frequently possible to analyse upon the plain air that has descended from the heights above, and to examine by bright daylight the effect of night upon the atmosphere.

Still other difficulties show themselves in such investigations. It seems very easy to collect carbonic acid in potash tubes, and to determine its amount from the increase in weight of the tubes; but,

* An address before the Paris Academy.

alas! to how many sources of error is this method exposed. If the potash has been in contact with any organic substance, it will absorb oxygen. If the pumice that takes the place of the potash contains protoxide of iron, it will also absorb oxygen. In both cases, the oxygen increases the weight of the carbonic acid.

Every experimenter who has been compelled to repeat the weighing of a somewhat complicate piece of apparatus, with an interval of several hours between, knows how many inaccuracies he is exposed to if he is compelled to take into calculation the changes of temperature and pressure, and the moisture on the surface of the apparatus. After fighting all these difficulties, and frequently in vain, the experimenter begins to mistrust every result that depends only on difference in weight, and to prefer those methods whereby the substance to be estimated can be isolated, so that it can be seen and handled, weighed or measured, in a free state, and in its own natural condition.

The classical experiments of Thenard, of Th. de Saussure, of Messrs. Boussingault, on the quantity of carbonic acid in the air, are well known to every one: they need only to be organised, repeated, and multiplied.

J. Reiset, who has conducted a long and tedious series of experiments on this subject, has adopted a process that seems to offer every guarantee of accuracy. The air that furnishes the carbonic acid is aspirated through the absorption apparatus by two aspirators of 600 litres capacity. The temperature and pressure of the air are carefully measured. The carbonic acid is absorbed by baryta water in three bulb apparatus. The last bulb, which serves as a check to control the operation, remains clear, and proves that no binoxide of barium is formed. The baryta water used is titrated before and after the operation, and from the difference is calculated the quantity of carbonate formed, and hence of the carbonic acid.

These tedious experiments, which varied in duration from 6 to 25 hours, require at least two days of continuous labour. They were repeated 193 times by Reiset in 1872, '73, and '79. They were made in still weather, and in violent winds and storms. The air was taken at the sea-shore, in the middle of the fields, on the level earth, during harvests, in the forests, and in Paris. Under such varied conditions, the quantity of carbonic acid varied but little; the numbers obtained were between 2·94 and 3·1, which may be taken as a general average of the carbonic acid in the air.

The quantity of carbonic acid in the free atmosphere is tolerably constant, which must necessarily be the case according to Schloesing's proposed relation between the bi-carbonate of lime in the sea and the carbonic acid in the air. The only cause that seems at all competent to change the geological quantity of carbonic acid in the atmosphere is the formation of fog. As the aqueous vapours condense, they collect the carbonic acid; and the foggy air, as a rule, is more heavily laden with this gas than ordinary air.

It is not surprising that there is less carbonic acid in the air collected on clear summer days, in the midst of clover, &c., that is in an active reducing furnace; if anything is surprising, it is that the quantity of carbonic acid does not sink below 2·8.

It is also a matter for surprise that in Paris, among so many sources of carbonic acid, the furnace fires, the respiration of men and animals, and the spontaneous decomposition and decay of organic substances, the quantity of carbonic acid does not exceed 3·5.

If, then, the great general mean of normal atmospheric carbonic acid deviates but little from 2·9 or 3·0, it is not doubtful that under local conditions, in closed places, and under exceptional meteorological conditions, considerable variations may occur in these proportions. But these variations do not affect the general laws of the composition of the atmosphere.

There are two entirely distinct points from which the measurement of the atmospheric carbonic acid may be contemplated.

The first consists in considering it as a geological element which belongs to the gaseous envelope of the earth in general, and it leads us to express the general relation of carbonic acid to the quantity of air, as about three volumes in 10,000.

The second, which relates to accidental and local phenomena, to the activity of man and beast, to the effect of fires and of decomposing organic matter, to volcanic emanations, and finally to the action of clouds and rain, permits us to recognise the changes which can occur in air exposed to the influences mentioned, and to a certain extent confined. Without denying that it is of interest from a meteorological and hygienic standpoint, it does not take the same rank as first.

J. Reiset's experiments, by their number, accuracy, the large volumes employed, and the interval of years that separate them, have definitely established two facts on which the earth's history must depend: the first is, that the percentage of carbonic acid in the air scarcely changes; the second, that it differs but little from $\frac{3}{10000}$ by volume.

These results are fully confirmed by the results which were obtained by Franz Schulze, in Rostock, in 1868, '69, '70, and '71. The averages which he got, with very small variation, were 2·8668 for 1869, 2·9052 for 1870, and 3·0126 for 1871.

More recently Muentz and Aubin have analysed air collected on the plains near Paris, on the Pic du Midi, and on the top of Puy-de-Dome. Their results agree with those published by Reiset and Schulze.

The grand average of carbonic oxide in the air seems to be tolerably fixed, but after this starting-point is established it remains to study the variations that it is capable of, not from local causes, which are of little importance, but from general causes connected with large movements of the air. Upon this study, which demands the co-operation of a definite number of observers stationed at different and distant points of the earth, the experiments being made simultaneously and by comparable methods.

M. Dumas called the attention of the Academy to this point, in connection with its mission of selecting suitable stations for observing the transit of Venus. The process and apparatus of Muentz and Aubin offer the means adapted for making these experiments, and seem sufficient to solve the problem which science proposes, of determining the present quantity of carbonic acid in the air.

If these experiments yield satisfactory results, as we have good reasons to believe they will, it is to be hoped that annual observations will be made in properly-chosen places, so as to determine the variations which may possibly take place in the relative quantity of atmospheric carbonic acid during the coming century.—"Compt. Rend.," p. 589.

Although this proposition was made by a Frenchman to his fellow scientists, would it not be well for some American to accept the challenge, and bring it before the coming meeting of the American Association for the Advancement of Science, in the hope that we too may contribute our mite of effort in the same direction?—ED.]

ANCIENT MONUMENTS.—The following are the antiquities to which, so far as England and Wales are concerned, the Government Bill for the better protection of ancient monuments applies. In Anglesey, the tumulus and dolmen, Plas Newydd; in Berkshire, the tumulus Wayland Smith's forge, and Uffington Castle; in Cumberland, the stone circle Long Meg and her daughters, near Penrith, the stone circle on Castle Rigg, near Keswick, and the stone circles on Burn Moor; in Derbyshire, the stone circle, the Nine Ladies on Stanton Moor, the tumulus Arbor Low, Hob Hurst's house and hut on Bastow Moor, and Minning Low in Glamorganshire, Arthur's Quoit, Gower; in Gloucestershire, the tumulus at Uley; in Kent, Kit's Coty-house; in Northamptonshire, Danes' Camp and Castle Dykes; in Oxfordshire, the Rollrich Stones; in Pembrokeshire, the Pentre Evan Cromlech; in Somersetshire, the ancient stones at Stanton Drew, the chambered tumulus at Stoney Littleton, Wellow, and Cadbury Castle; in Westmoreland, Mayborough, near Penrith, and Arthur's Round Table at Penrith; in Wiltshire, Stonehenge, Old Sarum, the Vallum at Abury, the sarcen stones within the same, those along the Kennet-road, the group between Abury and Beckhampton, the long barrow at West Kennet, near Marlborough, Silbury-hill, the Dolmen (Devil's Den), near Marlborough, and Barbury Castle.

ELECTRIC RAILWAYS.—The development of electric railways and tramways is now considerable. Putting aside numerous lines that are merely talked of or projected, those which are working, authorised or in course of construction, show a total length (according to the *Revue Industrielle*, July 19) of 160 kilomètres, i.e., about 100 miles, and grants are becoming even more numerous. The lines actually at work are those of Lichterfelde (about 2·6 kilomètres in length), and that from the Spandauer Rock to Charlottenberg, near Berlin; another line, from Port Rush to Bush Mills, in the north of Ireland, has been inaugurated (length about 10 kilomètres), and also in Holland, one from Zandvoort to Kostverloren (length a little over two kilomètres). Among lines authorised or in construction, the following are noted: In Austria, the Mödling line, near Vienna (2½ kilomètres), to be constructed by the Southern Railway Company there. In Germany, the line from Wiesbaden to Nurnberg (two kilomètres), and that from the Royal mines of Saxony to Zankerode. In England, a line under the Thames, connecting Charing-cross and Waterloo Stations (1·2 kilomètres); also a line in South Wales (60 kilomètres), for which the force will be derived from fall of water. In Italy, Turin, and Milan will soon begin the construction of electric tramways. In America the Edison Company have arranged for the working of 80 kilomètres on one of the great lines from New York. Another small line (1·8 kilomètres) is to be made at St. Louis, in Missouri, by Mr. Heisler.

Letters to the Editor.

The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.

All Editorial communications should be addressed to the Editor of KNOWLEDGE; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

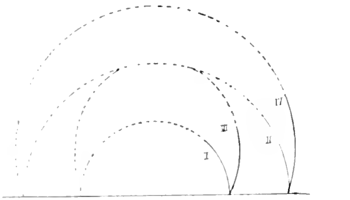
⁂ *All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

SINGULAR RAINBOW.

[562]—What J. R. Rounthwaite describes in KNOWLEDGE for Aug. 18 is a very rare sight, owing to two circumstances which he appears not to have noted. When such a tertiary bow has been seen before, there has been a sheet of water lying between the observer and the bow, and the sun has been at a low altitude. M. Etienne saw one at Chartres on Aug. 10, 1665; and Halley, the astronomer, saw a tertiary bow on Aug. 6, 1698; in both the cases a river was between the observer and the bow, and the sun was only about 6° above the horizon. Half-a-dozen such bows, or fragments of them, have been seen during the last ten years, and in all there has been a reflecting sheet of water and a low-lying sun.



Some ninety years ago a fragmentary quarternary bow was seen. The observer was a Mr. Sturge; the place Alverstoke, on the sea-coast of Hampshire; and the time evening, July 9, 1792, with the sun low in the horizon to the N.W. Portions of the primary and secondary were accompanied by fragments of tertiary and quarternary bows, as in the accompanying diagram. I have dotted the continuations of these fragments to give an idea of what would have been seen if the atmospheric conditions had been favourable. Where the secondary and tertiary bows overlap, there would have been, as in the case of Halley's observation, a portion of a white arch.
WILLIAM ACKROYD.

MECHANICAL PARADOX.

[563]—The "learned person" with the dead language name, who made the inquiry about Ferguson's mechanical paradox, will find the original apparatus in the museum collection of the ... Institute, Northampton-square. It was made to demonstrate the Unity of the Trinity.
C. S. M.

HOT AND COLD DRINKS.

[564]—Surely Mr. Allinson (534) is wrong in saying that "a temperature of 100° Fahr. destroys pepsin and leads to indigestion." According to M'Kendrick ("Physiology," p. 250, ed. 1878) "the transformation of albumen into peptones" is only "arrested at 5° and 60° C., *i.e.*, 41° and 140° Fahr." Again, the "redness" of the stomach, which Mr. Allinson says follows the imbibition of hot drinks, follows equally (does it not?) the deglutition of a piece of bread.
E. D. G.

[565]—Mr. Allinson (534, p. 235) says that "a temperature of 100° F. also destroys the active power of the gastric juice—pepsin." This is a mistake—very likely the printer's. 100° F. is the normal temperature of the stomach, and the most favourable for the action of pepsin, whether in the stomach or as found in experiments on artificial digestion. Kirkes, in his "Handbook of Physiology," says: "Pepsin probably acts the part of a hydrolytic ferment." The characters of these ferments are (page 291): "This action is quite prevented, or much retarded, by cold, a moderate warmth (100° F.) greatly facilitates it, while a high temperature (above 140° F.) completely prevents this action." Ice-pudding after a heavy dinner, and the American habit of drinking much iced water, are often the cause of indigestion. In the matter of drinks, as in most things, the rule *medio tutissimus* holds good.
M.D.

SKELETON LEAVES.

[566]—A large saucepan of cold water, a piece of scrubbing soap about four inches square, cut into small slices. Gather *mature* leaves, seed-vessels, &c.; put some soap into the water, then a layer of leaves *one by one*, then more soap, then leaves, and so on. Put on a lid, set the pan by the side of a fire, and let it simmer. After an hour take out a few leaves, and try them between the finger and thumb; if the pulp separates readily from the fibre, remove them from the fire; if not, let the pan remain. Some leaves, such as ivy, orange, &c., are done in an hour or two; others of a tougher fibre take half-a-day. Seed vessels of mallow or campanula take a short time. Large poppy or stramonium requires perhaps two days. Now lay a leaf upon a plate, under a tap of running water, and beat it with sharp strokes with a hard brush—say a toothbrush; the green matter will run off with the water. When the skeleton is quite clean, dry it upon blotting-paper.

To bleach the specimens put a quarter of a pound of chloride of lime into a large bottle of water, cork it, and let it stand some days. Strain it, and mix with more water in a basin; immerse the leaves, &c. Again carefully watch and remove them as soon as they are white, for the lime soon renders them brittle and rotten. Wash again in pure water, and dry as before. As the stems usually come away from most leaves, it is well to boil several stalks separately, and after bleaching to mount the leaves by gumming them to the stems.
E. C. N.

BRAIN TROUBLES.

[567]—I have had lately a good deal of reading to do in a relatively small amount of time—more exactly, I have been "cramming" for an examination. In this painful process, one has to tabulate facts, or make a *précis* of a paragraph either mentally or on paper. To write out these tables, &c., takes up more time than I can spare, hence I have to do it mentally. Now the brain trouble, if it can be so-called, comes in. In reading light literature, as I generally do for a short time before going to bed, I find myself carrying on the same *précis*—tabulating facts or fictions of the smallest importance, and, more annoying, referring back to previous paragraphs to refresh my memory as to the earlier parts of the table. The same thing takes place when any conversation is going on around me, and even while walking about I find myself trying to impress faces, even the appearance of any of the various objects one meets, on my memory; in case any of the same nature may turn up in the examination. This is done involuntarily, and, indeed, requires some mental effort to overcome. It is interesting as an example of the force of habit—I don't know if we should call it "unconscious cerebration." It is a small trouble, but very annoying.
JOHN JOPE, M.D.

A LUMINOUS SEA.

[568]—Your extract from the *Scientific American* on "A Luminous Shark" reminds me of an interesting sight I once had the good fortune to witness, viz., a luminous sea. On Monday, Jan. 26, 1871, I was about 750 miles S. 78° E. from Aden Lighthouse, in the Arabian Sea, and at 1.30 a.m. was called on deck to see the abovementioned phenomenon.

The whole sea to the horizon was as white as milk, being one unbroken expanse of phosphorescent light, and presented to me what I should imagine a plain of snow in the Arctic regions would resemble at night. The ship I was in at the time was drawing about 22 ft. of water—the suction-valve to the circulating pump of the engines would be about 20 ft. below the water-line; all the water sucked through this valve was discharged from the ship's side at the water level, after having passed through the condenser. This condensing water was as brilliant with phosphorescence as that at the surface, and the mingling of the two was quite invisible. This shows, then, that the water was impregnated with the organisms that cause the light just as thickly at 20 ft. deep as at the surface. And I would ask to what depth does this phosphorescence extend? or are the organisms that cause it universally distributed over a certain area to an unknown depth, and only flash into existence, as it were, when near the surface?

It was a calm night, with a cloudless sky, and for half-an-hour I enjoyed the novelty of this milky sea before turning in again, though I believe we were nearly two hours passing through it altogether. It was curious, also, to note how much darker the sky appeared at the horizon—[doubtless an effect of contrast.—ED.]—where the line between sea and sky was very definite, than immediately over head.

H. P. VACHER.

"A GLASS OF WINE."

[569]—In the article by Dr. Lowe, headed "A Glass of Wine," which appeared in KNOWLEDGE of Aug. 25, there is a want of precision of statement as to what is to be understood by the term "alcohol." This uncertainty may lead to undue apprehension in the minds of some readers when the medical aspect of a glass of wine comes to be noticed, as no doubt will be the case in subsequent numbers of Dr. Lowe's paper. The matter will perhaps strike you as important enough to call for some explanation or correction.

When Dr. Lowe states that "port and brown sherry contain, naturally, about 22 per cent. of alcohol by volume," he surely must mean 22 per cent. of proof spirit, the alcohol metric standard of this country; 22 per cent. of pure alcohol by volume corresponds to 38·87 per cent. of proof spirit, as shown by the tables in Thudicum's and Dupré's "Treatise on Wine," and in other accepted books; 22 per cent. of alcohol by *weight* answers to 40·07 per cent. at proof—a still higher quantity. In point of fact, no natural wine contains so much as 39 per cent. of proof spirit by volume. A wine may be fortified by the addition of strong spirit up to this point, but in the natural state, 20 per cent. of self-developed proof spirit would be more than the average.

There are other statements in the last paragraph of the article affected by the same misuse of the term alcohol. It would be, indeed, a terrible reflection to the moderate drinker that, in every pint of port or sherry imbibed by him, he was consuming two-and-a-half wine glasses of pure alcohol!—two-and-a-half glasses of proof spirit, which is about half the strength, would not alarm him quite so much.

W. H. JOHNSTON.

[570]—Dr. Lowe, in his article on "A Glass of Wine," makes rather a curious mistake, which you may perhaps think it worth while to correct. He states that methyl, ethyl, and amyl alcohols are *isomeric!* *Homologous* is probably what he means.

H. F.

POISONOUS LIZARD.

[571]—A poisonous lizard is well known amongst the planters in the west-end of the island of Jamaica. When living there some years ago I often heard of it, but never saw one. The planters call it the "Galliwasp." No doubt it is the *Heloderma horrida* of Dr. Wilson.

SOLANUM.

BOTANICAL REPULSION AND ATTRACTION.

[572]—Thank you for your outspoken words on "Elementary Botany Books." The last sentence in the review has been thoroughly verified in my case—viz., "all the good they will ever get from them will be a profound and deeply-rooted hatred of systematic botany. I had to cram so much technical botany into my brain from such books as you refer to, and condemn, for my examination (by Professor Bentley), that the disgust at the very name of botany was intense; when my eye lighted upon a botanical work, either in my library (for I did not yield to the temptation to burn them), or on a bookstall, that day, from that moment, I considered spoilt. This hatred of systematic botany haunted me for nearly twenty years, during which time I never opened a book upon the repulsive subject. Two or three years ago a friend asked me out to the fields "to commune with wild flowers"; with much persuasion I consented, and I found that botany, like all else, had two sides to it, and, unfortunately, that the seamy side was the first one presented to me in the text-books, and which had so disgusted me. Since, however, my friend showed me its refined *face*, I have become an enthusiastic botanist, and cannot find food enough to satisfy my botanical appetite. I have devoured Hooker, Bentham, Bentley, Bobington, Lindley, and Lubbock, and still my appetite is craving for more. The relishes I offer it these days are Grant Allen's Vignettes and Evolutionist, and the tit-bits that appear from time to time in KNOWLEDGE from the pen of the same interesting writer. Could you, sir, not induce Mr. G. A. to write a book on botany on the lines pointed out in the review?

BECCABUNGA.

TARNISHED DAGUERREOTYPE.

[573]—The tarnish referred to by "F." is oxide of silver, and it can be removed by floating over the plate a solution of cyanide of potassium. The strength of the cyanide solution will depend on the amount of oxide to be removed. If the discoloration is very dark, the cyanide must be strong, but a slight oxidation may be removed by a weak solution. A small lump of cyanide may be put into, say, two ounces of water, and in about two or three minutes the solution may be poured over the plate repeatedly. The solution will, of course, at first be weak, and the effect, as the cyanide dissolves, must be watched. As soon as the tarnish disappears, the plate may be washed in clean water, and then dried over a spirit-lamp or by a bright fire. The plate may be held by one corner with pliers all through the process. As the cyanide of potassium is a deadly poison, the greatest care must be taken in using it.

The daguerreotype referred to is "tinted." This colour is only on the surface, and will probably be removed by the cyanide and water in washing. The surface of the picture must not be touched, or it will be injured. Dust may be removed with a very soft brush.

Daguerreotypes, when the air is carefully excluded, are very permanent; they should be covered with glass, and the edges bound together with gummed paper. But all daguerreotypes do not require even this protection, as I have in my possession many portraits taken over twenty-five years since by Messrs. Beard & Foard, which are as perfect as on the day they were taken, and they have had no other protection than a grooved deal box.

A. BROTHERS.

TURKISH TOBACCO.

[574]—I see W. P. wishes to know "where Turkish tobacco, mentioned by Constant Reader, page 79, Vol. II., can be obtained."

The only place I ever got it was in the Bazaar at Constantinople. It is cheap; the best, if I remember rightly, being about a mejidieh (3s. 10d.) an oke (or 2 lb.). Whether it is mild—that is, whether it contains less of the active principle of tobacco than other sorts—I am uncertain. The water through which the tobacco is drawn in the nargileh becomes very much discoloured and offensive. The tobacco is coarse and uninviting in appearance.

At Athens they give you quite a different sort of tobacco, which I found hot, pungent, and too strong for my delicate stomach.

TUNBEKI.

SINGULAR EFFECTS OF ALCOHOL.

[575]—"Mephisto's" letter, No. 537, p. 250, I quite agree with, although the quantity he mentions (a teaspoonful of brandy) is very small, and would have scarcely any effect on very many people.

I am very sensitive to alcohol, and one of its effects on me is peculiar, I think. If I drink an ordinary glass of beer or stout, and sit quite still after doing so—say reading for about twenty minutes—and then attempt to speak or move my mouth in any way, the attempt is accompanied by exceedingly sharp pains on each side of the face, just below and in front of the ears. This effect does not follow if, instead of sitting still, I work actively after drinking. I know no other person similarly affected, but perhaps some of your correspondents do, and will kindly explain

I very seldom taste, and never more than one glass, and stout suits me best, excepting brandy, which I take in two, and occasionally three, teaspoonsful.

DEO FIDO.

LETTERS IN TYPE.—Size of Rising Moon, by G. E.; Local Weather Lore, by Michael Rearden; Singular Mental Illusion, by W. H. Perkins; Physiological Experiment, by Z.; The Use of Drunkenness, by J. Ralph; Talking Canary, &c., by Charles L. Cane; New Method of Preserving Organic Bodies, by W. Mattieu Williams; Defects of Bicycles, by John Browning and H. T. Round; Jordan-Glycerine Barometer, by C. J. W.; Dr. Hunter's Experiments, by Mathilde Van Eys; Monkey and Mirror, by Deo Fido.

Answers to Correspondents.

**** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded; nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to letters, reference should be made to its number, the page on which it appears, and its title.*

S[illegible] wishes to know if Bayma's Molecular Mechanics [illegible], and what works, if any, have been published since [illegible]ry of simple elements."—J. T. HINTON. There is [illegible] mistake in the passage quoted from Ferguson. See [illegible] subject.—IOTA. A September transit of Mercury is [illegible], because when Mercury is in inferior conjunction in September, he is not near a node of his orbit. His longitude when he is in inferior conjunction is the same as the earth's; and as she passes in September from longitude 338° to longitude 8° (roughly), whereas Mercury's nodes lie in longitudes 45° and 225° (roughly), a transit cannot possibly occur in September.—T. H. LAING. It is not a "new discovery" that 0^{-2} is not equal to 0; $0^{-2} = (\frac{1}{0})^2$, that is, [illegible] infinity squared. Substitute x instead of 0 for 0^{-2} in your syllogism, and where is it?—E. WILSON. De Morgan's "B[illegible] of Anomalies."—J. DIMMOCK. Do not know where there is any translation of Prof. Virchow's address on "The Liberty of Science[illegible]."—COSMOS. Thanks. I was away from town when proof [illegible] for return. Transit shortly.—W. BROWN. [illegible] promised work appeared several years ago under the title "Geometry of Cycloids" (including Trochoids, &c., &c.), publishers Longman & Co. Price 10s. 6d. I cannot speak confidently of any [illegible] on geometry beyond ordinary course of Euclid, Solid and Conic Sections, &c., not quite knowing whether you include analytical books. Have you read Salmon's books on Conic Sections, and the Higher Plane Curves, Frost and Wolstenholme on "Solid Geometry"? (Both analytical, however.) Between ourselves, I have not been a great reader of mathematical books. When a mathematical difficulty, outside my reading, occurs to me, I [illegible] my own method of dealing with it. Hence I am [illegible] the last person in the world to recommend "a book or books in English, German, French, Italian, or Spanish." That old edition of Euclid, by Isaac Barrow, should be full of interest to a geometrical student.—E. A. BROWN. I most heartily thank you for your kind and encouraging letter.—F. BINYON. Many thanks, but at present we are "choked" by matter standing over, and [illegible] alphabet could hardly find space.—E. S. B., E. K. RALLI[illegible], A. W. TIT[illegible], J. THOMAS, JOHN THOMSON, C. HARRIS, E. G. H. Thanks.—R. P. TYLER. If there were no air, a ship or other object would be depressed eight inches below horizon plane when she was a mile distant, four times as much two miles away, [illegible] three miles away, and so on. But, owing to the refractive power of the air, the depression varies (according to [illegible] to about seven inches per [illegible], the depression at a distance of [illegible].—G. T. RAVES. I would insert your letter if it were not quite so long. Our arrears increase, despite [illegible] we can do to keep them down. Pray excuse me on [illegible]. I think the tone I have taken [illegible]. I take, in reality, much the [illegible] Mr. Williams: we neither of us are tee[illegible] exuberant honesty (which, like all virtues [illegible] a "vice," vide Webster, Worcester, and [illegible] he calls his moderate use of wine or [illegible] I do not, you may depend there [illegible] between us as to the use of [illegible] going shortly to give his views [illegible] have expressed myself very ill, if I [illegible] Mr. Williams's own words came near humbug [illegible] any one to be another who is taking [illegible] foolish or vicious, then I [illegible] mortality statistics [illegible], those who [illegible] who do not so abstain, it is [illegible] the class of non-ab[illegible], but it can prove [illegible]. It might [illegible] that if men were [illegible] from total abstainers to [illegible] would be to aid gradually to [illegible] the Abbé Moigno, [illegible] in all allow-ance, and thence gradually to increase till the topers were reached.—SWIMMING. Try wadding, soaked in oil, for the ears when swimming.—H. TATE. Your theory will not explain curved tails.—J. A. OLLARD. Thanks for the stories, for which I will try to find room, but fear may not be able to. As to the dates, unfortunately, as soon as we have got once round, we lose all we had gained, or regain all we had lost.—E. F. B. HARSTON. It is said to be proved (which only proves it is said) that two ships on a calm sea approach each other. Theoretically they should, as they are bodies having mass, and, therefore, attracting each other, but so slowly that a lifetime should pass before they collide.—CARB. FER. Can find no trace of missing query. Index long since ready.—CONSTANT READER wants to know which are best books for study of zoology, whether there is a zoological society in Liverpool, and if a Liverpool clerk can become a B.Sc. without leaving or giving up his situation.—H. B. The snow does not withstand the blazing heat. It melts "like anything." I have been there, and know.—A. R. MOLISON. See abstract of Sir W. Thomson's discourse in our columns. The *Times* report, followed by *English Mechanic* and other papers, altogether too absurd.—J. WATSON, JUN. I do not know Todhunter's smaller Algebra, but should imagine it would suffice for your purpose. If you got the larger you should leave out a great deal. The chapters on Infinite Series, Continued Fractions, Probabilities, would be of little use. Spherical Trigonometry is essential for the study of theoretical astronomy, though much in Todhunter's book, small as it is, can be omitted. The elements of the Differential Calculus—really as easy as Algebra or Trigonometry—should also be studied, as you advance.—A READER desires to know which is the best work on Logic.—BEGINNER, ditto for naming specimens in *Herbarium* (cheap book).—W. MACKWORTH. Cannot undertake to forward geological specimens to authorities on the subject.—ORION (1) All solid food, I fear. I cannot vouch for the value of the remedy. It seems heroic, but Orion was a hero. (2) The property may be thus proved. Let the digits of a number, N, be p_1, p_2, p_3, &c., p_1 being in the units' place. Then $N = p_1 + 10p_2 + 100p_3 + 1000\ p_4 + \&c.$, and if n be the sum of the digits p_1, p_2, &c., then

$$N - n = 9p_2 + 99p_3 + 999p_4 + \&c.,$$

a multiple of 9.—J. GREENFIELD. Only admitted for the sake of argument; there is nothing in nature to show it likely, or even possible, that solar undulations can return in any form.—H. AUBREY HUSBAND. As much heat is added as would be required to raise the quantity of rain which has fallen from the form of water to that of aqueous vapour. But, as stated, the problem is not sufficiently definite. We must, however, deprecate the sending of problems to us, easy or difficult. The solution of problems is outside our purpose.—GEO. CRAIG asks whether a friend of his is right in saying "that London Bridge had been lit up by the electric light, but was discontinued on account of the restive condition of the horses." "Is this correct," he asks, "as applied to London or any other bridge?"—SLASHER. Slash away, to your heart's content, at us, but not at poor old Horace. What has he done that you should cut him up as you do? What Horace says is *not* "that noble hexameter" (!)

Mutato nomine de te fabula narratur.

It is enough to make him turn in his grave, if he had not already turned (into dust), to alter so his familiar

. . . . mutato nomine de te
Fabula narratur.

A. B. C. Does not the difficulty arise from taking a case where δU does not vanish, and in treating it, putting $\delta U = 0$?—T. A. (1) Yes; rain often falls after a lightning flash, often so soon after as to suggest (considering how long the rain must have been falling) that the rain began to fall before the lightning flash was seen. (2) It is the case that in explosions there is condensation and a consequent rush of air towards the scene of the explosion. In a great explosion which occurred at a chemical factory in France, the windows were all blown inwards. (3) Have forgotten my reply to H. Askew, and subject of his question. May I ask you what it was about?—A. R. W. Seeing how our correspondence is overflowing, you will understand and forgive my inability to insert your rather long letter about Mr. Williams's views and "Mr. Editor's." You overlook one point. You speak of the indulgence in an occasional glass for other than medicinal purposes as "doing no good," though you speak of it as "giving pleasure." Is the pleasure (if not harmful) no good? Surely it counts for something. For my own part, looking back over my past life, I repent me (I can use no other word) for every missed opportunity of taking pleasure, innocent to myself and not harmful to others. Moreover, I believe the doctrine to be a most wholesome one, and calculated to greatly increase the happiness of the human race, both directly and indirectly, that, when we are morally certain a pleasure will neither harm ourselves nor others, it is a duty to take it. The energy devoted to self-restraint in legitimate pleasure-taking may be better employed (and is all wanted) in resisting temptation to what is really wrong—if it be only to bad temper. I believe in a doctrine of mental and moral correlation as surely as in the correlation of physical forces, and hold that the self-conceit, detraction, and sour temper of ascetics (to say nothing of subtler defects) are directly due to their waste of moral energy in resisting and rejecting innocent pleasures.—ALG. BRAY. You are right. The $(p+1)$ is in the numerator. Your letter appeared because it was the easiest way of indicating the problem. I could not afford time for an answer which would have been of no use to any other reader. I do not think you have quite caught the answer to the paradox. The paradox arises in reality from our assuming knowledge that does not exist. The proof for the series $1^2+2^2+3^2+$&c., has occurred to others. It shall appear; though, probably, after some delay.—A. H. wishes to know how photographs are produced in which the figures stand out brilliantly white, like statuary, against a dark background; also to know which are the best books for Stage 10 Mathematics of the Science and Art Department.—J. P. We could not venture to give an opinion without seeing the planisphere. The course you propose would be the best.—LORESMITH. Thanks.—J. C. L. There is some mistake, certainly. The R. A. of mean sun quoted is not exactly that of the mean sun at noon at Greenwich on May 28, 1874; the seconds should be 25.13, not 25.73; but it is near enough to be very far from the R. A. at noon at New York.—IOTA (1). The moon appears larger near the horizon, through an optical delusion only; when measured with any angle-measuring instrument, the moon is found to be smaller near the horizon. (2.) The moon turns on its own axis once in every lunar month.—G. M. The question is rather too wide to be dealt with in this section; may be made the subject of an article.—HALYARDS. Are not all those cases explicable as mere coincidences? Considering how many thoughts arise in us and how many events occur to us, such coincidences must be always occurring. Why should we wonder when they do occur?

MATHEMATICAL ANSWERS.

GWERFYL. If you had worked correctly, you could not have an error of five millions in dealing with numbers of 8, 9, or 10 digits. Give some example, and the matter may be explained. I do not know of an eight-dec.-place logs. The seven-decimals suffice for all ordinary purposes. The calculation of logs is a subject rather too complex and requiring too much space to be dealt with in Answers.—R. N. Thanks for solution of Problem 44. It avoids the difficulty you point out in mine. The other point you notice is obviously an erratum. Will find space for solution if possible; but we are already much in arrears with mathematical matter, and consequently short of space.

Our Whist Column.

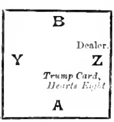
By "FIVE OF CLUBS."

THE following game illustrates early lead from a short suit of trumps when the long suit is established, and there are good re-entering cards:—

THE HANDS.

A.
Hearts—A, 3.
Clubs—K, 10, 9, 6, 5, 4, 3.
Diamonds—A, 3.
Spades—A, K.

B.
Hearts—K, Kn, 4.
Clubs—A, 7.
Diamonds—Kn, 10, 7, 4.
Spades—Kn, 9, 6, 4.



Y.
Hearts—Q, 7, 2.
Clubs—Q, 8.
Diamonds—6, 5, 2.
Spades—10, 8, 7, 5, 3.

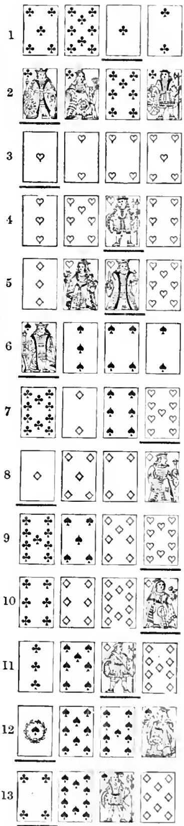
Z.
Hearts—10, 9, 8, 6, 5.
Clubs—Kn, 2.
Diamonds—K, Q, 9, 8.
Spades—Q, 2.

Score:— { *A*, *B*, = 0 / *Y*, *Z*, = 4 }

THE PLAY.

NOTE.—The card underlined wins the trick, and card below leads next round.

A *Y* *B* *Z*



REMARKS, INFERENCES, &c.

1. *A* having seven Clubs, leads the antepenultimate.

2. *B* having no very good suit, returns his partner's lead; from the fall of the cards he sees that all the remaining Clubs are with *A*.

3. Although with only two trumps, *A* having five winning Clubs, two winning Spades, and Diamond Ace, leads trumps, hoping, by forcing, if necessary, to get out trumps and bring in his long suit. He leads Ace to ensure two rounds of trumps at least.

4. *B* knows from *A*'s play that *A* has not led from a long suit of trumps. For if *A* had had five trumps, headed by the Ace, he would have led trumps first round. *B* should have helped *A* in getting out as many trumps as possible, by playing his King and leading the Knave. The finesse succeeds, as it happens, but it was not good play.

5. Remaining trumps are with *Z*.

6. *B* leads Spades in response to *A*'s discard of a Diamond.

7. *A* forces *Z*, of course. *Y* discards from his weakest suit; *B* likewise.

9. *A* again forces *Z*.

The rest of the game plays itself.

ANSWERS TO CORRESPONDENTS.

J. MOYLE and L. PANTERN.(?) Whist will continue weekly (or perhaps only fortnightly) later.—A. GORHAM. 1. See Nos. following 13, in which *Y*'s play of the Ten is discussed at length. My corrected opinion is that the play was not good, except under the particular circumstances. *Y* knew his partner would draw the desired inference. *Y* and *Z* had played much together—that was the only excuse for *Y*'s departure from rule. 2. In the first case under this heading, *Z* having enacted one penalty, no other can be enacted. *B* can take the card again into his hand or leave it exposed, it can scarcely matter which. In the second case, where the other penalty is enacted, the card can be called either as a lead, or in its turn (if playable without a revoke) to a trick. 3. In No. 43, p. 22, *A* has already shown that he holds but three Diamonds by leading Queen and following with a smaller one. What new information can he give by playing Six instead of Two second round? *B* knows that *A* has not more than three cards, and also that he must have had three at least; for there are no possible conditions under which Queen would be led from Queen and another at the first round. 4. Honours are counted, I imagine (though the game without honours is far better, and more scientific), because inferior players would have but a poor chance were it not for the element of chance introduced by counting honours. Counting half honours, that is, two for four honours, and one for three honours against one, would be a fair compromise, if the clubs could agree in recommending it.—NEMO. (i.) I know nothing of Besique. (ii.) *A* having already won the trick, *B*, on taking his partner's trick, seeing *A* about to lead, says: "Partner, the trick is mine; don't play?" Is the remark allowable? It seems to us *B* is not only allowed but bound to prevent his partner, if he can, from leading out of turn. But it would have been better to say simply, "*My* lead, partner." FIVE OF CLUBS.

Our Chess Column.

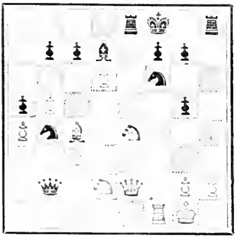
By Mephisto.

THE [illegible] occurred in a game played at the [illegible] Brighton:—

[illegible] after Black's eighteenth move.

Mr. W. Bennett.

Black.



White.

Mr. A. A. Bowley.

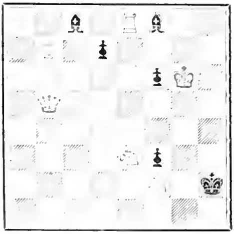
[illegible] position [illegible] from an Evans' gambit declined. White (Mr. Bowley) proceeded with

19. Q to B3	19. B to Kt5
20. Q takes B	20. Kt takes Q
21. B takes P (ch)	21. K to Kt sq
22. R to B6 (ch)	22. K to R2
23. Kt takes P (mate).	

PROBLEM No. 54.

By John Simpson, Edinburgh.

Black.



White.

White to play and mate in three moves.

We have received "The Taz Chess Diagram and Game Recorder [illegible]." It contains forty diagrams for problems, which can [illegible] used for recording games; published by Hopwood, Manchester.

SOLUTIONS.

Problem No. 51, by H. A. N., p. 238.

1. Kt takes P	1. P takes Kt
2. P to B7	2. P takes P
3. P to B8 (Kt) (checkmate).	

Problem No. 52, by Herbert Jacobs, p. 254.

1. B to Kt5	1. B takes B
2. Kt to B5 (mate).	
or	1. R takes B
2. R to Q2 (mate).	
or	1. P to K6
2. P takes P (mate).	

Problem No. 53, by Leonard P. Rees, p. 254.

1. K to Q2	1. K to Q5
2. R to B6	2. K to K4
3. B to B3 (mate).	

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess-Editor.*

Philo. No such book published. "Cook's Chess Primer" is good.

J. A. Miles.—Problem received with thanks.

A. Johnson.—Thanks for specimens of games at odds. Will give as much attention to particular openings as our space permits. Will soon introduce you to a partner.

F. J. C.—Thanks for your problem; will be examined. H. B. Kimpton v. A. W. Overton.

D. B.—You must look up some old game in "Staunton's Handbook."

G. G. R.—We think White can win. We shall attempt an analysis of the position in our next number.

J. Watson.—Cook's "Synopsis" (W. W. Morgan), price 3s. 6d.

Correct solutions received. Problem No. 51, J. P., G. W., Alfred B. Palmer, Belmont, Agnes Larkcom, John O'Keefe. Problem No. 52, Iota, Tafsir, Z. Y. X., T. Wilson Morris, James Dyson, C. W. Crosskey, Novice, T. W., J. B. B., C. S. Bright, F. W. Cooper, Belmont, R. J. P., H. V. T., T. T. Dorrington, John Watson, G. W., John O'Keeffe, Squire, J. Carraway. Problem No. 53, G. W., John O'Keeffe, John Watson, H. V. T., T. T. Dorrington, R. J. P., Belmont, F. W. Cooper, C. S. Bright, J. B. B., T. W., F. J. C., Novice, C. W. Crosskey, A. J. H., T. Wilson, Morris, Alfred B. Palmer, Squire, J. Carraway.

Contents of Knowledge *No.* 46.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, SEPTEMBER 29, 1882.

Contents of No. 48.

Science and Art Gossip.

School of Telegraphy.—On Monday, October 2, Mr. W. Lynd, a gentleman of several years' experience, will open a school of telegraphy for young ladies and gentlemen at Fair Bank, 13, Oaklands-grove, Uxbridge-road, W. Instruction is to be given in the various telegraphic systems used in the Postal Telegraph service, the apparatus for the purpose being made after the Post-Office pattern. While a course of instruction at this school will give an initial advantage to those of its pupils who join the permanent staff of the service, by far the greater gain will, we imagine, accrue to those who desire employment at the numerous sub-offices, which constitute a considerable portion of the postal system, and are destined, at the present rate of progress, to still further increase in number and importance.

Crystal Palace Exhibition.—The amount subscribed by gas companies towards the expenses of the special committee of the Gas Institute in connection with the forthcoming exhibition at the Crystal Palace now reaches about £4,000.

In addition to the prizes already announced to be awarded at the forthcoming exhibition at the Aquarium, a £50 prize is to be awarded for the best electro-motor for stationary work, or for tram-car work, (*a*) absorbing ½ h.p., (*b*) absorbing 2½ h p., (*c*) absorbing 5 h.p. The effective value of the receptor as economical for the transmission of power will be the chief point of contest—that is to say, if 1 h.p. is put in by strap indication at one end, the strap indication of the work done at the other end will be measured, and the comparison thus made.

Edison *v.* Swan.—At the meeting of the Swan United Electric Light Company held last week, the chairman stated, with reference to the threatened litigation between Edison's Company and theirs, that there could be no doubt as to the separate character of the inventions, and that he thought it not unlikely that the companies would join forces rather than fight each other.

Mineral Productions in Europe. — The French Minister of Public Works has just issued the annual statistics of mineral industry. We extract therefrom the figures below showing the mineral production of the principal countries in 1880. The total amount is 380,657,000 tons, representing a value of about £250,759,467. France, 23,257,657 tons; England, 171,061,476 tons; Germany, 59,680,754 tons; Belgium, 17,172,749 tons; Austria, 14,216,282 tons; Hungary, 2,281,373 tons; Italy, 1,107,624 tons; Spain, 2,584,361 tons. These amounts include combustible minerals, iron, lead, copper, zinc, sulphur, tin, manganese, antimony, marine salt, and rock salt.

The following table, which has been prepared by the French Ministry of Public Works, gives the railway mileage of the various countries of Europe and the United States up to the end of last year, with the number of miles constructed in that year, and the population per mile :—

	Total.	Built in 1881.	Population per Mile
Germany	21,313	331	2,154
Great Britain	18,157	164	1,939
France	17,134	895	2,170
Russia	14,745	3	5,586
Austria-Hungary	11,880	262	3,200
Italy	5,450	109	5,321
Spain	4,869	176	3,492
Sweden & Norway	4,616	273	1,408
Belgium	2,561	48	2,203
Switzerland	1,557	22	1,831
Holland	1,426	83	2,835
Denmark	1,053	25	1,919
Roumania	916	56	5,860
Turkey	866	—	2,891
Portugal	757	8	5,870
Greece	6	—	28,000
Total	107,306	2,455	3,168
United States	104,813	9,358	502

It appears from this that the United States mileage was only 2,493 less than the total of all Europe, and at the present time it exceeds it, as the former country has built about 6,000 miles this year, whereas Europe has not exceeded 1,500. The difference in the number of persons per mile in the two cases is also very great, Europe taking six times as many persons to support a mile of railway as the States, and can only be accounted for by the fact that American railways are constructed much cheaper than the European ones.

According to the census reports, the population of the United States in 1880 was 50,155,783, of whom 36,843,291 were whites native born, and 6,679,943 were whites foreign born; the coloured population being 6,632,549. Of foreign born whites, 2,772,169 were natives of the United Kingdom, 1,966,742 Germans, 717,084 British-Americans, 194,337 Norwegians, 181,729 Swedes, 106,971 French, 104,541 Chinese.

"The Americans," says Mr. G. Phillips Bevan, "who were to a certain extent influenced by the representations of that colossal scoundrel Kearney, in California, were not a little surprised when the figures of the census revealed the presence of the Chinese in very much smaller numbers than were stated and believed. So vague, indeed, was the previous knowledge, that even our Consul in San Francisco reported that in 1876 there were over 150,000 Chinese in the States, which numbers, during the agitation of the next year, were conveniently increased to 200,000 in California alone. The census tables of 1880 showed that the whole number of Chinese in the States was only 105,717; and although, from climatic and labour reasons, the percentage in a few of the States was rather large, the total proportion of 105,717 Chinese to the 51,000,000 inhabitants of the United States was so absurd, that the Chinese bugbear collapsed at once, to the shame of many who had taken part in the agitation."

Infection at Seaside Lodgings.—We are continually receiving cuttings from newspapers and communications of various kinds, pointing out—in too many instances very painfully illustrating—the perils of infection which lurk in seaside lodgings to which the weakly or jaded resort for rest and health. There is an irony in the fate which makes these places notorious as centres for the propagation of disease. It is not easy to suggest a remedy, because those who live by letting lodgings regard their visitors as fair game at any risk. If a lodger contracts fever or diphtheria, and dies or is removed one week, the bill "To Let" will be up again the next week. It has been repeatedly suggested that there should be a systematic registration and inspection of lodgings, but apparently the time has not arrived for the need of such a measure to be publicly felt. Perhaps, when the many cases which are now scattered, and therefore overlooked, come to be collected and reported *en masse*, public opinion may be stirred in the interests of self-preservation and common sense.—*Lancet.*

Indians as Workmen.—The popular theory that the Indian cannot be made to work is not altogether unfounded. It by no means follows, however, that he cannot be induced to work, and work well, when removed from his native surroundings and supplied with the proper incentives. The Indians in the industrial schools at Hampton, Va., and at Carlisle, Pa., have shown a readiness to acquire trades and a capacity to learn to handle tools skilfully, that must stagger the prejudices of those who have adopted the frontier creed that the only useful Indian is a dead Indian. At the recent public exercises at Carlisle, a Plains Indian was the proud, though seemingly stolid, exhibitor of a waggon built entirely by himself, a piece of work that older mechanics might not have been ashamed of. The Springfield *Republican* says that there are now on exhibition in Boston samples of shoes and harnesses made at Hampton Institute, which both in finish and serviceableness are able, in the opinion of competent inspectors, to compete successfully with the products of regular workmen. The shoes are part of a contract for two thousand pairs which the Government gave to the Superintendent of the Institute, General Armstrong, last spring. The Government has also ordered seventy-five sets of double-plough harnesses. General Armstrong is confident that within five years, as the hundred Indians at Hampton, the three hundred at Carlisle, and others under instruction elsewhere, become masters of the craft, all the shoes and harnesses needed for the plains, can be made by Indian young men at home.

The largest strap for the transmission of motive power in the world was recently completed at Berlin. Its width is 160 centimetres, or about 6 feet 3 inches, and its weight a ton and a half. As many as 200 of the largest and heaviest ox hides had to be used in making this gigantic strap. It is intended for a starch manufactory in Germany, where it is to transmit a motive power equal to 500 horses.

Medical men have always differed as to whether the best treatment of frozen persons was by a gradual or rapid application of heat. To settle the matter, Laptchinski has made a series of careful experiments upon dogs, with the following result. Of twenty animals treated by the method of gradual resuscitation in a cold room, fourteen perished; of twenty placed at once in a warm apartment eight died, while of twenty immediately put into a hot bath, all recovered.

The largest locomotive ever built has just been completed at Paterson, N.J., and is one of twenty-five ordered by the Central Pacific Railroad. Its weight without the tender is sixty-two tons. The size of the cylinders is twenty by thirty inches. These engines have eight drivers and a four-wheeled truck.

Statistics of the Postal Union.—The following statistics for 1881 have been issued by the central authority of the Postal Union in Switzerland. During the year the Union was reinforced by the accession of Chili, Columbia, the Little Antilles, Grenada, St. Lucia, Tobago, the Turks Islands, Barbadoes, St. Vincent, Guatemala, Haiti, and Paraguay, while, since the commencement of the present year, Hawai and Nicaragua have also joined. In round numbers, the amount of business carried on during 1881 included the transmission of 3,866,000,000 letters, 619,000,000 postal cards, 3,000,000 cards with paid answers, 1,983,000,000 newspapers, 1,023,000,000 printed packets, 61,000,000 patterns, 98,000,000 small parcels. The post office orders granted were 95,000,000, representing a value of 8,015,000,000 f. Daily throughout the globe, the Postal Union expedites upwards of 13,000,000 letters and post-cards, without counting printed matter, while the distribution of each year includes 3,418,000,000 letters in Europe, 1,216,000,000 in America, 76,000,000 in Asia, 36,000,000 in Australia, and 11,000,000 in Africa.

The Velocity of Light.—Preparations are nearly completed at the Case School of Applied Sciences, Cleveland, Ohio, for a reinvestigation of the velocity of light, by Professor A. A. Michelson, late of the Naval Academy at Annapolis. The velocity found (186,380 miles a second) differed slightly from that obtained by M. Cornu at the observatory at Paris in 1874, and also, it is said, from that obtained more recently by Professor Newcomb at Washington. The results of the last-named observations have not been published. Mr. Michelson has, accordingly, been requested to repeat his experiments, money for the purpose, about $1,200, having been promised from the Bache scientific fund. The Cleveland *Leader* says that two small buildings have been erected for the experiments on the grounds of the Case School. The larger of the two, 16 × 45 ft., contains the chief apparatus. Two thousand feet west of it is a smaller building containing a stationary mirror. In the experiments the light traverses the space between the buildings and back again to the apparatus, by whose movement data are obtained upon which the velocity of the light is measured.

The Area of Modern States.—Some interesting facts may be gleaned as to the relative size, according to area, of the various European and American States. The largest State in the civilised world is Texas, which boasts an area of 274,356 square miles; the smallest is the little State of Monaco in Europe, which has only an area of six square miles. The Austrian Empire contains 240,943 square miles; the German Empire, 212,091; France, 204,091; Spain, 177,781; Sweden, 168,012; California, 157,801; Dakota, 150,932; territory of Montana, 143,776; Norway, 122,280; New Mexico, 121,201; Great Britain and Ireland, 120,879; Italy, 114,296; Arizona, 113,916; Nevada, 112,090; Colorado, 104,500; territory of Wyoming, 97,883; Oregon, 95,274; territory of Idaho, 86,294; territory of Utah, 84,476; Minnesota, 83,531; Kansas, 80,891; Nebraska, 75,995; territory of Washington, 69,994; Indian territory, 68,991; Missouri, 65,350; Turkey in Europe, 62,028; then come a number of other American States, after which are Roumania, 45,642; Bosnia and Herzegovina, 28,125; Bulgaria, 24,360; Servia, 20,850; Netherlands, 20,527; Greece, 19,941; Switzerland, 15,235; Denmark, 14,553; Eastern Roumelia, 13,500; Belgium, 11,373; and Montenegro, 1,770.

MONKSHOOD.

By Grant Allen.

To look at these queer, irregular blue flowers, growing on a long and handsome spike in the old-fashioned garden border, nobody would ever dream of saying that they were in reality altered and modified buttercups. And yet that is just what they really are, with all the marks of their curious pedigree still clearly impressed upon their very form. Pull one of the blue blossoms off, and pick it carefully to pieces, and you will see how strangely and profoundly it has been distorted by insect selection. Monkshood is most essentially a bee-flower, and in examining it we see the results of bee action plainly set forth in every organ. If we pick a common meadow buttercup for comparison with it, we shall be able to see exactly wherein the two flowers differ, as well as why the one has gained an advantage in the struggle for existence over the other.

The outside whorl of the buttercup consists, of course, of five separate greenish sepals, which together make up its calyx. Inside the sepals come the five golden petals composing the cup-shaped corolla; and inside the petals, again, come the numerous stamens, and the equally numerous carpels or unripe fruits, each containing a single, solitary little seed. Moreover, all these parts are regularly and symmetrically arranged round a common centre, so as to form a series of concentric whorls. But when we look at the monkshood, we see no such simple and orderly arrangement in its architectural plan. At first sight, we recognise no distinct sepals or petals; and the coloured organs that take their place are very irregular in shape, and disposed in an unsymmetrical fashion—or rather, to speak more correctly, their symmetry is not radial, but bilateral. When we begin to pull our blue blossom to pieces, however, we gradually recognise the various parts of which it is composed. First of all come five sepals, not greenish as in the buttercup, but bright blue; and not all alike, but specially modified to fulfil their separate functions. The uppermost sepal of all is helmet-shaped, and it forms the curious cowl which gained the plant its suggestive name from our mediæval ancestors. The two side sepals, to right and left, are flatter and straighter, but very broad, while the two lowest of all are comparatively small and narrow. The whole five are bright blue in colour. Pull off these petal-like sepals, and you come to the real petals beneath them. At first you can hardly find them at all; you see only two long blue horns, covered till now by the helmet-shaped upper sepal or cowl, and each with a queer cup-like sac at its extremity, containing a small drop of clear fluid. That fluid is honey, but I should advise you to be careful in tasting it not to bite off any of the flower, for monkshood is the plant from which we get the now famous poison, aconitine; and a very little of it goes a long way. Unlike as they are to the familiar yellow petals of the buttercup, one can still gather from their position that the two long horns are really petals. But where are the three others? Well, you must look rather close to find them, and perhaps even then you won't succeed after all; for sometimes the three lower petals have disappeared altogether, being suppressed by the plant, as of no further use to it. In this particular specimen, however, they still survive as mere relics or rudiments, three little narrow blue blades, not nearly as big as a gnat's wing, placed alternately to the lower sepals. As for the stamens, they are still present about as numerously as in the buttercup; whereas the carpels, or fruit-pieces, are reduced to three only, which in the ripe seed-vessels here on the lower and older part of the spike grow into long pods or follicles, each containing several seeds.

Thus, then, the flower of monkshood agrees fundamentally with the flower of the buttercup; while, at the same time, it has undergone some very singular and suggestive modifications. In both there are five sepals; but in the buttercup all five are alike, and all five are greenish; whereas in the monkshood they have acquired different shapes, exactly fitting them to the bee's body, and they have become blue, because blue is the favourite colour of bees. Again, in both there are five petals; but in the buttercup all five are similar and yellow, and all five secrete a drop of honey at the base; whereas in the monkshood two of them have become long and narrow specialised nectaries, while the other three, being no longer needed, have grown obsolete or nearly so. Once more, the stamens remain the same; but the carpels have been immensely reduced in number, at the same time that the complement of seeds in each has been greatly increased by way of compensation.

Well, how are we to account for these peculiar modifications? Entirely by the action of the fertilising bees. The secret of the monkshood depends, in the first place, upon the fact that its flowers are clustered into a spike, instead of growing in solitary isolation at the end of the stem, as in the common buttercups. Now Mr. Herbert Spencer has pointed out that solitary terminal flowers are always radially symmetrical, and never one-sided, because the conditions are the same all round, and the visiting insects can light upon them equally from every side. But flowers which grow sideways from a spike are very apt to become bilaterally symmetrical; indeed, whenever they are not so, one can always give an easy explanation of their deviation from the rule. Probably the blossoms of the monkshood began by arranging themselves in a long and handsome spike, so as more readily to attract the eyes of insects; and that was the real starting point of all their subsequent modifications. Or, to put the same thing more literally, those monkshoods which happened to grow spike-wise succeeded best in attracting the bees, and therefore were most often fertilised in the proper manner. Next, we may suppose, the large green sepals, being much exposed to view, began to acquire a blueish tinge, as all the upper parts of highly developed plants are apt to do; and the bluer they became, the more conspicuous they looked, and therefore the better they got on in competition with their neighbours, especially since bees are particularly fond of blue. As each bee would necessarily light on the middle or lower portion of the flower, he would begin by extracting the honey from the two upper petals; but it would be rather awkward for him to turn round, head downward, and suck the nectaries of the three bottom ones. Hence, in course of time, especially after the flower began to acquire its present shape, the two top petals became specialised as nectaries, while the three lower ones gradually atrophied, since the coloured sepals had practically usurped their attractive function. But as the flower can only succeed by being fertilised, all these changes must have been really subordinate to the great change which was simultaneously going on in the mechanism for ensuring fertilisation. Slowly the blossoms altered to the bilateral shape—they adapted themselves by the bee's unconscious selection to the insect's form. The uppermost sepal grew into the hood, so arranged that the bee must get under it in order to reach the long nectaries containing their copious store of honey. At the same time the bee must brush against the stamens, and cover his breast with a stock of adhesive pollen-grains. When he flies away to the next flower he carries the pollen with him: and as he rifles the nectaries in the second blossom, he both deposits pollen from the last plant upon the sensitive surface of the carpels in this, and also collects a fresh lot of pollen to fertilize whatever other flower he may next favour with a call. The increased certainty of fertilisation thus obtained enables the plant to dispense with some of the extra carpels which its buttercup ancestors once possessed: and by lessening the number to three, it manages to get the whole set impregnated at a single visit. But, as three seeds would be a small number to depend upon in a world of overstocked markets and adverse chances, it makes up for the diminution of its carpels by largely increasing the stock of seeds in each.

Thus the whole shape and arrangement of the monkshood bear distinct reference to the habits and tastes of the fertilising bees. It is a mountain plant by origin, belonging to a tribe which took its rise among the great central chains of Europe and Asia, and these Alpine races are usually highly developed in adaptation to insect fertilisation, because they depend more absolutely upon a few upland species than do the eclectic flowers of the plains, which may be impregnated hap-hazard by a dozen different flies, or moths, or beetles. We can still dimly trace many of the links which connect it with very simple and primitive buttercups, if not directly, at least by the analogy of other plants. For all the buttercup tribe show us regular gradations in the same direction. The simplest kinds are round, yellow, and many-carpelled, like the buttercups. Then those species which display their sepals largely have dwarfed petals, like hellebore and globe-flower, or have lost them altogether, like marsh-marigold, which trusts entirely for colour display to its big golden calyx. The still higher anemones have the sepals white, red, or blue; and the very advanced columbine has all the petals spurred, and developed into nectaries, like those of monkshood. But columbine still keeps to single terminal flowers, so that here the five petals remain regular and circularly symmetrical, though the carpels are reduced to five. Fancy a number of such columbine flowers crowded together on a spike, however, and you can readily picture to yourself by rough analogy the origin of monkshood. The sepals would now become the most conspicuous part; the two upper petals would alone be useful in insuring fertilisation, and the lower ones would soon shrivel away from pure disuse. The development of the hood, and the lengthening of the upper petals, would easily follow by insect selection. It is a significant fact that our only other spiked buttercup, the larkspur, has equally irregular and bilateral flowers, though its honey is concealed in a long spur formed by the petals, and accessible to but one English insect, the humble bee.

VENUS NEARING TRANSIT.

By the Editor.

(Continued from page 275.)

In the first part of this article, I have given an account of the various changes of appearance presented by the beautiful star which sometimes shines as Hesperus, the star of evening, and sometimes as Lucifer, the morning star. Let us now consider what this star really is, so far, at least, as we can learn by using telescopes and other instruments.

Venus has, in the first place, been measured, and we find that she is a globe nearly as large as the earth. Like the earth, she travels round and round the sun continually, but not in the same time as the earth. The earth goes round the sun once in twelve months, while Venus goes round once in about seven-and-a-half months; so that *her* year, the time in which the seasons run through their changes, is four-and-a-half months less than ours. If Venus has four seasons like ours, — spring, summer, autumn, and winter,—each of these seasons lasts eight weeks. Venus also, like our earth, turns on her axis, and so has night and day as we have. Her day is not quite so long as ours, but the difference—about twenty-five minutes —is not very important.

So far there is nothing in what we have learned about Venus which does not agree well with the idea that the planet is a world like our earth, where people like ourselves might live very comfortably. For it would not matter much to us, probably, if the year were shortened by four or five months, and the day by half-an-hour—supposing always that trees and vegetables were so made that they could thrive under the change. In fact, if anyone leaves the temperate regions to visit the tropics, he has to undergo a greater change. For in England, and throughout the United States, the seasons change from the heat of summer to the cold of winter, and back again to the heat of summer, in twelve months; but at the equator, the greatest heat occurs in spring and autumn, or at intervals of only six months. So far as the length of the year is concerned, an American or an Englishman could very well bear the change to the temperate zone of Venus, where the interval between the successive seasons of greatest heat amounts to seven-and-a-half months.

But when we consider some other points, we see that Venus, beautiful though she looks, would not be a comfortable home for us. Venus is much nearer to the sun—the great fire of the solar system—than our earth is. She receives, then, much more heat from him. In fact, it is easily calculated that if our earth were set travelling on the path of Venus, we should receive almost exactly twice as much heat from the sun as we do at present. This would be unbearable, except, perhaps, in the Polar regions; and even there the summer, with that tremendous sun above the horizon all through the twenty-four hours, would be scarcely bearable. Besides, what a contrast between the hot Polar summer and the cold Polar winter, when for weeks together the sun would not be seen at all. Altogether, this earth would be a miserable home for us if her path were as close to the sun as that of Venus.

We see, then, that either there must be some peculiarities about Venus which prevent the sun from heating people there as he would certainly heat us if our home were there, or else the creatures which live on Venus must be different from ourselves and the other animal inhabitants of our earth. Unfortunately, we cannot make telescopes large enough to show us what is going on upon that planet, and there is no reason for hoping that such telescopes can ever be made. What we know, however, about the planet's condition does not seem to show that creatures living there would be more comfortable than we should be if the earth were put where Venus is. Just the contrary, so far as we can judge. The seasons on our earth are caused by the fact that she turns on a slanted axis. If her axis were upright, there would be no seasons; if it were more slanted, the contrast between summer and winter would be greater. Now Venus has her axis much more slanted than the earth's, so that her seasons must be very marked indeed. Thus the heat of her summer weather must be even more terrible than if her globe were inclined like the earth's.

But there is yet another point to be noticed. On the upper slopes of lofty mountains, there is snow all the year round, even in the torrid zone. That is because the air up there is so rare that it does not act like the denser air lower down, which is a sort of clothing for the earth, keeping the heat from escaping. Now if the air of Venus were very rare, something of the same sort might happen on that planet. Just as people who live in torrid zones seek the high mountain slopes in the hottest seasons of the year, and find there a temperate climate, so the inhabitants of Venus might find it possible to bear the sun's intense heat if the air of the planet were rare like that above the snow-line in our mountain regions.

But it seems that, on the contrary, the air of Venus is even denser than ours. And it seems also to be a moist air, which is just the kind of air that keeps the heat in most. The air of Venus is, in fact, so dense and moist that the planet would be very uncomfortable (quite apart from the intense heat) for creatures like ourselves.

The density of the air of Venus has been shown in several ways. Perhaps the most satisfactory proof is that which was obtained during the last transit of Venus across the sun's face, on December 9, 1874.

On that occasion, when the planet traversed such a path as is shown in Fig. 4, a phenomenon of great physical interest and importance was observed.

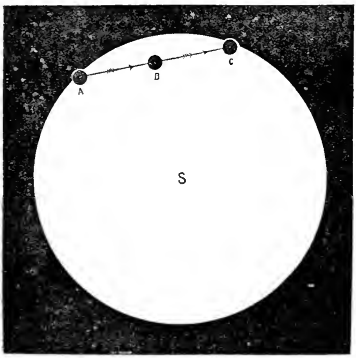


Fig. 4.

When the planet was at A, entering on the sun's face, a bright arc of light was seen round the part of the planet which had not yet entered upon the sun's face. This arc was not a mere faint light, but strong sunlight, as bright as that derived directly from the sun's disc. When the planet was at C, a similar arc of light was seen, as shown in Fig. 4.

Fig. 5.

There is only one way in which this arc of light can be accounted for, and that is by the action of air upon Venus bending the sun's rays, as shown in Fig. 5, so that the sun is seen *round the corner*. Our air shows us the sun in this way, when he would be quite out of sight if there were no air; for when we see the sun's disc just touching the horizon, it is the air which really brings him into view, by bending his rays round the curved surface of the earth.

So we are quite certain that there is air of some kind on Venus. And we can even tell how much there is. Professor Lyman, of Yale College, America, has made observations of this kind (not exactly the same as are illustrated in Fig. 5, but depending upon the same bending power of the air on rays of light); and from what he has seen, it appears that the air on Venus is about twice as dense (at the planet's surface) as the air on the earth.

Remembering that the sunlight has passed through this air, we can understand that the light which comes to us as in Fig. 5 may tell us what sort of air it has passed through. The spectroscope can tell as certainly—though the observation is, of course, more delicate—that it has passed through the vapour of water in the air of Venus, as the rainband spectroscope on our own earth can tell us of the presence of aqueous vapours in our air. That is what astronomers learnt in December, 1874, when the globe of Venus was passing, as in Fig. 4, between our earth and the sun.

There cannot be moisture in the air of a planet unless there are seas and oceans on the planet's surface. No doubt, then, Venus has her continents and oceans, her islands and promontories, and inland seas and lakes, very much as our earth has. Then there must be rivers on the land, and currents in the ocean; there must be clouds and rain, wind and storm, thunder and lightning, and perhaps snow and hail.

Whether the planet is an inhabited world or not, it would be difficult to say. Perhaps it is a world getting ready for use as a home for living creatures. Most physicists believe that the sun is gradually parting with his heat. If, millions of years hence, the sun should only give out half as much heat as he does, Venus would be as comfortable a place to live in as our earth is now. But at present it may safely be said that if Venus is inhabited, it must be by creatures very different from those inhabiting the earth.

(*To be continued.*)

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

By Miss Amelia B. Edwards.

X.—PA-RAMESES.

Our first step when seeking to identify the sites of Pithom and Raamses is to collect such scattered mention of cities bearing these famous names as may be gathered from ancient Egyptian writings. These references are, perhaps, more numerous than might be expected.

The name of Pa-Rameses occurs much more frequently than the name of Pa-Tûm. We meet with it in several documents of contemporary date (that is to say, in papyri of the time of Rameses II. and his immediate successors), and also in one important lapidary, or stone-cut, inscription. This last is found in the great rock-cut Temple at Aboo-Simbel in Nubia, and covers a large tablet built up between two of the Osiride columns in the first Hall. The text* consists of 37 lines of sculptured hieroglyphs, and it purports to be an address from the God Pthah Tatunen to Rameses II., followed by the King's reply to the same. The speech of the God is conceived in the most florid style of oriental compliment. The King is his son, made after his own likeness, an eternal King: a prince for ever, with "limbs made in [illegible] truth, with bones of brass, with arms of iron." There is plenty wheresoever he bends his footsteps. The Nile is always high for him; the harvest always abundant; the fishing always plentiful. To him his divine father grants success in all his works, enabling him (in allusion to the enormous Colossi seated in front of the temple) "to cut the mountains into statues immense, gigantic, everlasting." He then goes on to say:—"Thou hast built a great residence to fortify the border of the land, the city of Rameses (Pa Rameses); it is established on the earth like the four pillars of the sky. Thou hast constructed within it a royal Abode, where festivals are celebrated to thee as is done for me within." This last "within" does not mean within the walls of the same "Abode," or temple, in which Rameses was himself worshipped as a divinity. It is used in the sense of the inner, or inland, country, as opposed to the frontier country; and means Memphis, which was the great centre of the cult of Pthah. The topographical and strategical allusions in the above lines are very valuable. They show that the Pa Rameses in question was a new city; that it was a fortified place upon the borders; and that it was dedicated to the worship of the Pharaoh in his divine character. It thus fulfills all the conditions necessary to its identification with the "Raamses" of the Bible.

The contemporary papyri in which we find mention of a city (or possibly of various cities) called "Pa Rameses" are chiefly letters, or copies of letters; some being the intimate correspondence of private persons; others being business letters on the most matter-of-fact subjects; while some, in a more ornate style, would seem to have been transcribed either as exercises in penmanship, or as specimens of elegant composition, like the epistles in "The Polite Letter-writer" of our grandparents. That such documents, written upon a material so perishable as papyrus, should have survived the wreck of ages, is at least as wonderful as that the language in which they are expressed, and the crabbed script in which that language is written, should be as intelligible, and as legible, to Egyptian scholars of this day as they were to those who wrote and read them three-and-thirty centuries ago. And if in these pages of fugitive correspondence we indeed find passing mention of one, or both, of those "treasure-cities" which were the scene of the oppression of the Hebrews, the marvel culminates. These letters, found buried with mummies in their coffins, or in earthen pots among the ruins of ancient dwellings, or in hiding-places excavated in the rock, have been bought up from time to time by travellers in Egypt, and have so been resold to various European Museums. Some with which we are now especially concerned are among the famous "Anastasi" papyri of the British Museum, while others form part of a very large and curious document called "The Great Hieratic Papyrus of Bologna." The "Anastasi papyri" (so called because purchased from M. Anastasi by the trustees of the British Museum) consist of a collection of letters, copies of letters, miscellaneous memoranda, minutes on judicial matters, treatises written apparently for educational purposes, and the like. The Great Hieratic Papyrus of Bologna (which is in one piece, and measures nearly two-yards-and-a-half in length) contains transcripts of sixteen letters by various scribes, mostly in the service of Menephthah, the son and successor of Rameses II. It is dated by the copyist in the eighth year of that Pharaoh. The allusions to Pa Rameses which occur in these letters are casual and unimportant. The scribe Mahoo of the Royal Workshops, writing to the scribe Pinem, cautions this latter to pay particular attention to the building of certain chariots for the superintendent of Panegyries, adding "As I am despatched to the town of Rameses Mer-Amen (Pa Rameses* Mer-Amen) take care that they are got ready." The Chantress of Amen, Sherau Ra, writes a letter of affectionate greeting to one Piai, evidently her near relative, invoking the Gods to grant him health, strength, and the favour of the King. "All is well with me," she says, "I live. Be not anxious about me; but my heart would fain have news of thee daily. Behold, I go to-morrow to rejoin thee at Pa-Rameses Mer-Amen," &c. Others of these letters name Pa-Rameses still more incidentally, the writers merely invoking "all the Gods of Pa-Rameses" to bestow health, and strength, and long life upon the person to whom the communication is addressed. Some of these scribes and letter-writers lived at Memphis, but others were evidently residents of Pa-Rameses. We must not forget, however, that there were three towns of this name†, and possibly more than three. It is therefore just as likely that the foregoing allusions may have been made with reference to a Pa-Rameses not identical with the Pa-Rameses which was built by the Hebrews. When, however, we turn to the evidence of the Anastasi papyri, we at once tread on surer ground. Here is a curious descriptive fragment, of which we possess two copies, in the above collection:—

"His Majesty has built himself a Bekhen, the name of which is Aa nekht. Its station is between Zahi (Palestine) and Egypt. It is provisioned with all kinds of delicious food. It is planned like Hermonthis (Erment). It is stable as Memphis. The sun rises and sets upon its double horizon. All men hasten to remove from their own cities, that they may live within its boundaries; having the Abode of Amen[1] in the west, the abode of Sutekh[2] in the south, Astarte[3] in the east, and Ouadji[4] in the North. The Bekhen is as the double horizon of heaven, Rameses Mer-Amen is its God," &c.

The word *Bekhen* is of frequent occurrence in the papyri. Its meaning is somewhat vague, but in its ordinary occupation it would seem to be a military store-house and stronghold; a place where provisions and arms might be kept in readiness, and where booty might be conveniently deposited. In this sense it answers with peculiar fitness to the Hebrew עָרֵי מִסְכְּנוֹת translated "treasure-cities." Professor Maspero renders "*Bekhen*" by "villa"; meaning thereby a sumptuous royal residence including temples, barracks, and all kinds of buildings, like the villas of the Roman Emperors. In this sense, a *Bekhen* of the extent and splendour above described may well be translated by "villa." All *Bekhennu*, however, were not fortresses,

* Translated for the first time completely, by M. E. Naville, in "Records of the Past," Vol. XII. The same inscription with a few [illegible] was appropriated to his own honour by [illegible] II[illegible], and is sculptured on one of the pylons of the Temple of Medinet Habou, built by that Pharaoh.

* Mer-Amen (beloved of Amen) is an integral part of the name of Rameses II. Its addition here in no wise affects the identity of the name of the town. "Pa-Rameses Mer-Amen" would, in fact, be more correct than "Pa-Rameses." It was also sometimes called Pa-Rameses Aaneckht, or the town of Rameses the Victorious.

† See Knowledge, No. 44, p. 229.

1. *Amen*, the great God of The Thebaid. 2. *Sutekh*, the God of the Hykshos and Hittites. 3. Astarte, a Sidonian Goddess admitted into the Egyptian Pantheon. 4. Ouadji, the Goddess of the North.

or palaces, or temples; and, as M. Chabas has pointed out, the name *Bekhen* is sometimes applied to the dwellings of private persons.

Although the *Bekhen* of the present papyrus is not actually called Pa-Rameses, we are told that its name was Aa-nekht, and Aa-nekht was the secondary name of Pa-Rameses (see preceding footnote). Also, it was a new *Bekhen*, which his majesty had "built for himself"; and it was stationed between Egypt and Palestine, which was the precise position of the Land of Goshen; and Rameses Mer-Amen was "its God." Here, again, we have all the conditions necessary to the identification of the *Bekhen* Aanekht with the Pa-Rameses of the Aboo Simbel inscription, as well as with the "Raamses" of the Bible.

The following description of Pa-Rameses (evidently the same Pa-Rameses) is from the pen of the scribe Amen-em-apt, who writes to the scribe Panbesa, announcing the arrival of the Pharaoh, Menephthah, then travelling in Lower Egypt:—

"Lo, here is one shall bring to thee this writing of cadenced words. When thou receivest my letter, see that thou takest 50 bronze outen*—or rather 100 outen—from the hand of the scribe Ra-aii for the use of the servitors in the divine abode (Temple) of Rameses Mer-Amen. . . . . See that thou do it quickly, for behold Ba-en-ra Meramen (Menephthah) to whom be life, health and strength, comes this way towards his birthplace in Heliopolis. . . . . Oh, very bright is the day of Thy coming† ! Oh, sweet is Thy voice in speech ! It is Thou who has enclosed Pa-Rameses with a wall—the frontier of the land of the foreigner; the boundary of Egypt, Oh, gracious Lord ! the beautiful outpost; the tower adorned with lapis and turquoise; the exercise-ground of the cavalry; the parade-ground of the archers; the landing-place of Thy maritime auxiliaries who bring Thee tribute ! Praises be to Thee who comest with thy warriors discharging poisoned and burning arrows! The Shasu (Bedaween) flee when they behold the Pharaoh," &c.

In this extract, the points to be especially noted are, firstly, the allusion to the Temple of the deceased Pharaoh, Rameses, deified; secondly, the fact that this Pa-Rameses is a frontier place on the side of the Shasu, or Bedaween Arabs; thirdly, that it was a place of communication by water with the sea, and that the maritime auxiliaries came thither in their galleys; fourthly, that it had been enclosed in a wall of circuit by the reigning Pharaoh, Menephthah Ba-en-Ra Mer Amen, son and successor of Rameses II. This last, as we shall hereafter see, is a point of much importance.

THE statistics of longevity in Prussia are striking. In December, 1880, there were living 359 persons who were at least 100 years old, 128 of them being men and 231 women. Of the men, 32 were still married; of the women, five were. Twelve of the men had never married and nine of the women never had. Of persons born between 1781 and 1790, 5,355 were still living, the men being 2,025 in number and the women 3,330. The records further show that the number of persons born in the last century and still living—those, therefore, who were at least eighty years of age—reached a total of 77,668.

* The ancient Egyptians had various metallic substitutes for coin, which were used as conventional signs of exchange. The bronze outen weighed 91 grammes. The subject of later Egyptian moneys of the Ptolemaic period has been learnedly and exhaustively treated by M. Revillout, in his "Chrestomathie Démotique;" so solving many problems that have long baffled both Egyptologists and numismatists.

† The scribe here breaks into an effusion addressed to Menephthah. This change of tense is common in Egyptian texts.

THE RAIN-BAND.*

BY C. PIAZZI SMYTH, ASTRONOMER ROYAL FOR SCOTLAND.

WHAT may be done with the spectroscope in the matter of weather is, for the present at least, confined almost entirely to the question of rain—as, Will it rain, or will it not; and, if it will, heavily or lightly? The manner in which the spectroscope accomplishes this useful part is by its capacity for showing whether there is more or less than the usual quantity of watery vapour permeating the otherwise dry gases in the upper parts of the atmosphere, this watery vapour not being by any means the visible clouds themselves, but the invisible water-gas out of which they have to be formed, and by means of which, when overabundant, they obtain their privilege for enacting rainfall. So that never were wiser words uttered and more terse philosophy than those which are to be found in the ancient Book of Job, wherein, of the wondrously "balanced clouds" high up in mid-air, it is said, "They pour down rain according to the vapour thereof."

More or less of this water-vapour is always in the air, even on the very clearest days, and a happy thing for men that it is so; for, as Dr. Tyndall and others have well shown, it moderates the excesses of hot solar radiation by day and cold radiation of the sky at night, and is more abundant in the hotter than the colder parts of the earth. Wherefore, according largely to its temperature for the time being, the air—otherwise consisting almost entirely of nitrogen and oxygen—can sustain, and does assimilate, as it were, a specified amount of this watery vapour, invisibly to the naked eye, the microscope, or the telescope; but not so to the instrument of recent times, the spectroscope. And if the air vertically above any one place becomes presently charged with more than its usual dose of such transparent watery vapour (as it easily may, by various modes and processes of nature), the spectroscope shows that fact immediately, even while the sky is still blue; clouds soon after form, or thicken if already formed, and rain presently begins to descend.

But how does the spectroscope show to the eye what is declared to be invisible in all ordinary optical instruments? It is partly by its power of discriminating the differently-coloured rays of which white light is made up, and partly by the quality impressed on the molecules of water at their primaeval creation, but only recently discovered, of stopping out certain of those rays so discriminated and placed in a rainbow-coloured order by the prism and slit of the spectroscope, but transmitting others freely. Hence it is that, on looking at the light of the sky through any properly-adjusted spectroscope, we see, besides the Newtonian series of colours from red to violet, and besides all the thin, dark Fraunhofer, or solar originated lines, of which it is not my object now to speak, we see, I say, in one very definite part—viz., between the orange and yellow of that row of colours, or "spectrum," as it is called—a dark, hazy band stretching across it. That is the chief band of watery vapour, and to see it very dark, even black, do not look at a dark part of the sky or at black clouds therein, but look, rather, where the sky is brightest, fullest of light to the naked eye, and where you can see through the greatest length of such well-illumined air, at a low, rather than high, angle of altitude, and either in warm weather, or above all, just before a heavy rainfall, when there is and must be an extra supply of watery vapour in the atmosphere. Any extreme darkness, therefore, seen in that water-

* From the *Times*.

…our band beyond what is usual for the season of the year and the latitude of the place is an indication of rain-material accumulating abnormally; while, on the other hand, any notable deficiency in the darkness of it, other circumstances being the same, gives probability of dry weather, or absence of rain for very want of material to make it; and the band has, therefore, been called, shortly, "the rain-band." Thus, also, "rain-band spectroscopes" have been specially constructed by several most expert opticians in size so small as to be carriable in the waistcoat pocket, but so powerful and true that a glance of two seconds' duration through one of them suffices to tell an experienced observer the general condition of the whole atmosphere. Especially, too, of the upper parts of it, where any changes —as they take place there almost invariably earlier than below—enable such an observer to favour his friends around him with a prevision of what they are likely soon to experience.

As an example of what may be done, and done easily, after a certain amount of experience and understanding of the subject has been acquired, I append, from a lady's meteorological journal, her notes of the mean temperature of the air and the intensity of the rain-band for each of the first fifteen days of the present month; and in a final column have entered the amount of rainfall measured at the Royal Observatory, Edinburgh, on each of those days. The darker the rain-band the larger is the figure set down for it; and it will be seen pretty plainly, on running the eye down that column and the next one, that with an intensity of either 0 or 1 no rain follows, or, we might almost say, can follow; but with an intensity of 2 rainfall begins, and with 3 it may be very heavy. All these rain band notes have been made with a spectroscope no larger than one's little finger, purchased some six years ago, and taken on many voyages and travels since then:—

Date, September, 1882.	Mean Temperature of the air. Deg. Fahr.	Rain-band intensity.	Depth of Rain measured in gauge at Royal Observatory, Edinburgh. Inch.
Friday, 1	57·1	3	·011
Saturday, 2	59·2	2	·353
Sunday, 3	58·6	2	·015
Monday, 4	54·4	0	0
Tuesday, 5	55·7	1	0
Wednesday, 6	55·2	0	0
Thursday, 7	53·8	1	0
Friday, 8	59·1	0	0
Saturday, 9	54·0	1	0
Sunday, 10	57·0	1	0
Monday, 11	52·2	1	·010
Tuesday, 12	48·6	0	0
Wednesday, 13	52·8	1	0
Thursday, 14	49·5	3	·62
Friday, 15	56·2	2	·570

(To be continued.)

HIGH TIDES.

MR. JAS PEARSON, M.A. (author of an excellent treatise on the Tides), writes as follows to the *Times*:—The spring tides of March and September always rise considerably higher than those in any other months of the year, but it is only when a combination of astronomical and atmospheric circumstances favours their development that their effects become remarkable. The magnitude of the lunar and solar attractions on the ocean is a matter of accurate prediction; the disturbing influence of the atmospheric pressure, both as regards direction and magnitude, is fickle and uncertain from year to year. It so happens that at the end of the present month—*i.e.*, on Tuesday, Wednesday, Thursday, and Friday in next week —each of the constituent forces by which the tides are generated is at its *maximum*, or very nearly so; it depends entirely on the weather how far their effects may be augmented. But there is this to be noticed, that the night tides considerably exceed the day tides by reason of what is technically called the "diurnal inequality." The explanation of this inequality has up to the present time been a difficulty, and even now the latest interpretation of it has not been generally published. Old-fashioned observers used to say that its periodicity coincided with that of "the dews," and they supposed the two classes of phenomena were in some way connected. Nothing, of course, could be more foolish than such an idea. The "diurnal inequality" of the tides can be most satisfactorily accounted for. Although to an ordinary observer the day and night tides seem to approach our shores under precisely similar conditions, yet, in reality, neither in their course of travel nor in their mode of production do they exactly resemble each other.

The largest tide has its magnitude augmented by the fact that the crest of the tide-wave which follows the moon travels daily from the Southern to the Northern Hemisphere in a direction most nearly coincident with that of the great expanse of water in the Atlantic Ocean over which it passes; the smaller tide has its magnitude diminished not only because it is due to the action of the moon on that side of the earth most remote from it, but more than all because its course is partly diagonal to that of the former, the tide-wave crossing the Atlantic, roughly speaking, in the direction of its breadth, while in the other case it crosses in the direction of its length.

Computation gives the following as the heights of the tides at Liverpool on the before-mentioned days:—Tuesday: day tide, 27 ft. 3 in.; night tide, 29 ft. 1 in.; Wednesday: day tide, 28 ft. 6 in.; night tide, 30 ft. 2 in. Thursday: day tide, 29 ft. 2 in.; night tide, 30 ft. 4 in. Friday: day tide, 29 ft.; night tide, 29 ft. 5 in.; 8 ft. 6 in. to be subtracted for height above Old Dock-sill at George's Pier.—Yours, &c., JAMES PEARSON, M.A., F.R.A.S.

Fleetwood Vicarage.

WHO DISCOVERED THE DIVISION IN SATURN'S RING?

THE real historical importance of the subject of this letter must be accepted as my excuse for an intrusion into your already terribly overcrowded columns.

On p. 217 of Breen's "Planetary Worlds," the author says: "Shortly after this discovery a division in the ring was detected by the English observer Ball; and Huyghens was written to in 1665 by Wallis to direct his attention to the anses (*sic*) or ring, and to see "whether he there meets with nothing that may make him think that it is not one body of a circular figure that embraces his disc, but two?"* Can any one of my brother readers of KNOWLEDGE tell me where this letter of Wallis's is to be found? My reason for inquiring is this, that during a recent very interesting discussion with my friend Mr. C. Leeson

[* It seems to me, by the way, quite possible that Wallis here referred to two bodies on opposite sides of the ball, not to two concentric rings. Ball's picture shows nothing of the latter sort; yet seems somehow to have been regarded *at the time* as agreeing with Wallis's idea; whence possibly, *later*, when that idea was misunderstood, the mistake as to Ball's observation. The inquiry is interesting.—ED.]

STARS FOR OCTOBER

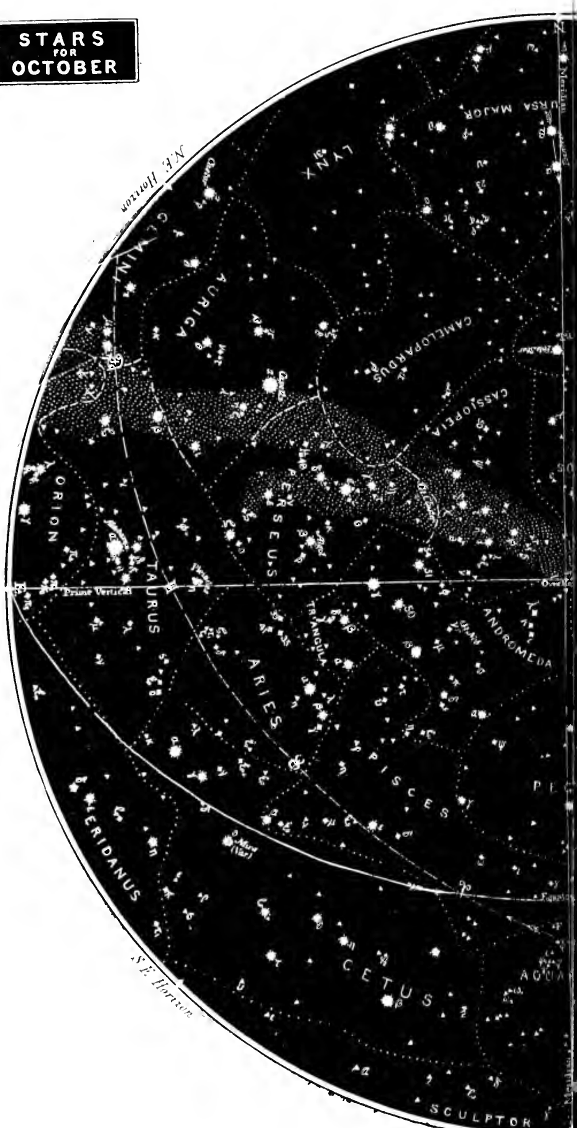
[illegible] Star Maps.—The circular boundary [illegible] represents the horizon. The [illegible] shows also the position of the equator [illegible] that portion of the Zodiac now most [illegible] situated for observation. The [illegible] of ninety nine stars of the first three [illegible] are given below.

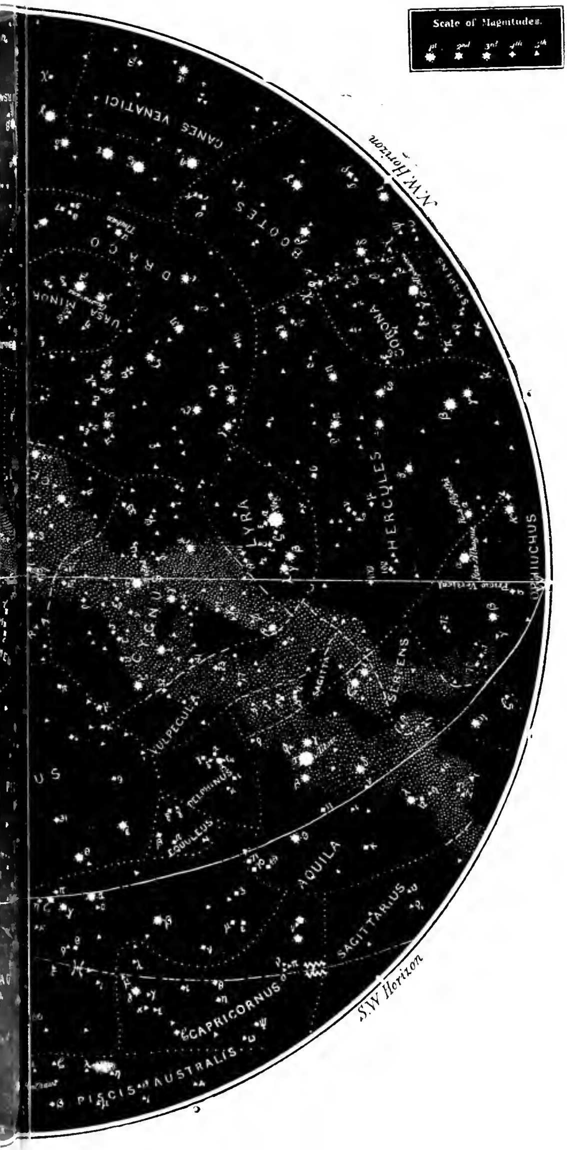
On Sept. 29, at 10.30 p.m.
On Oct. [illegible], at 10.15 p.m.
On Oct. [illegible], at 10.0 p.m.
On Oct. [illegible], at 9.45 p.m.
On Oct. 1[illegible], at 9.30 p.m.
On Oct. 1[illegible], at 9.15 p.m.
On Oct. 21, at 9.0 p.m.
On Oct. 25, at 8.45 p.m.
On Oct. 29, at 8.30 p.m.

ARABIC NAMES OF STARS

The following table exhibits the names of all the stars of the first three magnitudes whose names are in common use.

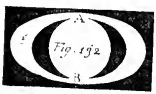
α A[illegible]	[illegible]
β ———	[illegible]
γ ———	Almach
α A[illegible]	[illegible]
β ———	[illegible]
γ ———	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]





α Cassiopeiæ	...	... *Schedar*
β ———	...	... *Chaph*
α Cephei	...	... *Alderamin*
β ———	...	... *Alphirk*
γ ———	...	... *Errai*
α Ceti	...	... *Menkar*
β ———	...	... *Diphda*
ζ ———	...	... *Baten Kaitos*
ο ———	...	... *Mira*
α Columbæ	...	... *Phact*
α Coronæ Borealis		... *Alphecca*
α Corvi	...	... *Alchiba*
δ ———	...	... *Algores*
α Crateris	...	... *Alkes*
α Cygni	...	... *Arided, Deneb Adige*
β ———	...	... *Albireo*
α Draconis	...	... *Thuban*
β ———	...	... *Alwaid*
γ ———	...	... *Etanin*
β Eridani	...	... *Cursa*
γ ———	..	... *Zaurac*
α Geminorum	...	... *Castor*
β ———	.	... *Pollux*
γ ———	...	... *Alhena*
δ ———	...	... *Wasat*
ε ———	...	... *Mebsuta*
α Herculis	...	... *Ras Algethi*
β ———	...	... *Korneforos*
α Hydræ	...	... *Alphard, Cor Hydræ*
α Leonis	...	... *Regulus, Cor Leonis*
β ———	...	... *Deneb Aleet, Denebola, Deneb*
γ ———	...	... *Algeiba*
δ ———	. .	... *Zosma*
α Leporis	...	... *Arneb*
α Libræ	...	. *Zuben el Genubi*
β ———		. *Zuben el Chamali*
γ ———	. .	... *Zuben Hakrabi*
α Lyræ	...	.. *Vega*
β ———	...	... *Sheliak*
γ ———	...	... *Sulaphat*
α Ophiuchi	...	... *Ras Alhague*
β ———	...	... *Cebalrai*
α Orionis	...	... *Betelgeux*
β ———	..	... *Rigel*
γ ———	..	.. *Bellatrix*
δ ———	.	.. *Mintaka*
ε ———	.	. *Alnilam*
α Pegasi	.	. . *Markab*
β ———	.	. . *Scheat*
γ ———	.	. *Algenib*
ε ———	.	. . *Enif*
ζ ———	.	. *Homan*
α Persei	.	. . *Mirfak*
β ———	..	*Algol*
α Piscis Australis		*Fomalhaut*
ε Sagittarii	.	*Kaus Australis*
α Scorpionis		*Antares, Cor Scorpionis*
α Serpentis		. . *Unukalhai*
α Tauri		. . *Aldebaran*
β ———		. *Nath*
η ———		*Alcyone* (Pleiad)
α Ursæ Majoris		. *Dubhe*
β ———	..	*Merak*
γ ———	.	*Phecda*
ε ———		. . *Alioth*
ζ ———	.	*Mizar*
η ———		*Alkaid, Benetnasch*
ι ———		*Ta'lita*
α Ursæ Minoris		*Polaris*
β ———		*Kochab*
α Virginis	.	*Spica Azimech, Spica*
β		*Zavijava*
ε ———		*Vindemiatrix*

Prince, F.R.A.S., on the subject of Saturn's ring, I have been induced to examine into the evidence which exists as to the personality of the observer who first saw it divided into two concentric ones. On p. 49 of the first edition of your own "Saturn," Sir, I find you saying that "in 1665 William Ball discovered a black stripe of considerable breadth, running quite round the northern surface of the ring, and having its outer and inner edges concentric with the ring." Going back, I find Mr. Hind, in his "Solar System" (published in 1852), p. 105, attributing this discovery to William Ball and his brother Dr. Ball; and prior to this again the late Admiral Smyth stating the same thing as to the two brothers seeing it, in vol. i. p. 51, of his "Celestial Cycle" (the "Prolegomena"). Now, I fancy that I have succeeded in tracing the (at all events, modern) authority for this, in that wonderful farrago, Kitchiner on Telescopes. On p. 354 of that work the "Cook's Oracle" thus delivers himself: "The earliest account which I have met with of an observation of the Division in Saturn's Ring is in the *Phil. Trans.* for 1666, by Mr. Wm. and Dr. Ball, on October the 13th, 1665, at 6 o'clock, with a very good telescope, near 38 feet long, and a double eye-glass. This observation has induced the supposition that Saturn is surrounded not by *one* circular body or ring only, but by *two*." I would ask the reader to note carefully the verbal correspondence between this concluding sentence and that alleged by Breen to have been used by Wallis in his letter to Huyghens of the same year. Well, naturally, the first thing Mr. Prince and I did was to refer to the *Philosophical Transactions* for 1666, and, on doing so, I found to my great astonishment that everything that appeared there on the subject was a communication from Mr. William Ball, of Mainhead, which I here reproduce *verbatim et literatim*. "LXXVII Oct. 13, 1665, at six of the clock, with a very good telescope near 38 foot long and a double eye-glass, *Saturn* appeared to me somewhat otherwise than I expected, thinking it would have been decreasing, but I found it as full as ever, and a little hollow above and below (Plate 3, Vol. I., Fig. 132)."



I append a facsimile of the engraving which illustrates this bald and meagre statement. Not one word about the "Dr." Ball who appears in the later narratives, nor of the "two bodies of circular figure that embrace the planet's disc." Nay, in the illustrative drawing not a vestige of an indication of division in the ring! It is, of course, possible that Wallis (who, as is well known, was the Savilian Professor of Geometry at Oxford, and was one of the founders of the Royal Society) may have been in communication with the brothers Ball on the subject of their observation, and may so have learned orally what induced him to write and question Huyghens; but certainly nothing in William Ball's printed observation could have justified Wallis's question. This is why I am curious to learn whether Wallis's letter to Huygens is still extant, and, if so, where it is to be found. At present the evidence connecting Ball with the original discovery of the division in Saturn's ring seems to me to be of the most slender kind possible.

Forest Lodge, Maresfield, Uckfield. — William Noble.

ANIMALS IN NORWAY.

A CORRESPONDENT of the *Times* (A.G.B.K.), makes the following remarks on a very pleasant feature of the Norwegian character, viz., kindness to domestic animals. "In that country," he says, "these animals are treated as the friends rather than the slaves of man. As a result, vicious horses are unknown; foals follow their dams at work in the fields or on the road as soon as they have sufficient strength, and thus gently accustom themselves to harness. I heard of a foal trying to force its head into a collar in imitation of its mother. Horses are trained to obey the voice rather than the hand, bearing-reins are not used, and the whip, if carried at all, is hardly ever made use of. Great care is taken not to overload carts, especially in the case of young horses, and consequently a broken knee is rarely seen, and the animals continue fat, in good condition, and capable of work till the advanced age of 25 or 30. So tame are the Norwegian horses and cows that they will allow casual passers-by to caress them while they are lying down. Even domestic cats will approach a boy with confidence, knowing that no chasing or worrying awaits them. One very hot summer's day I met a woman holding up an umbrella to carefully screen what I supposed was a little child at her side from the scorching rays of a mid-day sun, while her own head was covered only by a handkerchief. In driving by I tried to gain a glimpse of her charge, and found, to my great surprise, that the object of her care was a fat, black pig. The question of humane methods of slaughtering animals has lately been prominently brought forward in England. In this the Norwegians show us a good example; they never use the knife without first stunning the animal. In the above remarks I am alluding to the country districts of Norway; in the towns the national characteristics become modified, although even under these conditions kindness to animals is still remarkable.

To those whose hearts are sickened by the sights of cruelty daily witnessed in our streets it must be a consolation to learn that a country exists where these things are unknown, where men are instinctively considerate to the animals dependent on them, and where no legislation is required to enforce the claims of the dumb creation.

THE ENDOWMENT OF RESEARCH.

A DISCUSSION took place on this subject on the second day of the Social Science Congress in the Department for Education. The general feeling seemed to be against those special forms of endowment which have been advocated by certain *now* tolerably active workers. The discussion is thus reported in the *Times*:—

Mr. Rowland Hamilton, hon. secretary of the Department, introducing the question from the general educational standpoint which it had always been the object of the department to maintain, inquired (1) into the relation which the prosecution of research bears to our national system; (2) how it may affect and be affected by the efforts now made to extend general culture; and (3) into its claims on our national resources. In the early stages of training the methods which conduce most to insure sound teaching are the same as those which will best qualify pupils in after life to take their part in such work as that of original investigation, and the endowment of research should not trench upon the means devoted to thorough liberal education in any of its branches. The advantages which the introduction of scientific method should afford to our educational system will be amply repaid by the increased number and efficiency of those who will hereafter be able to take part in scientific work and an intelligent and practical interest in its progress. The educational uses of scientific teaching have yet to be fully considered, and we might reap them by the endowment of one or more professorships, round which the experiences of many who are interested in this important branch of the subject might concentrate, alike to the advantage of "liberal" culture and of more special training for the labours of research. As to the endowment of the more special forms of research as more commonly understood, there is hardly any limit which it is desirable to assign to it, provided due assurance is given that the work desired is efficiently carried out. The services thus rendered are pre-eminently of general and national importance, and must be provided for by national expenditure. The economic doctrine of supply and demand as regards the interchange of individual services is wholly inapplicable to the question. The difficulty lies in the administration of the funds devoted to such purposes, so as to insure that they are given to those duly qualified to use them. The method of State grants in aid, dispensed through the agency of existing societies and learned bodies who have earned a title to public confidence, might be largely developed with the greatest advantage, and the relative functions of the Government and of such societies in their relation to this subject were discussed. The multiplication of "idle fellowships" had a demoralising tendency. While any undue interference on the part of the central administration was to be altogether deprecated, it was essential to reserve to the State an ultimate and *quasi* judicial control, which would best secure that publicity and definite responsibility which are the best safeguards against abuses in any direction.

Mr. Cooke Taylor, who opened the discussion, said this was an age of investigations. He was not much in favour of the endowment of research, but if they were to have it, it should be upon the lines laid down by Lord Bacon in his "New Atlantis."

The Rev. J. F. M'Callan, one of the local secretaries, believed that discovery was promoted not by endowment, but by enthusiasm. In his opinion, the endowment of research would be merely making a perch for active men to go to sleep upon, and would not promote investigation in any special way.

The Rev. J. Bevan thought a good deal might be done by private enterprise.

Mr. Walter Wren (London) said that rewards ought to be given for something done, and not payment for something to be done. He regarded this agitation for the endowment of research as a new form of alms-begging or charity hunting. By endowments they would be simply opening the door to jobbery on a most gigantic scale.

After some further discussion,

Mr. Hamilton replied. He said he entirely agreed with Mr. M'Callan and Mr. Wren with regard to what was called the abuse of the endowment of research. By the endowment he simply meant that those who were engaged in research should, upon due proof that they were so engaged, be exempt from carking cares and difficulties. People could not live upon nothing, and there was no doubt that at present any object of research must be investigated by people of independent means. He thought it would be well that means should be provided so that those engaged in research might obtain assistance without feeling under a personal obligation to anyone.

Reviews.

A SCHOOL BOOK ON HEAT.*

It is singular how few of those who are not actually students of physics have any clear idea of the nature of heat, the laws of its reception, transmission, and radiation. The most absurd mistakes are made on these subjects when any simple phenomenon of heat is familiarly discussed. As the phenomena of heat are the most common of all those which ordinary life brings into our notice, they might well be studied in our schools, instead of some of those preposterous subjects which the folly of the fifteenth century set as the chief matters for school-training, and the stupidity of the nineteenth persists in retaining. If the wiser of the earlier period had selected subjects for study, or if the more sensible of our own day had their way, our children would not be obliged to learn a number of matters of no earthly use to most of them while subjects which actually include the very laws of their existence are utterly neglected. A bright boy of fourteen shall repeat for you glibly, in Latin, the rules of Greek syntax or prosody, and translate a page of some more or less offensive poetry about the loves of gods and goddesses; and when he is forty he will positively remember enough of his classical lore to know the origin of most of those English words which have been derived from Latin or Greek (which knowledge might all have been obtained in the compass of a week at the outside). But ask him how exercise makes him warm? why flannel is good for his cricket suit on a hot summer's day, and also for his football suit in winter? why his breath forms a visible cloud on a cold day and not on a hot one? or any simple question of this sort, and the chances are (even now, when physical science is supposed to be taught in our schools) that he will be all at sea.

Among the adult, ignorance about the laws of heat is still more common and still more surprising. For a boy cannot be expected to learn what no one cares to teach him; and if he finds that he cannot gain credit and prizes without being able to write Latin verses or to show that triangles are to each other in the duplicate ratio of their homologous sides, he will give all his studying time to these things, just as he would give it to the study of chess or whist if proficiency in these pursuits were made (as it might as wisely be) the test of progress. But that persons who have leisure for study should remain absolutely ignorant of such subjects as the laws of heat, light, and so forth, laws relating to phenomena constantly occurring, is less easily explained, unless it be regarded as the result of a carefully instilled feeling of disregard for all that takes place around them.

Yet our own experience shows us that many who obviously know little would like to know a great deal about such matters. We receive multitudes of letters showing that though the writers may not know the difference between conduction and convection, or may regard specific heat as some special kind of heat (like obscure heat, for instance), while the mechanical theory of heat is obscurer to them than a half obliterated manuscript in Goojurattee Indian, they are very anxious to learn what science has to say on these subjects.

To all such we very strongly recommend Mr. Larden's excellent book on Heat. It is intended as a text-book for use in our public schools; but (while admirably suited for that purpose) it should be read by all who wish to have

* *A School Course on Heat.* By W. Larden, M.A., Assistant-Master in Cheltenham College. (Sampson Low, Marston, & Co., London.)

clear ideas about the physics of heat as at present understood. Mr. Lardner assumes that the reader of the book has no previous knowledge of physical science at all. His explanations, therefore, are at first very elementary in character. Farther on, as the reader gradually becomes familiar with his subject, they become more succinct. The mathematical parts require no very profound study of mathematics, and are very clearly, yet satisfactorily, dealt with. (The general reader, even if he has enough mathematical knowledge to master these portions easily, can pass lightly over them, content to recognise the principles on which calculation is based, without wasting his time in testing their accuracy.) The questions and examples given at the end of each chapter are excellent. We have been particularly struck by the completeness of the treatment of the various subjects: just, too, where difficulties are likely to occur, they are referred to, and removed. The illustrations throughout are excellent.

There are a few slight errors here and there. For instance, at p. 8, "the end C" of a tube is mentioned, though it has no existence in the figure; on page 204, we find specific heats C_1 and C_2, instead of c_1 and c_2; and so forth. But the work contains so much, that the wonder rather is that there are not more mistakes of this kind. Among errors of a different sort may be mentioned the statement that astronomers believe the sun's heat to be maintained by the downfall of bodies which had been travelling around the sun, and the remark that the planets are known to be slowly but surely closing in towards the sun. (There is a footnote on the same page—288—referring to Dr. Siemens's theory, which has been unanimously rejected, or neglected as not needing rejection, by all who are competent to form an opinion upon it.) Our author's remarks on the tides also, are open to misconception, where he speaks of the earth "in its daily revolution sweeping through the protuberance of water due to the moon's attraction."

But these faults are slight and easily corrected in later editions of the work. They detract scarce perceptibly from the great value of this thoroughly excellent and honest book, every page of which shows signs of careful study to make matters clear and simple to the reader. The contrast between this book and some of the trashy text-books of science which are finding their way into use is most marked. The latter part of the work is naturally the most interesting, as there is less occasion for explanation of general principles. The chapters on Radiation, the Mechanical Theory of Heat, and Heat Engines, ought to be as interesting as a well-written story to an intelligent learner.

BIBLE ENGLISH.*

MR. WASHINGTON MOON is the self-appointed guardian of the English language. Ever since he sat in judgment on "The Queen's English" in "The Dean's English," and was commended by those rather questionable judges, "the young buccaneers of the press," he has missed no opportunity to exhibit his logical precision, his acumen in detecting faults, and his familiarity with Lindley Murray. He not only points out errors in the writings of all our best authors, but when those among the living ones who think it worth while, defend themselves, he shows them how their defence ought to have been worded. In the work before us he "presumes," he says, "to take upon himself" the "consideration of the revised New Testament regarded grammatically."

* "The Revisers' English," by G. WASHINGTON MOON, F.R.S.L., author of "The Dean's English." (London: Hatchard's.)

We do not know Mr. Moon personally; but we should imagine he must be a troublesome person to converse with. If not, his works belie him. We picture him speaking—in the ordinary converse of life—somewhat as in the following imaginary scene:—

TRAVELLER (meeting Mr. Moon).—Can you tell me, sir, where this road goes?

MR. MOON (*aside*).—He should have said, "If you can, *will* you tell me?" (*Aloud.*) Sir, the road does not go anywhere, it remains always here.

TRAVELLER.—Pardon me. I should have said, "Where does this road lead?"

MR. MOON.—To lead, sir, is to go before—to guide (*vide* Webster, Worcester, and Walker, especially Walker). The road cannot go before you.

TRAVELLER.—I perceive, sir, you are precise. I want to know where I shall arrive if I follow this road?

MR. MOON.—You cannot follow that which is at rest, for the word *follow*——

TRAVELLER.—Excuse me, my time is limited. Where shall I arrive if I travel on this road?

MR. MOON. Your query is wanting in precision. Where you arrive will depend principally on the duration of your progression.

TRAVELLER (*after a pause*). Supposing I should walk upon this road, at a rate of, say, four miles per hour, during, let us suppose, two hours, what are the various places through or near which my walk will bring me?

MR. MOON. This is very painful. There are no less than seven mistakes of the most glaring kind in the sentence you have just spoken. Your use of the word "supposing" is quite inaccurate. Who are supposing? Then, having already used the word once, you should not have used it again in the same sentence. Again, what does "say" mean? Also, why use the Latin word *per*, when "in an" would have served your purpose? You speak of *various* places. But the word various, so used, is quite unmeaning. If it were not redundant it would be incorrect, for the word various implies that the objects to which it is applied vary from each other. Now, the places through which you have to pass may, for aught you know, be precisely alike. Further, you should not have said "my walk," but "my walking." The word "bring," also, is inappropriate. I will go home and write an essay on each of the questions which I have raised respecting your incorrect language; and——

TRAVELLER. In the meantime, will you kindly tell me what I want to know?

MR. MOON (*aside*.) He does not mean "in the meantime," but *before that*. (*Aloud.*) No, sir; that is what *you* should tell *me*. Not to speak of telling you, how can I even *learn* what you want to know, when you fail to express yourself in terms at once clear and accurate. Permit me to quote for your edification a passage from the preface to my treatise on the "Revisers' English." "The mind which allows itself complacently to delight"—

TRAVELLER. How about tautology? [*He goes upon his way.*

MR. MOON. (*Aside*. A most inexact expression!) Understand, sir, that in what I write no one has ever yet detected imperfections—"complacently to delight," I say (*raising his voice*) "in anything below the highest standard of excellence, is thereby dwarfing its faculties; for (*louder*) we become assimilated to that which we worship, and (*shouting*) we are ennobled or debased by the influence of that upon which our minds dwell with satisfaction." He is beyond hearing; I will write a series of letters for *Public Opinion*, and point out his multitudinous errors. I *will* be heard; he shall (Saxon, *scealan*) listen to me.

In this spirit Mr. Moon has revised the revisers' English. We do not much admire the revised version of the New Testament. Its authors set themselves an impossible task. They proposed to correct the faults of translation in the Authorised Version, to retain as much as possible of its antique style, to adhere to English idioms, and to write what all should understand. The result is a singular conglomeration of tautology, Greek idiom, obsolete expressions, and commonplace language.

In all former attempts to translate the Bible, the language of the time was adopted, and thus each translation not only expressed the ideas of the Bible writers in such language as men commonly employed, but left to future ages a record of the language in each successive stage of its development. Our revisers have been afraid to attempt this. As priests wear garments which were fashionable several generations ago, and as in former times flint implements were used in sacred offices to do what for ordinary purposes was done with instruments of steel or iron, so now archaic forms of expression seem to be regarded as essential in religious books. One wonders whether faith has become so weak that the Bible would not bear translation into the language used by the prose writers of the present day.

The difficulties which the revisers thus created for themselves have naturally led to faults of execution, and on such faults Mr. Moon has pounced with characteristic delight. Where the revisers have very carefully followed the text, they scarcely write English, though they have adopted as a principle that the idiom of our language should not be violated by forms of expression which it cannot bear. But Mr. Moon, in his anxiety to do battle, charges recklessly on perfectly defensible positions. For instance, he adopts as a principle that a verb must be plural when it relates to several substantives; and he will not hear of any objections to this principle, based on the practice of our best writers and speakers. But, as a matter of fact, the question whether the principle is sound or not depends entirely on the practice of writers and speakers. The Greek language is logical, so is ours, so is the French; but in the Greek Mr. Moon's principle has no existence, whereas in French it rules absolutely. Whether it exists in English or not, depends on the practice of our best writers in use,

Quem penes arbitrium est, et jus et norma loquendi.

(A line, which, by the-way, illustrates the Latin practice). Now, the English custom in this matter is more nearly akin to the Greek than to the French. We can say either "Thine is the kingdom, and the power, and the glory," or "Thine are the kingdom, the power, and the glory." We cannot say "Thine are the kingdom, and the power, and the glory," for the simple reason that the first "and" indicates the reiteration, in reference to the power, and then to the glory, of that which has already been said about "the kingdom." Mr. Moon, in dealing with this particular example, seems quite unable to see how much stronger is the form actually used for the doxology than that which he would substitute. All good writers know that by the use of the singular in such cases, the word "and" acquires the force of "and also." Mr. Moon would probably answer that in that case, "and also" might with advantage be used instead of "and;" for he appears to have not the slightest conception of the weakness, dulness, and heaviness resulting from the constant use of every word which may be essential to the logical completeness of a sentence. His own writing is ponderous to a degree. He crowds incongruous ideas together in long and involved sentences, the meaning of which can seldom be seen at a first reading. Like all criticasters, he aims at fine writing; but in his attempt to combine glowing description with logical accuracy, he often succeeds only in affording "awful examples," and he is not always even quite so accurate as he might be. Here, for instance, is a sentence of his writing:—

[illegible] the varied themes of the Word of God for the [illegible] utterances of language; and these, bearing those [illegible] through the mighty cathedral of the world, in [illegible] not but thrill with responsive vibrations the [illegible] of its many million worshippers.

This is very fine writing. The "organ-utterances of language" are good: and when you clearly see how these and those are related, you dimly recognise that "these, bearing those, can peal, &c., but whether the many million worshippers (it should be many millions of worshippers), worship the cathedral or the world, or what they worship, is by no means clear. Can Mr. Moon possibly have been afraid to speak of "the many millions who worship in it," because there is a rule which very much troubles weak writers (and a very silly rule it is) that a sentence should not end with small words, prepositions, or pronouns?

It would be well if one who can write English well—accurately yet without affectation—would try the effect of one of the gospels, or even a chapter of one, in the English of our day.

METACHROMATISM, OR COLOUR CHANGE.

By William Ackroyd.

It is usual for people to regard colour as a fixed quality—a quality which it would be as difficult for a substance to alter as for the Ethiopian to change his skin, or the leopard his spots. This idea of the fixity of colour is, however, easily got rid of. Let the reader by an effort of imagination condense a year into a few moments of time, and let him follow with the mind's eye all the changes in fruit, flower, and foliage. Then will it appear to him that the colour of the landscape is ever changing.

On a very small scale the same changeableness of colour may be shown in the laboratory without any appeal to the imagination. Coloured substances may be made to change from tint to tint while one is looking on.

Take a small fragment of bichrome (potassic dichromate) and put it on a piece of white porcelain; heat it strongly over a spirit lamp, Bunsen burner, or any other clean source of heat, it will then be seen that the bichrome changes its colour from red to dark red. Upon cooling, it regains its original colour. Note well that the cold bichrome was red, and the hot, dark red; in other words, the expanded bichrome was dark red, and the contracted red simply. These facts we may tabulate thus:—

Bichrome

When heated or expanded.	↓	Red Dark red	↑	When cooled or contracted.

The arrows refer to the order of colour change—*e.g.*, when one heats the bichrome it changes in the direction of the left-hand arrow, and when one allows it to cool it changes in the opposite order, as shown by the right-hand arrow.

Now, there are many substances which change their colour when they are heated. Thus, oxide of zinc changes from white to yellow and orange, and porcelain even will change from white to yellow. Chromate of barium changes from yellow to orange; chromate of lead from orange to brick-red and black red; mercuric oxide from orange yellow to orange, red, and brown; and suboxide of copper glass from scarlet to blackish red and black. Colour changing bodies regain their usual colour, as a rule, when they have cooled to their usual temperature, although sometimes the exact shade is not regained, probably from the substance not having fully contracted. We have here cases of inorganic adaptation to environment as striking in their way as those of animals acquiring white coats under the influence of Arctic cold, or of white folks becoming dark skinned under the influence of equatorial heat.

In running over the few examples we have given, it will be perceived that in these colour changes, when a body is being heated, there is a certain order which is invariably followed; thus white substances become yellow, but never red or black, and a red substance may become brown or black, but never white. It will be further noted that in one kind of coloured substances black is the extreme result of heating, and, on the other hand, no amount of cooling will carry a substance beyond whiteness; *i.e.*, a hot orange-coloured body may become yellow when cooled, or even white, but nothing else beyond. If we, therefore, arrange a series of colours with white at one end and black at the other, the intermediate members of the scale being placed in the order in which colour changes are observed to take place in various substances, then we obtain a metachromatic scale. The following is *my* metachromatic scale:—

Heating or expanding.	↑	Black Brown Red Orange Yellow Green Blue White or colourless.	↓	Cooling or contracting.

It appears that another metachromatic scale has been devised besides my own. The two scales are not identical, however, nor does the same meaning appear to be attached to both. Thus the deviser of the scale to which I refer, writes :—" White (as being the combination of all colours) concludes the scale at the limit of expansion, and black (as an absence of light) at that of contraction."* This is the very opposite of anything I have ever taught regarding metachromatism, and from the experimental evidence I have already given, the reader will perceive that it is undoubtedly a mistake.

By spectroscopic examination, I have ascertained that the change of colour in a body upon elevation of its temperature is due to increased absorption of light towards the violet end of the spectrum. A simple experiment suggests itself to me by which the reader may demonstrate this point to his own satisfaction without the spectroscope. A borate of copper bead, as obtained in blow-pipe analysis, is blue when cold and green when hot. Now a transparent yellow substance generally absorbs the violet end of the spectrum as far as the blue border of the green, according to the thickness of the absorbing substance. Treacle is a body of this kind. Take the blue bead and dip it in treacle. Upon taking it out with a thin film of treacle covering it, *it appears green.* In other words, covering the bead with a thin film of a substance absorbing the light of the violet end of the spectrum has the same effect, so far as its appearance goes, as raising the temperature of the bead, and consequently the latter operation increases the bead's absorption of the violet end of the spectrum.

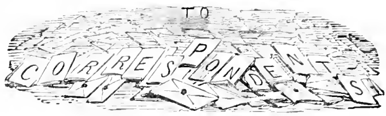
As we have seen, this increase in the absorption of light to which metachromatism is due, culminates in blackness, or what would be termed spectroscopically continuous absorption. At the other end of the scale, one would have a continuous spectrum from the absence of absorption, and between the two extremes, partial absorption. In 1874 Lockyer proposed† five orders of spectra, ranging from the spectroscopic appearances of bodies at ordinary temperatures to the emission spectra of high temperatures. I regard his 3rd, 4th, and 5th orders as misplaced, and would substitute for them the orders I have placed opposite them in the following comparison. The error has evidently arisen from a mixed study of what I have termed transverse and structural absorption effects.‡

ORDERS OF SPECTRA.

After Lockyer.	After Ackroyd.	Metachromatic scale.
1st Order, Line spectra; 2nd Order, Channelled-space spectra	Class I. Radiative.	
	Class II. Absorptive.	
	1. Continuous absorption	Black.
3rd Order, Continuous absorption at the blue end; 4th Order, Continuous absorption at the red end.	2. Partial absorption—*i.e.*, absorption at the blue and red ends, or at any intermediate part of the spectrum	Brown. Red. Orange. Yellow. Green. Blue.
5th Order, Unique continuous absorption	3. Continuous spectrum	White.

Space will not allow of my going into the theory of metachromatism, and I would add, in conclusion, that those readers who are interested in its biological applications may consult the "Proceedings of the British Association for 1877," pp. 100-1, and "Science for All," vol. i., pp. 251-56.

* *Chemical News*, Sept. 8, 1876, p. 109.
† "Proceedings of the Royal Society," June 11, 1874.
‡ *Phil. Mag.* for December, 1876.



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

*** *All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

CONSUMPTION FROM STAYS.

[576]—It appears to me that in his haste to denounce the editor of Knowledge (560), E. H. has omitted to read, with any care, my remarks of June 23 (431), which are the ostensible cause of his letter. I was well aware that, according to statistics, consumption was commoner among men than women, but I cannot see that I say in that letter that stays produce lung disease directly in the wearer.

What I said then, I say now, that they cause an external deformity, which many people, (E. H. probably among the number) are not ashamed to admire, forgetting that the corresponding internal deformity, which they do not see, produces a state of things incompatible with health and vigour, and that the children of women in this lowered state of constitution are more likely (as in the offspring of other deformed animals) to fall a prey to consumption and other diseases of that class which belong to feeble constitutions.

E. H. is partially right in what he says as to women being able to breathe higher up than men, but that only holds good as long as no exertion is made. Women engaged in hard work breathe much as men do, and I should like to see a woman walk up a hill, or run upstairs, without *requiring* the full use of her lungs. They do not generally get it, but that is not to the point.

What E. H. says about a particular state of health curing consumption, *on account of the difficulty of respiration*, will probably cause amusement to most of the readers of Knowledge. The fact as to the cure is so, but the reason is very different and too well known to need repeating here; besides, not being a doctor, it is hardly a subject the explanation of which I am qualified to enter upon.

We have not yet come fully to the end of the evil to the community of this system of "waists." It is only within the last twenty years that stays have been cheap enough for all classes to wear them, from the age of ten years old and upwards. Therefore, till lately, the nation was constantly recruited by the children of mothers whose bodies were of the shape that nature ordained. This is now being fast altered. How many people, for instance, realise the fact that 28 to 30 inches would be the size of the waist of a healthy woman of medium height when left to nature? In conclusion, might I suggest to E. H. to read Mr. Trèves' "Dress of the Period," published by the National Health Society, 44, Berners-street, and also a letter written by Dr. W. B. Carpenter, in the *Echo* of April 6 or 7, as he will there see what men who understand anatomy and disease think of waists.

F. W. Harberton.

THE TUBERCULOUS OR WARTY-SKINNED LIZARD.

(*Heloderma Horridum.*)

[577]—In reply to the paper on the "Heloderm," in Knowledge of Sept. 15, and in allusion to my own error in venturing a guess as to the meaning of its name, permit me to offer a word. In announcing the arrival of this venomous lizard in *Land and Water* of Aug. 5, I wrote :—"Conjecturally, *helo may* have reference to the sunny colour"; because, while having been verbally informed that this was the meaning of the word, I myself rather doubted it. Books have subsequently proved better instructors, and, on comparing the

[illegible] given by various authors with the living animal, we see [illegible] the [illegible] of the word [illegible], as given in Knowledge [illegible] from ἧλος, a nail, a wart, or stud. [illegible] the skin [illegible] other zoological terms, *hel* is similarly [illegible] to [illegible] a warty or tuberculous tegument; as, for [illegible], wart-bearing. One of this [illegible] "avec les écailles tuberculés" [illegible] exactly describes the little prominences [illegible] with which its skin is covered. The [illegible] plates is hexagonal on the back, but a [illegible] at limbs.

[illegible] rough, warty derm, would not the adjective [illegible] the skin, and [illegible] to the animal, and therefore [illegible] the neuter gender, to agree with *derma*? At [illegible] associate the "horrid" with the reptile; [illegible] whether Wiegmann did so in giving it the [illegible] is probably from [illegible], rough, shaggy, rugged. [illegible] way may not the *horridus*, as applied to the *crotalus*, [illegible] explained because this species has a particularly rough [illegible] of dull, sharply carinated and deeply imbricated scales? [illegible] merely conjecture, until I can consult the authorities.

Catherine C. Hopley.

ALCOHOL.

[578] Adverting generally to your correspondence concerning [illegible] of alcohol as food for the body after its physical powers [illegible] by mental labour, I should like to offer a few remarks [illegible] "Mephisto's" letter (p. 250, No. 537) in particular.

"Mephisto" appears to mean that the action upon the human system of fresh air, pure water, and moderate exercise is almost, [illegible] with that of alcohol. Can this be correct? [illegible] In the former case those elements are supplied, [illegible] loss of which have caused the exhaustion. [illegible] case the already wearied muscles and nerves are [illegible] to further activity. Although a similar result is obtained [illegible] there is a most essential difference in the real [illegible] of the system. The physical feelings of a man who has [illegible] his exhausted energies with open-air exercise, and mental [illegible] are widely removed from those of one who has stimulated his [illegible] worked faculties by the use of alcohol.

I am no "Blue Ribbonist," but I do think that there is no state [illegible] which alcohol is really essential, except, perhaps, when one [illegible] to its regular use. Chemical analysis shows little or nothing in the composition of alcohol that can be termed "food" [illegible] for brain or body.

[illegible] a more humble, if not less enthusiastic, follower of the same [illegible] "Mephisto" makes his daily avocation. I also am [illegible] "mental and literary" labour. In the study of [illegible] appliances I do an appreciable amount of brain work. I read Knowledge not cursorily but with a view of [illegible] the information from that valuable source I can, yet I [illegible] the need of alcohol, and, as I dislike the taste of it, I [illegible]. I find I can retain sufficient energy for at least one [illegible] and so can every man who is in really good [illegible]. I rise every morning with enough vital power to carry me [illegible] the day, unless I am affected by abnormal causes, [illegible] I can always trace.

[illegible] nothing *a priori* can be deduced from individual [illegible] and in conclusion, I would merely add, that if my friend "Mephisto" were to take a teetotal countryman from his [illegible] and healthy exercise, place him in one of our hard-working [illegible] offices, and supplement his ordinary fare with the [illegible] he proposes, I believe he would find in that [illegible] at a confirmation of his theory that alcohol [illegible] in any degree, the place of fresh air and [illegible]

Leonard P. Rees.

L[illegible] The [illegible] Size of Rising Moon, by G. E.; Local W[illegible] Rearden; Singular Mental Illusion, by W[illegible] Experiment, by Z.; The Use of D[illegible] Canary, &c., by Charles L. Cane; [illegible], by W. Mattieu [illegible], by John Browning and H. T. [illegible] by C. J. W.; Dr. Hunter's [illegible] Eye, Monkey and Mirror, by Deo [illegible] A. R. W.; [illegible] and Deception, by [illegible] Alfred Chadwick, M.D.

[illegible] 46, p. 278, second col., l. 44, for "ninety" read [illegible] 47, p. 273, second col., l. 24, for "deterioration" r[illegible]

Answers to Correspondents.

⁂ All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of Knowledge, *the increasing circulation of which compels us to go to press early in the week.*

Hints to Correspondents.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded, nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

Ivy. There are no copies of Dr. Muir Howie's paper on the Effects of Tobacco in pamphlet form, but the numbers containing it may be obtained.—E. A. H. wishes to know if any competent reader of Knowledge can state if it is feasible, advantageous, or otherwise, to apply compressed air as a means of locomotion for private carriages.—R. B. R. I can see no reason why a rainbow should not be seen by reflection at the surface of water.—C. Browne. Try Mr. Grant Allen's "Evolutionist at Large."—D. Phillips mentions that Normandy's "Commercial Handbook of Chemical Analysis" is a standard work on the subject (Crosby, Lockwood & Co.), 12s. or 12s. 6d.—C. J. Brown. Mr. Allinson certainly erred in saying the air contains more moisture in cold weather than in hot, the reverse being the case (on the average). He doubtless meant that usually in cold weather the air is more nearly saturated with moisture.—R. F. Waugh. The weather predictions are simply "bosh"—nothing. It would be "impossible" to consider all that correspondents say. Still, I have had useful hints; and one can fairly judge, from a preponderating majority, what is best for readers.—A. M. Swinton. According to my present lights I can do nothing to encourage any such publication.—A. H. W. Many thanks for your kindly and encouraging letter.—W. Probyn Nevins. According to the Darwinian theory there is no thinking in the matter. At some remote period, members of that family of lizards had a better chance of escaping their enemies the quieter they were when enemies were near. Thus more and more of the livelier perished, and by this process of natural selection of the quieter ones for breeding the race became more and more quiet in times of danger, until at length the present peculiarity was fully evolved.—J. H. A. Jenner notes that in letter 533, about Fairy Rings, in lines 15 and 16 the word "uppermost" should be "outermost."—E. P. B. Harston. Mr. Stradling evidently did not put very full faith in the snake story. There are, as you say, certain idiots who find a joke in inventing stories of the kind, that they may laugh at those who receive the stories. If they knew the utter contempt in which men of sense hold them, they would probably turn their ingenuity to something more profitable—as starting bogus companies, selling adulterated food, or other swindling. The startling theory that the equator is moving north is one of their stories. A change which would not be detected in a hundred years by the rough method described would be as obvious as the sun in the sky to astronomical observation.—Chemicus suggests that fermentation may be akin to that Catalytic action of which a theory was propounded by Berzelius. The "living germs" theory seems, however, demonstrated by the evidence.—D. Stewart. Your thinking of a "bear," and the lady saying a "bear" when you asked her to name an animal, was good evidence in favour of thought-reading. But "fuchsia" for "geranium" was not so well. I have just tried the experiment. I thought hard about the "geranium," and the flower unkindly selected by the lady experimented on ("wife of mine, in point of fact," as Mr. Dorrit, jun., might have said) was a "buttercup." I thought of an animal, the "bear," and her mind was forcibly impressed with the idea of a "giraffe." I next tried the "cow," and she could think of nothing but a "lion." After this, I concluded that either thought-ruling was not *my* "fort," as Artemus Ward puts it, or thought-reading was not *hers*. Yet in ordinary life we repeatedly anticipate each other's thoughts.—M. O'Connor. The writer of that review ought to receive £1,000,000 multiplied by 0+2.—D. T. Butler. Yes; that would now be thought very moderate dispersion for a 64½° prism. But in Newton's time glass prisms could only have been made of very inferior glass.—M. H. Crot. After what has been already said on the subject (which you either entirely misapprehend or else you are attempting a feeble joke), I find nothing to say about your letter but that your definition of the word "moment" is entirely wrong. That is one use of the word, but not its primary use. See an admirable article (undoubtedly by De Morgan) on the subject under head "Momentum," or "Moment," in the *Penny Cyclopædia*.—E. C. R. See letter from Mr. M. Williams, shortly.—G. St. Clair. (1) Ditto; (2) Nothing can be inferred on these points from a single observation of a comet, and the photograph is equivalent to that.—C. H. Romanes. We keep over your letter for a while. Could you not send a sketch, however rough, showing how the pipe and flap are situated?—P. H. M. wishes to know how best to polish stones for geological specimens.—W. H. S. Taking your postscript first, in which you express some anxiety lest I should "sit upon" your letter, my answer must be akin to that of the Cherubs, when the polite French saint on whom they had called said, "*Asseyez-vous, messieurs.*" "*Nous n'avons pas de quoi, monsieur,*" was their reply. In like manner I find nothing to sit upon in your letter; on the contrary, I find it very kindly, courteous, and considerate. The difficulty about supplements on special subjects is that they would have to be high-priced, as the number of specialists is small. From a rough calculation I find that for a thousand astronomical readers a supplement of 16 pp. would have to be priced at 4d. at least. After all, the purpose of KNOWLEDGE is rather to encourage general than special study of science. We want our specially astronomical readers to enjoy our papers on subjects botanical, zoological, electrical, chemical, &c., and so with other subjects. I suppose the professed botanist would hardly expect to learn much that was new to him from one of Mr. Grant Allen's charming papers, though I hope (for his own sake) that his special study of botany would not deprive those papers of the charm which they have for those who, like myself, have only a general knowledge about botanical matters. So again, though I hope that professed students of astronomy may find something to interest them in my lighter essays on astronomical matters, I do not write for them, but to interest, as far as I can, those who are not astronomers.—J. H. COBBETT (representing four others), L. K. MOORSOM, R. PROTHERO, FINE WEATHER, MEAGLES, H. H. TAYLOR, and others, in great number decide against the Weather Charts; JAS. WILSON, JUN., M. HARTINGTON, and a few others, like the charts, but are not disposed to insist on them; METEOROLOGIST must have them. "Must he?" If the majority decide against them, "let him not hope to have them."—M. R. I really must set that Top Spinning. (No occasion to explain that you "did not mean your severity." I read "fun" in the first line. "Cupidus Cognoscere" is referred by M. R. to Ferguson's Select Mechanical Exercises.—B. M. Well, I must confess I think with Tyndall and Huxley that many anti-Vivisectionists are *fanatics*. But who ever called them "bestial"? "Bestiarian" is a very different thing; it is a term no anti-Vivisectionist should be ashamed to accept. In fact, moderate as my own views are, I should call myself a Bestiarian in Owen's sense. You think I do myself injustice in saying that I have nothing to do with the atrocities of some Continental Vivisectionists. Would you think, if I said I had nothing to do with atrocities described in the daily papers, that I should be suspected of applauding them?—NEWTON CROSLAND. Hampden and Parallax no more consider their arguments refuted than you judge yours to be. I fear the distinction you draw between yourself and others of the heterodox is not generally recognised.—RERRY RIX. Such suggestions as yours (and so made), are really useful to an editor. I think the subject you name (spectroscopic analysis), one which specially requires treatment in such a journal as this. I thank you, and by no means complain as of the grumbling few.—A CRITIC. *All* egotism is silly. Why pile up epithets? One would almost imagine you were angry! Now, you are not egotistic; for you write rude things, on a post-card, anonymously; which means that you would rather know yourself contemptible than be so known to others. Being altogether above egotism, you should only pity, not abuse, those who still have some respect left for themselves. Not every one can go, as you do, beyond Mawworm, who only liked to be despised, whereas you evidently like to despise yourself. For portrait, see *Punch*, p. 123, current vol.—EBEN. JONES. Transit of Venus now fairly begun. Agree with you about the weather Charts; but if you only knew how we were entreated to have them, you would understand.—F. C. I trust the dyspepsia for which you want a remedy has not been *caused* by your "reading our answers to correspondents this last six months." By-the-way, I see it was not, as you go on to mention that it has lasted eighteen months. I doubt if even our medical contributors would venture to suggest a remedy for an ailment of such long standing, without much fuller particulars, and seeing you personally.—E. H. LEENEY, H. J. WATSON, A. J. Cannot drop either Whist or Chess.—W. C. THOMAS. Many readers want the smaller type to be all but wholly disused.

ELECTRICAL.

Z. Y. X., thinking it may interest our readers, has kindly sent to say that while in Brighton a few weeks ago there was exhibiting there "an electric boy; he gives an electric shock to anyone who touches him, and walks about so that he can be examined. The exhibitors state that he was born in Australia, of English parents, and has been exhibited there, as well as in New Zealand and the United States; that he began to show extraordinary electrical powers after his fifth year, which increased with his age; that he had good health and wonderful curative powers in cases of neuralgia, rheumatism, and headache." I do not remember having seen or heard anything of this marvel, and should be very careful to ascertain that there was actually no deception being attempted. Such a thing might easily be done. I should like to hear more of this.—HENRY MACEWEN. Urquhart's "Electric Light" is published by Messrs. Crosby, Lockwood, and Co. It does not give much of the information you require, but his "Electrical Engineering" will doubtless supply it. The book, however, is not yet published.—HENRY EDMONDS, saying that he knows nothing of electricity, asks for the name of a good initiatory text-book. I am afraid that unless he has the means of seeing or working experiments, his progress will be more apparent than real. He cannot do better than start with Angell's "Electricity" (Collins' series) and Deschanel's "Electricity and Magnetism."—C. R. In practice the terms "intensity" and "quantity" are still, and will doubtless for some time continue to be, freely used. The names or terms may be in themselves "remnants of an erroneous theory" concerning the nature and propagation of electricity, but they have still the same significance as regards the properties, or working capacities, of a current. The term "intensity" is synonymous with "Electro-motive force" and "quantity" with "current-strength." The question is being more fully dealt with in the articles on "Electrical Measurement" (see KNOWLEDGE, Nos. and 44), and I think a perusal of them will be much more efficacious than a restricted answer to a query could possibly be. Reference might also be made to previous "answers" appearing in previous Nos.

LETTERS RECEIVED.—G. Carid.—H. F.—C. Francis.—W. Davies.—E. R. Cowley.—T. P.—A. Stradling.—Pleni Almoni.—E. P. W.—A. N. S.—Hack.—W. B. Bishop.—X. Z.—Bryum.—A Perplexed Student.—H. H. French.—S. Lawther.—W. Moon.—Abstainer.—Stanley Baldwin.—W. S.—Leander.—No Alcohol.—Z. Y. X.—Iota.—J. Glover.—J. Watson.—Yale Yrneh Rubtra.—C. C. C. C.—J. Fraser.—E. Holloway.—G. Henslow.—C. H. Romanes.—E. D.—A. Gorham.—W. N. Bell.—E. S. B.—J. M. G.—J. A. Ollard.—G. Kamensky.—Sufferer.—Indicus.—W. Hicks.—A. R. Woods.—T. D. N. M.—A. Bray.—M. B. A.—Mangler.—H. McKendrich.—G. Glasgow.—C. J. Eve.—C. Pool.—J. Huddlestone.—W. H. Ruth.—H. A. Bulley.—L. R. L.—M. A. Close.—A. W. D.—H. M.—W. P. H.—A. A. Murdoch.—J. B.—F. Lobritz.—J. J. Rostri.—J. S.—R. Leigh.—B. M.—A. P. S.—Hallyard. Others received since Monday.

EUROPEAN POSTAGE.—A recent article in the *Deutsche Industrie Zeitung*, on the European postal traffic of 1880, shows that the total number of articles sent was 6,206,577,592. Letters and postal cards were in the proportion of 61·3 per cent.; newspapers, 22·9; book-packets and patterns, 15·8. England was first, with 27·2 per cent. of the whole; Germany second, with 23·3 per cent; France third, with 19·6 per cent. Nearly everywhere there is an increase of letters and postal cards per head of the population. An estimate shows that in England each inhabitant allows ten days between two letters; in Switzerland, two weeks; in Germany, twenty days; in Russia, two hundred and eighty days; in Bulgaria, about three years. There were 55,479 post-offices in 1880, an average of one to every 5,859·9 inhabitants. The *employés* numbered 250,665. The postal traffic has increased 58·8 per cent. in eight years, and in the whole of Europe the surplus is about $27,000,000.

INFLUENCE OF COERCIVE FORCE ON THE HEAT PRODUCED BY MAGNETISATION.—Mr. L. Pilleux has made some experiments from which he concludes that magnetisation produces great heat in paramagnetic metals. In order to obtain a marked effect, he magnetised and demagnetised iron and steel cores at short intervals by means of a De Mériten's alternate current machine. In this way he succeeded in raising the temperature of an iron core to at least 300° C. He states that a piece of pure tin brought into contact with the heated core melted instantaneously. Replacing the iron core by cores of copper, brass, and tin, Mr. Pilleux found that their temperature remained unaltered. Using a steel core, he found the heat considerably greater than in the case of the iron core. In the case of a very soft iron core the temperature was still less, and when using a core consisting of a bundle of very soft iron wire the temperature showed a further decrease. From his experiments Mr. Pilleux concluded, first, that the heating of the cores of electro-magnets must be attributed to magnetisation and not to induced currents; and second, that the coercive force of the cores increases their propensity for becoming heated in the same manner as the resistance of a wire causes its temperature to be raised by the passage of an electric current through it.—*La Lumière Electrique.*

Our Chess Column.

By Mephisto.

PROBLEM NO. 55.

[illegible] Play, by Leonard P. Rees.

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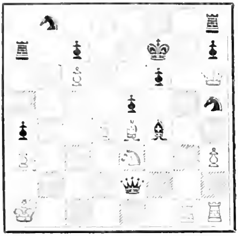

WHITE.

White to play and win.

ANSWERS TO CORRESPONDENTS.

**** Please address Chess-Editor.*

J. Duncans.—If in the game on p. 270 Black had played 20. B to R3, instead of Kt to R3, the game would probably have resulted in a draw, i.e. :—

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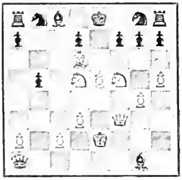


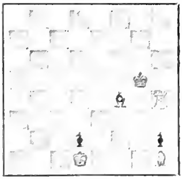
WHITE.

	20. B to QR3
21. Kt to B7 (ch) (best)	21. K to Q sq
22. Q takes R	22. Q to B6
23. Kt takes B	23. Q takes BP (ch)
24. K to K sq	24. Q to B8 (ch)
25. K to K2	25. Q to B7 (ch) and draws

by perpetual check. Should Black attempt to defend by Q to B sq, he would lose by B to B7 (ch), K to Q sq, and then Kt to Q6 (ch) winning the Queen. Again, White cannot play any other move, for if K to B sq he will be mated, or if K to B3 he will lose his own Queen by Black playing Q to KB7 (ch), K to K1, then Q to KKt7 (ch) winning the Queen.

G. G. R.—In the following position White can win by proper

BLACK.



WHITE.

play. He must, however, exercise proper caution, and never leave the dangerous Pawns out of sight.

1. R to R	1. K to Kt5
2. K to K2	2. K to Kt4 (or a)
3. B to B3	3. K to B4
4. K to Q3	4. K to Kt4
5. K to K4	5. B to B2
6. R to R5 (ch)	6. K to Kt3
7. K to K3.	

White now wins this Pawn and will be at liberty to proceed more vigorously against the Black King, the object being to bring him on to the eighth file. Play is very complicated and difficult; the Bishop must never leave the diagonal commanding the Rook's square, and yet he will be somewhat made use of for the attack. Play might proceed as follows :—

7. B to Kt sq ; 8. K takes P, B to B2 ; 9. K to K3, B to Kt sq ; 10. K to K4, B to B2 ; 11. K to Q5, B to Kt sq ; 12. K to K6, B to B2 ; 13. R to QB5, B to B5 ; 14. B to K4 (ch), K to R3 ; 15. K to B7, B to K6 ; 16. R to KB5, B to Q7 ; 17. B to B3, B to KKt4 ; 18. R to Q4. Black now cannot play his Bishop, for White threatens R to R5 mate. Black is, therefore, compelled to play P to R8, and after White playing B takes P he will easily be able to win. Of course, both White and Black might play differently, but the above variations show the principle on which play should proceed. If 2. K to Kt6. 3. R to Kt8 (ch), K to R6. 4 B to B3 and White wins the Pawn; for if K to R5, then R to Kt4, or if B to R3, then R to R8. By combined manœuvring of Rook, Bishop, and King, White will always succeed in winning first one of the Pawns and then driving the Black King to the edge of the board.

Squire.—You omitted to give your address.

W. Mead.—The game shall be withheld as you desire.

Squire, John O'Keeffe, T. T. Dorrington.—In Problem 54 if 1. Kt to Kt4 (ch), K to Kt4. 2. Q to KR5, P to B7 and there is no mate.

Novice.—1. Q to B sq, P to Q3 and there is no mate in two moves.

Solutions received of No. 51 by A. J. H., Kit, W. C. Thomas, Blackie. No. 52, Blackie, W. C. Thomas, Kit, Harold Jacobs, Agnes Larkcom, Evelyn. No. 53, Agnes Larkcom, Harold Jacobs, Kit, Evelyn.

Problem No. 54 correctly solved by H. Seward, G. W.

C. W. Stuart v. A. Johnson.

R. Pilkington v. John O'Keeffe.

Contents of KNOWLEDGE *No.* 47.

NOTICES.

OFFICE: 74-76, GREAT QUEEN STREET, LONDON, W.C.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, OCTOBER 6, 1882.

Contents of No. 49.

Science and Art Gossip.

The Astronomer-Royal for Scotland considers that the comet which has recently been observed near the sun is no other than our friend the Menacing Comet, otherwise known as the *Spectator's* Comet, which is to set the sun aglow after a return or two, and so bring about the destruction of the world, if not of the whole solar system. We give his remarks upon the subject in another column.

The comet seems not only to have been near the sun in the sky, but actually near to him in space. At least its spectrum showed the sodium lines, bright and well-defined; and we know that in the case of Wells's Comet, the only one which has shown these lines, they did not make their appearance until the comet drew near the point of nearest approach to the sun. The discovery that the cometic spectrum changes as a comet approaches perihelion is not only highly significant in itself, but full of promise. After all, the mysteries of comets may not be so inscrutable as it has seemed likely they would prove.

The sodium lines, writes Thollon, from Nice, seemed displaced towards the red end of the spectrum. This would show that at the moment of observation the comet was receding rapidly from the earth. The *New York Tribune* says it shows the comet was approaching the earth rapidly, but that is a mistake. Displacement towards the red means recession; approach is indicated by displacement towards the violet.

It was thought a triumph of science when the induction balance was used to determine the place of the bullet in President Garfield's body. The bullet was wrongly "placed"—a mere detail. Science is, however, consoled. The instrument worked all right, we are told, in a paper read before the Montreal meeting of the American Association for the Advancement of Science; only unfortunately, it mistook (or Professor —— mistook?) a bedspring for the bullet! No wonder some European surgeons doubt whether Guiteau really killed the President. Professor Esmarch says that "repeated probing by fingers and instruments, not protected by Lister's method, caused the suppuration which led to the fatal result." The little bills of the American doctors range from £5,000 for Dr. Bliss, the principal physician, to £200 to Dr. Lamb for the autopsy.

Remarkable luminous phenomena were seen in the southern skies on the evening of Monday last. There were auroral streamers and a strong auroral glare of a whitish red colour towards the north (about the direction of the magnetic meridian. The lights seen in the southern sky resembled whitish luminous clouds, along a band rising from the horizon about south-east, and passing over to about north-west. The way in which these clouds varied in apparent lustre, sometimes fading almost out of view, and anon seeming to glow with light, was most remarkable.

By the last San Francisco mail, we learn that Mr. Binnie, of New Zealand, has devised a plan for making gas from fat, air, and water. The machine employed has two retorts, and a constant dropping of gas is maintained from a service pipe, while from another, water trickles, the relative proportion being one drop of fat to four drops of water. The two ingredients are united with air admitted by a valve, and as the three unite, gas is immediately formed and afterwards purified in the usual way. One man can work several machines. The gas produced burns clearly and has no unpleasant smell. Mr. Binnie calculates that in Dunedin, where the method is to be tried, he can save the inhabitants full 8s. per 1,000 cubic feet.

The Commissioners of the Aberdeen Harbour have begun to lay pipes for "pouring oil on the water," to calm the surface in bad weather. Cheap fish-oil is used, and harbour authorities all over the Kingdom are anxiously hoping for stormy weather, that they may test, as soon as possible, the value of this method of allaying troubled seas.

It is said in several American papers, usually well informed, that all passenger trains in that country will before long be preceded by pilot-engines, like the queen's train in England. It is not clear how this is to add to the safety of passengers. What is to prevent the pilot-engine itself from causing a smash? *Quis custodes ipsos custodiat?* When Queen Victoria travels, the idea seems to be, Let every one get out of the way, *quam celerrime* (see her instructions to her loving but, it appears, too obtrusive people—"subjects" the law calls them, though it does not tell us the date of their subjection—after the impressive *Mistletoe* case, which none should forget). But though pilot engines may ensure safety to the train they precede, they are by no means an element of safety in themselves.

Georges Leclanché, the inventor of the justly-celebrated battery bearing his name, died in Paris, on the 14th ult., at the early age of 43. He was educated at the École Centrale des Arts et Manufactures de Paris, which he left in 1860, and entered the Compagnie du Chemin de Fer de l'Est as a chemical engineer. In 1867 he left this post to devote his attention to his invention, which, it is almost needless to say, has met with that universal favour it so justly merits.

Underground Temperature.—The report of the British Association Committee on "Underground Temperature," shows how impossible it is to give a mean rate of increase.

[illegible] fourteen years' observation shows that the increase of subterranean temperature [illegible] in its rate of increase downwards, from 1° Fah. per 13[illegible] ft. at the Bootle Waterworks, Liverpool, [illegible] ft. deep, to 1° Fah. every 34 ft. at the Slitt Mine, Weardale, Northumberland, 660 ft. deep. A mean increase of temperature per foot is found from these figures to be [illegible]563, or 1° Fah. in 64 ft.

The British Army Medical Department reports that [illegible] black troops suffer much more than white men from the evil influences of tropical climates. For example, in the West Indies, last year, while the mortality among white soldiers was a little more than eight and one half per thousand, the coloured men died at the rate of nineteen per thousand.

In the early stages of typhoid fever, Dr. Guillasse, of the French navy, has administered coffee with marked success. Three tablespoonfuls are given adults every two hours, alternating with one or two teaspoonfuls of claret or Burgundy wine. A beneficial result is immediately apparent. A little lemonade or citrate of magnesia is also administered daily, and after some time quinine is recommended.

An industrious statistician in England has found that out of 159,143 persons of both sexes engaged in literary work of various descriptions, only twelve became lunatics. It is doubtful if any other profession can make an equally favourable showing.

There are nine hundred inmates in the Georgia Insane Asylum, and a physician connected with the institution says four-fifths of them were insane from the effects of liquor drunk by themselves or their parents.

During a violent thunderstorm at Lebanon, Pa., a short time ago, a meteor weighing one pound eleven ounces fell into the centre of the principal street, appearing like a ball of fire as it struck the ground.

Severe Gale and Electric Storm. A gale of unusual severity visited our coasts on Sunday last, doing an immense amount of damage, especially on the Irish and Scotch coasts. In the Hebrides it is described as having been a perfect hurricane from the south-west. Many ships were torn from their anchors at Stornoway and driven ashore; others are supposed to have been driven to sea, and "a large number of pleasure and small fishing boats have been sunk, driven ashore, or broken to pieces. In places whole fields of unsecured corn have been scattered and destroyed. Early on Monday morning the telegraph wires, more particularly those running S.W. to N.E., were affected by the passage of earth currents, which continued at intervals throughout the day, and reached their greatest strength in the evening, when there was a brilliant display of aurora borealis, one of the most striking features being the "electric clouds." These were at a considerable height, and had a striking resemblance to masses of light *cirrus*, illuminated from behind by the moon. The earth currents ceased to be noticed at about [illegible] a.m. on Tuesday.

There is a kind of dwarf kangaroo in the Staked Plains in North-Western Texas. Its body is about eight inches long; its fore-legs are not more than an inch and a half to two inches in length; while its hind legs are all of six inches. It has a tail about eight inches long, completely bare, except a tuft of long hairs at the end and a ridge of short hairs on its upper part. It is also a marsupial, the pouch being well developed. It is of a soft blue colour. Its only mode of locomotion is by jumping, precisely like the kangaroo. It can jump eight or ten feet.

The Sutro Tunnel, now completed, discharges 3,000,000 gallons of hot water daily from the Comstock mines. This water has a temperature of 195°, and is conveyed through a closed pipe flume to prevent the escape of vapour. After a passage of four miles through the first tunnel, it loses suddenly 70° of heat. A second tunnel, 1,100 feet long, and an open waterway a mile and a half long, conduct the water to Carson River. Along its course are hot-water baths and laundries, and a plan is on foot to conduct the hot water through pipes under ground to be made available for purposes of irrigation and for supplying artificial heat to hot-houses.

Coal-Beds.—A correspondent of the *Times*, writing from the Cape, says:—"From the explorations set on foot by the Cape Government, and recently reported upon, it would seem as though the great Stormberg range of mountains contained an indefinite amount of coal. The Stormberg coal-beds have been locally worked for some time past with very poor appliances. A coal-mine, called the Molteno, is about to be opened some sixty miles north of Queenstown, in which the principal seam extends over an area of 200 acres. Though intercalated by beds of shale, it contains about 2½ ft. of workable coal, the section being thus given: (1) Sandstone roof; (2) coal, 6 in.; (3) grey shale, 5 in.; (4) coal, 10 in.; (5) black slate, 9 in.; (6) bottom coal, 14 in.; (7) shaly sandstone. No. 2 coal is described as soft, but bright, burning easily, with a white ash. No. 4 is a highly bituminous and good house coal. No. 6 is a hard, compact, and excellent steam coal."

Newspaper and magazine criticisms are sometimes striking. In the *Athenæum*, a few weeks ago, we were told that a *sentimental part* like that of Benedict, in "Much Ado about Nothing," would not suit Mr. Irving! This is quite a new light to play-goers and readers of Shakespeare alike. We shall hear next that Mr. Irving should take only heroic parts, such as Dogberry, Launce, and Aguecheek.

And now we learn from a trustworthy source that Mr. Charles Reade (whose humour is keener, deeper, and truer than Dickens's) has no sense of humour at all.

Which brings Ouida on the scene. This lady, it appears, cannot read most English novels (many English novel-readers cannot read Ouida—positively find her wearisome); but she *can* read Reade a little—at any rate, he is better than the rest, who always seem, to the judicial Ouida, to write either for school-children or for police-sergeants. This lady finds Reade humorous, though occasionally rather grim. But, sitting in judgment on him, *more suo* (a moth criticising an eagle), she finds that he has never attempted to depict the woman of the world. She evidently has not read "Love me Little, Love me Long" (indeed, from her remarks on Julia Dodd, she obviously does not know that Lucy Dodd—the most disagreeable of Reade's women—had already appeared as Lucy Fountain), or she would have found in Mrs. Bazalgette at least an attempt at the portraiture of a woman of the world.

GEOLOGY OF LLANDUDNO AND RHYL.

By W. Jerome Harrison, F.G.S.

THE arrangement of the rock masses which form the north-east of Wales is tolerably clear and easy to make out, contrasting strongly with the broken and intricate nature of the strata which lie further west. In this article I shall describe the geological structure of the country lying east and north of a line drawn from the mouth of the Conway to Cerrig-y-Druidion, and thence to Chester. Either Llandudno or Rhyl form convenient centres from which to explore this area, which has Denbigh almost in its centre, and Mold near its eastern boundary.

The Government Geological Map, sheet 79 (in four parts, price 3s. each), includes the greater part of the district, but Llandudno lies in Quarter Sheet 78 N.E. The purchaser of the new edition of Prof Ramsay's excellent Survey Memoir on the Geology of North Wales (Stanford, 21s.) will, however, find included in that book an extremely clear coloured geological map of the whole of Wales, although, of course, it is on a comparatively small scale (10 miles to an inch).

Surface Features of the District.—Starting from almost any point in the Vale of Conway, say Llanwrst, and walking eastwards, we ascend a long slope, and soon find ourselves on the table-land of Denbigh, a barren and scantily-peopled district, traversed by few travellers, and seamed by many little streams (of which the Elwy is the principal), running eastwards to pour their waters into the Clwyd.

The strata numbered from 1 to 8 constitute the *solid geology* of the district: they have been up-heaved, or tilted-up, on the west, so that they have a general easterly slant or dip; the glacial and alluvial deposits rest irregularly upon the upturned edges of these older rocks. The diagram (fig. 1) represents the *relation* of the strata to one another:—

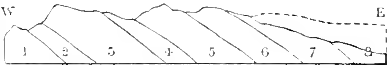


Fig. 1.

Unfortunately, the real position of the rocks is not nearly so simple as that shown in the diagram; the several rock-masses have been so upheaved, broken, and bent by the various movements of the earth's crust which have taken place since their formation, that their actual mode of occurrence is considerably more complex.

Lower Silurian Rocks.—Walking southwards from Llandudno, we come to the low ridge of the Diganwy Hills, formed of a cream-coloured felsite (an ancient lava) of Lower Silurian age; the felsite is overlaid by grey grits and blackish slates seen in several quarries. Tracing these beds southwards by Conway Mountain, they are found to increase greatly in thickness; they are, in fact, the well-known *Caradoc and Bala Beds* which form the entire mass of Snowdon.

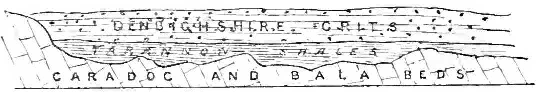


Fig. 2.

Crossing a breadth of ten miles of this table-land, we come to the eastern limit, overlooking the fertile Vale of Clwyd, which lies parallel to it. Continuing our easterly walk, the Vale is quickly crossed, but on its eastern side we get a long climb up the highest of the hills (Moel Fammau, 1,823 ft.), whose rounded summits form another north and south ridge; beyond this is a narrow table-land, or rather an elevated shallow valley, bounded on the east by a lower ridge, whose slopes run down to the plain of Cheshire.

Geological Formations.—The country over which our imaginary walk has extended is composed of eight main beds, or layers of hard rock, all resting one upon the other, with an easterly inclination, so that the lowest (and oldest) stratum forms the Vale of Conway, while the highest (and latest-formed) constitutes the plain of Cheshire.

The labours of Sedgwick, Murchison, and the officers of the Geological Survey have proved these beds to follow one another in the following order:—

Formation.	*Sub-divisions.*	*Thickness in feet.*
Recent	Alluvium	0 to 50
Pleistocene	Glacial Drift	0 to 100
Trias...	8. Bunter Sandstone	500
Carboniferous Formation	7. Coal-measures	1,500
	6. Millstone Grit	750
	5. Carboniferous Limestone	1,080
Upper Silurian	4. Wenlock Shale	2,500
	3. Denbighshire Grits	1,500
	2. Tarannon Shale	500
Lower Silurian	1. Caradoc or Bala Beds ..	1,000?

Upper Silurian Rocks.—To examine the strata next in succession—*the Tarannon Shales*—we must cross over to the town of Conway; from Conway due south to Llanbedr, a distance of about five miles, we shall find a band of fine smooth grey or blue slates, 500 feet thick, lying *between* the Bala Beds and the Denbighshire Grits; but no such smooth slates are to be found between Diganwy and the Llandudno Junction Station: in this area the gritty strata lie directly upon the Bala Beds. This local absence of the Tarannon Shale is due to an *overlap*; the Bala Beds formed a sea-bottom on which the Tarannon Shales were laid down; a rapid subsidence of this sea floor led to an irregular recession of its coast-line, so that the succeeding sandy deposit, the Denbighshire Grits, overlapped, or extended beyond the margin of the earlier mud, which, consolidated and compressed, now forms the Tarannon Shales (fig. 2).

This diagram also shows the great *unconformability*, or want of parallelism, between the Lower and the Upper Silurian rocks; a fact which points to a great interval of *time* having elapsed between the formation of the two sets of strata.

To examine the *Denbighshire Grits* we must walk along the eastern slopes of the Vale of Conway; except as a local development of sandy grits with interstratified shale, these beds are not interesting, for their fossils are few and hard to find. The same is the case with the overlying *Wenlock Shales*, which, with the Grits, help to form the wide and barren plateau that lies between the Conway and the [illegible]. On the western half of this plateau, the Silurians [illegible] to the east, [illegible] again as we follow them eastwards, thus forming a synclinal curve; still further east, they pass [illegible] the Vale of Clwyd, on the eastern side of which the Wenlock Shales are found with a *westerly* dip, forming the range that includes Moel Famman; along this eastern range they are well exposed at Cwm and many other points, as bluish grey unfossiliferous coarse slates or mudstones.

(To be continued.)

ENGLISH SEASIDE HEALTH-RESORTS.

By Alfred Haviland, M.R.C.S., F.R.M.C.S. Lond.

CLASSIFICATION. LAND AND SEA WINDS.

(Continued from page 212.)

EAST. From the east coast, within zone I.,* we look straight across to Denmark, as we have said, with its two stations, Tarm and Copenhagen. The peninsular and northern part of Denmark separates the Cattegat from the North Sea. This zone includes Berwick (1) and Tynemouth (2).

From Hartlepool (3), Redcar (4), Saltburn (5), Whitby (6), Scarborough (7), Filey (8), and Bridlington (9), within zone II., the observer when looking east is opposite the North Frisian Islands, Sylt Point, Vesterland, the Isle of Heligoland, and the mouth of the Eider.

The coast within zone III., including Spurn Point and Great Grimsby (11), is opposite Hanover and the mouth of the Elbe.

Cromer (14), Great Yarmouth (15), Lowestoft (16), Aldborough (17), within zone IV., look towards the East Frisian Islands, Terschelling, Vlieland, and Texel, which form a part of the Netherlands, and enclose the channel leading to the Zuyder Zee, on which Amsterdam, at about 52° 22' Lat. N., stands.

From the coast within zone V., on which we find Southend (18), Sheerness, Herne Bay (19), Margate (20), Ramsgate (21), and Deal (22). The observer, on looking due east, would have opposite to him the mouths of the Maas; at about 51° 38', Lat. N., the East Scheldt River; and at 51° 32', Walcheren Island, where in 1809 the marsh fever decimated the English army, under the incapable Commander-in-Chief, Lord Chatham, the elder brother of William Pitt, who managed to get 7,000 of his men killed by this disease, and half of the remainder permanently disabled. Walcheren Island is opposite the mouth of the Thames.

We have now seen that that part of the east coast which extends from Berwick to the mouth of the Humber look toward Denmark, which peninsula—averaging 85 miles across—separates the North Sea from the Cattegat and the Baltic Sea, so that winds proceeding straight from these easterly points have considerable marine characters. From the mouth of the Humber, however, southwards to the South Foreland, our coast faces the western end of a belt of continent unbroken by a single sea inlet from the west coast of Europe to the east of Asia; so that one could walk on dry land eastward within this belt from the west coast of Europe to the western shore of the Gulf of Tartary, in the Okhotsk Sea, 141° long. E., passing through Holland, Germany, Poland, Russia, the Steppes of the Kirghiz, and Asiatic Russia; but the Europe-Asian continent contains a still longer belt to the the one just mentioned.

We have called attention to these geographical facts, not that we believe that any wind that reaches our shores has ever passed along this belt in its entire length, but to show how impossible it is for any wind that comes to us for any length of time from a remote part of the Continent to be otherwise than deprived of any marine character it might have set out with. We are speaking now of those east winds that blow to us from the Continent, week after week, at some periods of the year, especially during the spring months; and which have such a baneful effect on the consumptive and those subject to rheumatism and neuralgia. We do not include in the category of east winds those which come to us from off the sea in the course of their circuits around some local area of low barometric pressure; nor the morning *sea breezes* on the east coast, which are caused by the sun-heated surface of the land causing the air above it to ascend, and the cooler air over the sea to take its place. After sunset, the earth rapidly radiates its heat, and cools down to a lower temperature than the sea, over which the warmer air ascends, and, as it were, makes way for the cooler air of the land which flows towards it, causing the evening *land* breeze. On the west coast, of course, the morning *sea* breeze would be westerly and the evening *land* breeze easterly. Simple as the phenomena of the *land* and *sea* breezes are, they contain the elements which bring about the circulation of the whole atmosphere of the globe; and when once mastered and studied in connection with the earth's rotation, will considerably help the student to understand the causes of the winds and their influence on oceanic currents.

The east wind as we get it in England is characterised by great dryness; in fact, it is the driest of our winds, and is in direct contrast to our south-west wind, which is the most moist. Mr. Alexander Buchan, in his papers on the prevailing winds of the world, has shown why these winds prevail in Great Britain in spring. He says that they are always dry; but in some years, as in May, 1866, they reach an almost unprecedented dryness, such low humidities as 44 and 37 (saturation point being 100) having been observed at many places in Scotland at nine a.m. As to their cause, he remarks that the Isobaric charts for the spring months exhibit a smaller difference of mean pressure between Great Britain and the north of Europe than during the other months. This smaller difference arises from the more frequent occurrence during these months of *higher* pressures to the north and north-east, or *lower* pressures to the south and south-east of Great Britain than in Great Britain itself; and it is from the repeated occurrence of these throughout the year, that next to S.W. or W.S.W., easterly winds are the most prevalent. Sometimes, and in some years—notably during 1867—high pressures prevail to the north-west of Great Britain, in which case the cold current comes to us a north, north-west, or even west wind. But it matters not from what direction, or in what guise, the cold, dry current comes to us, its noxious characteristics are the same, and it is *nearly* as injurious to health and vegetation as the "horrid east."

It must be remembered that mere *dryness* would not cause all the evil that is laid to the charge of the east wind. So far as this character, is concerned, it is just possible that, under the circumstances named by Mr. Buchan, the winds he names would be dry and exhaust all the moisture possible from trees and plants, and it is possible also that their keenness and dryness combined would materially affect the public health in the manner generally attributed to east winds, but the winds named are essentially sea winds, and never lose their marine character entirely, for, although they may be deprived of much of their moisture, they

* See "Climate Chart," p. 184.

remain still ozoniferous, and never can become entitled to the term *effete*, as the wind that comes to us from the Continent always is.

After floating over the Continent for days, and perchance weeks, such a vast volume of air as blows over the narrow sea between England and the Continent could scarcely acquire in the short space of time occupied by its passage a true marine character; and evidence of this is seen in its great *dryness* and the deficiency in what has been termed ozone. For many years we took observations at all hours and in a variety of localities, both inland and coastal, and we invariably found that the east wind was defective in, if not entirely free from, ozone.

This want of the vivifying element of pure air, combined with a want of moisture, we believe to be the cause of the obnoxiousness of the east wind to all, and especially to those who are delicate. We shall show, in a future paper, how fatal it is in those parts of England that are not protected from its malign influence.

OF AN OBSERVATION NOT LONG SINCE MADE IN ENGLAND OF SATURN.

THIS Observation was made by Mr. William Ball, accompanied by his brother, Dr. Ball, October 13, 1665, at six of the Clock, at Mainhead, near Exeter, in Devonshire, with a very good Telescope near 38 foot long, and a double Eye-glass, as the observer himself takes notice, adding that he never saw that Planet more distinct. The observation is represented by Figure 3, concerning which the Author saith, in his letter to a friend, as follows:—"This appear'd to me the present figure of Saturn, somewhat otherwise than I expected, thinking it would have been decreasing; but I found it full as ever, and a little hollow above and below. Whereupon the Person, to whom notice was sent hereof, examining this shape, hath by Letters desired the worthy Author of the *Systeme of this Planet* that he would now attentively consider the present Figure of his *Anses* or *Ring*, to see whether the appearance be to him as in this Figure, and consequently whether he there meets with nothing that may make him think that it is not *one* body of a Circular Figure that embraces his *Diske*, but *two*."

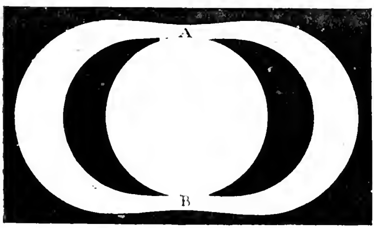


Fig. 3.

And to the end that other Curious men in other places might be engaged to joyn their Observations with him, to see whether they can find the like appearance to that represented here, especially such Notches or Hollownesses, as at A and B, it was thought fit to insert here the newly-related Account.—*Philosophical Transactions*, Vol. I. for 1665 and 1666, p. 152-3. (The engraving faces p. 155.)

THE RAIN-BAND.*

By C. Piazzi Smyth, Astronomer Royal for Scotland.

(*Continued from page* 294.)

BUT if so much can be done by so small a spectroscope, the question may be well asked whether more still might not be accomplished with a bigger and more powerful one, especially seeing that the dispersive powers of both chemical and astronomical spectroscopes have in late years been increased to a most astonishing extent. The question is important, and somewhat new as well. I propose, therefore, to devote the remainder of my space to its answer, rather than to the practical rules for using the smaller instruments, especially, too, as they have been already introduced to the public, both by my friend, Mr. Rand Capron, in his pamphlet, "A Plea for the Rain-band," and by myself, in the fourteenth volume of the "Edinburgh Astronomical Observations;" also in the Journal of the Scottish Meteorological Society, and in the September number of the Astronomical Register for 1877.

The greater part of higher power spectroscopes are not suitable to rain-band work, for their fields are usually too dark. But having recently built up for myself a large-sized variety of the instrument, possessing perhaps the greatest combination of power with transparency yet attained, and having it always mounted in an upper chamber looking out at an altitude of about 5° over the north-western horizon (or most suitably for rain-band work), I will try to describe shortly its action therein.

The classical "rain-band," which in the little instrument is merely a very narrow fringe to an almost infinitely thin black line, is so magnified laterally in the larger instrument as to fill the whole breadth of the field. The thin black line before spoken of is now not only split into two, but each of these are strong, thick, sharply-defined lines, separated from each other by six or seven times the breadth of either. These are the celebrated Solar D lines, D1 and D2 arising from the sodium metalloid burning or incandescent in the sun. They are, therefore, perfectly uninfluenced by changes of the terrestrial atmosphere, hot or cold, wet or dry, and are, therefore, invaluable as references for degree of visibility of the water-vapour lines and bands which rise or fall in intensity precisely with those changes. There are several of these earthly water-vapour lines and bands in and between and about the D lines themselves; then a long breadth of band towards the red side of D1; then a pair of lines not so widely apart as the D lines, but sometimes just as sharp and black; then two or three fainter bands; then a grand triple, of which the nearer line sometimes attains greater blackness than either D line; then beyond that three distinct, equal-spaced, isolated bands; and further away towards the red a stretch of faint haze and haze-bands.

All these go to make up the one thin rain-band of the little spectroscopes; and I fortunately had, through the month of August and the early days of September, occupied myself each morning in noting the greater or less intensity of each, and all these water-vapour lines and bands in terms of the two Solar constants D1 and D2; and every such morning there was an abundance of details to see, to recognise, and to measure. But on the morning of Monday, September 4, when the little instrument had truly enough marked 0 on its very small scale, I almost started at finding in the large instrument every member of its long rain-band group, unless it were a vanishing trace of one or two of the strongest, utterly gone; while the two D lines were in their accustomed strength, but far greater clearness, for now they were all alone in the field, save the ultra thin Solar nickel line between them and one or two others, equally thin and Solar on their blue side. The stages of perceptible shade of water-vapour lines which had thus been swept away, between their this day's invisibility, and their tremendous strength no longer before than the previous Friday, might have been expressed by a scale not divided into three parts only, but into 30; and implied such a very unusual amount of absence of water vapour, that I not only felt sure of no rain falling either next day, or perhaps for several days after, but that the weather must also be coming on colder as well. Therefore it was that I took the step of instantly writing as I did to a local paper, promising the perplexed farmers dry weather at last, though probably sharp and cold, to get in their crops.

And how was that expectation fulfilled? Various meteorologists in different parts of the country have already declared themselves well satisfied with it. But I would now beg further attention to the little daily register already quoted, showing that from and including that day, Monday, September 4, up to and including the next Saturday, not a drop of rain fell at the Observatory. Between the following Sunday and Monday, a drizzle, but only amounting to 0·04 inch, occurred, and after that there were three more days equally dry with the preceding ones. But on Thursday, the 14th, the rain-band reappeared in both spectroscopes in all its force; rain began to fall the same day, and next day's measure at the Observatory amounted to more than half an inch. Wherefore it is to be hoped that the farmers had busied themselves effectively while the dry weather lasted, for the return of these spectral lines of watery vapour showed that their autumn opportunity was then gone by.

LEARNING TO SWIM.

By Natator.

(Continued from page 213.)

In my former papers I considered chiefly the beginner, showing how one who knew absolutely nothing about swimming might make his first attempts with safety, and learn readily the all-important art of keeping his balance, whether on his back, which is very easy, or with his back uppermost in the more usual position, which is more difficult. To swim properly requires somewhat more study and practice.

The great general principle in swimming is that the arms and legs, in all methods of swimming, are to be brought forward with the least, and to be carried, or rather driven, back, with the greatest possible effect. This not only distinguishes good swimming from bad, in any given style, but also distinguishes the different styles from each other. Thus the "breast-stroke" is better than the style called "swimming like a dog," because in the former the whole arm is used in propulsion, while in the latter little more than the hand is used; and again, because in the "breast-stroke" the legs are driven back in a much more effective manner, as will be presently explained. So also, the "side-stroke" is more effective than the "breast stroke," at least for short distances, because the arm, or rather one arm, is carried forward clear out of the water, or without encountering any water resistance at all.

But before our learner begins to learn any stroke, let him carefully note the following point, the neglect of which has ruined the style of many promising swimmers: *The body should remain, as far as possible, at the same level during the whole of each stroke.* Many swimmers act as though at each stroke they were striving to save themselves from a watery grave. They drive the hands downwards as forcibly as they drive them backwards, the result being that the shoulders rise out of the water at each stroke, instead of keeping as much under as possible. A good swimmer will scarcely be seen to rise perceptibly in the water, even as he draws in his breath, for he always inflates his lungs when the body would otherwise be slightly sinking. There are, indeed, some who adopt a slightly different plan: they swim with the mouth under water, except when they want to breathe, when they turn the head round as if to lie with the cheek on the water as on a pillow—a movement which brings the mouth just enough above the water to enable the swimmer to breathe. This is theoretically the proper way to breathe so as to minimise work, for in this way a maximum amount of the body's volume remains all the time under water; but it is better to learn this method of breathing later. It is sufficient at first to bear in mind the general principle that, in swimming, not a particle of strength is to be wasted in up-and-down movements. The strokes should be taken so that they shall drive the body steadily forward without either lifting the body or causing it to sink so as to require raising.

So much premised, let us consider how the "breast-stroke" is to be taken.

The swimmer is supposed to be simply balancing himself in the water when he prepares to try the movements now to be described. Placing the hands together close to the breast, with the wrists touching the collar-bones, or nearly so, the palms downwards, and in horizontal plane with the closed fingers, the swimmer launches his arms forward to their full reach in front of him, still keeping his hands together. While he is doing this, he kicks his legs out backwards to their full extent, and so as to throw the feet as far apart as possible. Of these movements only the latter is propulsive. The former merely brings the arms to the right position for their backward propulsive stroke. But though the legs and feet in being kicked out backwards produce a propulsive effect, especially if the feet are well planted, as it were, against the water during their backward sweep, yet it is not in this motion that the legs do the most effective part of their propelling work. The arms are now to be carried backwards with a powerful sweep, the hands being held in the slightly cup-shaped form already described, and the stroke being taken with just so much downward movement, and no more, as is necessary to counteract the tendency of the head to sink when the support of the hands is removed. While the hands are thus brought towards the hips, the legs are to be brought forcibly together, like the legs of a pair of shears when we close it. It is in this movement that the legs produce their greatest propulsive effect, an effect which many who think they know how to swim, entirely lose, simply kicking their legs straight out backwards, and then drawing them up under them for the next stroke. This drawing up of the legs under the abdomen must only be begun when the legs have been forcibly brought together, both perfectly rigid till they are in contact. The closing movement of the legs is completed while the arms are doing their backward stroke. The legs are then drawn up under the stomach, the feet being bent back as when we stand on tiptoe, while the hands are brought to their first position by passing from the hips to the chest, the palm and fingers as it were gliding over the body. Then the movements described are repeated. The arms are thrust forward as before; the legs are kicked out; then, while the legs are brought forcibly together, and afterwards carried forward, the arms take their propulsive stroke backwards to the lips. Then the movements are repeated, and so on, till the swimmer is tired, or thinks well to change his stroke.

(*To be continued.*)

THE COMET.

IN a letter to the Editor of the *Scotsman* (dated Sept. 24), Prof. Smyth, Astronomer-Royal for Scotland, writes as follows :—Could there have been anything more heartbreaking to all astronomical souls than the uninterrupted cloud by day and cloud by night of our unfortunate climate ever since the announcement of the brilliant daylight comet of Monday, Sept. 18 ? Tuesday, Wednesday, Thursday, Friday, Saturday, and thus far Sunday also, and their several nights, have each and all been uniformly, utterly covered in with thick, impenetrable clouds ; and yet we ought to confess that one other thing might have occurred even so as to make that cloudy appearance more aggravating, more grievously disappointing still. That one overtopping culmination of misfortune would have been, if the spectroscopic observers of Dunecht and Nice had reported that the bright sodium lines of the comet's nucleus were deflected towards the blue end of the spectrum. For in that case the comet would have been coming up to its perihelion ; and its necessarily ecstatic display at that period, under fervid solar illumination, might have been taking place precisely during these ultra-cloudy days of the past week.

But both of the spectroscopists of last Monday—the one in France and the other in Aberdeen—declared that the displacement of the lines was towards the *red*, the meaning of which is that the comet was going rapidly away from us,* that it had already passed its perihelion, and was rushing off into distant, cold space, to cool down its substance, which the incandescent-making heat of a very near sun had just caused to give forth the bright spectral lines noticed by the observers. And, in fact, by the time that our terribly thick and moist clouds do at length clear away from above our heads, the comet may be so far away on its aphelion path from both the illuminating sun and ourselves as to be barely visible.

But what comet was it ?

The little that was seen on Monday in Scotland is not enough to give any clue ; and no London journals, whether scientific or political, which I have seen up to the end of last week throw any light on the matter. But your paper, sir, I am happy to say, did contain on Saturday a note by cable from America, which, if fully correct, is of most profound import. Indeed, nothing so important to all mankind has occurred before through 1800 years at least of astronomical history ;† and there is this prospect of the statement being true, that it is given under the name of Professor Lewis Boss, one of the most able and learned mathematical astronomers of the Union, and we may say now (such has been the rapid progress of astronomy during the last few years in that country) of the *world*. He is said then to have concluded from his observations that the comet of last Monday was the comet of 1880 and 1843. A comet on each of these occasions was recognised to have passed closer to the sun's surface than any other known comet. But why has it come back so soon ?

In 1843 it appeared to be moving in an orbit of one hundred and seventy years, and yet it came back in 1880, or in only thirty-seven years ! That was startling enough, though only looked on by the world as a case of failure of astronomical prediction. But having gone off in 1880, on an understanding generally come to by the best astronomers in Europe, North America, Rio Janeiro, the Argentine Republic, and Australia—at all which latter places it had been well observed—that it was not to return before thirty-seven years (and other comets, such as Halley's and Encke's keep to their times of revolution round the sun nearly uniformly for centuries), behold this comet has returned now, on the strength of your cablegram from America, in two years !

In which case, who can say whether it may not be back again from space in a few months ; and then, not merely to graze close past, but actually fall into, the sun, which is so evidently increasing its hold upon it at every revolution. Wherefore we may be near upon the time for witnessing what effects will be produced when such an event takes place in the solar system, as astronomers have only distantly speculated on, and no mortal eye is known to have ever beheld. But we must be calm, patient, philosophical, judicial ; for the calculations involved are excessively tedious and difficult when much accuracy is required. The whole of the observations, too, require to be gathered in from all parts of the world, and extensive comparisons of the varying results of different computers have to be made, examined, and discussed with the greatest severity ; for how often are there not two appearances very like each other in the immensity of nature, and yet not the same identical thing ?—I am, &c. C. P. S.

[We venture to make a slight remark on the above. It relates merely to a matter of detail. Whatever the comet seen on Sept. 18 may have been, it certainly was not the comet of 1843 or of 1880. Professor Boss may be a very able astronomer : but, if so, he is a very careless man. We fear the same must be said of Professor Smyth. For it may be shown (we shall show it next week) that the comet of 1843 or 1880 *could not, in any part of its orbit, be seen from the earth's place on or about Sept. 18 within two degrees of the position in which the comet near the sun was actually seen that day.* Nor was it a matter of calculation or requiring nice study, or "calm, patient, philosophical, judicial investigation," to show this. Any one who has clear ideas of the actual relations of the solar system ought to be able to see in a few moments that *the whole orbit* of the comet of 1843, seen from the place of the earth on Sept. 18, would lie far north of the place in which Thollon saw the new comet on that day.—ED.]

* It by no means follows that because a comet is receding from the earth it is receding also from the sun. A comet may be approaching the sun rapidly when receding rapidly from the earth. Or it may be passing its perihelion when so receding from us. But as the comet's apparent distance from the sun was increasing at the time, it is more probable that the comet had passed its perihelion. —ED.

† There is a reference here, we imagine, to the Grand Gallery in the Great Pyramid. Of course, the comet seen near the sun on Sept. 19 indicates the approaching end of the Christian Dispensation. Possibly it may be a return of the star seen by the Wise Men at the time corresponding to the other or northern end of the Grand Gallery.—ED.

VICTORIA HALL. It is sometimes said that London working men are less interested in science than the mill-hands of our northern manufacturing towns. If this is so, it is probably, in part, because their attention has not been adequately directed to it. An experimental course of lectures has been planned by the Committee of the Victoria Hall, Waterloo-road, to be held on Friday evenings, at one penny admission, or sixpence and threepence for seats in the balcony. The first is to be by Mr. W. Lant Carpenter, on "Telegrams and How they Come," on the 29th inst., followed, on Oct. 6, by one on "The Dog as the Friend of Man," by Mr. Arthur Nicols, F.G.S., and on Oct. 13 by one on "A Telescopic Visit to the Moon," by Mr. Mattieu Williams. If these succeed, it is proposed to extend the course.

NIGHTS WITH A THREE-INCH TELESCOPE.

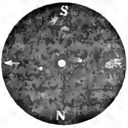
By a Fellow of the Royal Astronomical Society.

OWING to the delay which has unavoidably taken place in the publication of this series of papers, the constellation Scorpio, with which we shall begin to-night, now souths in daylight, and from the very small altitude of the chief objects in it, is most indifferently placed for the observer.* The chief object in it, α, or Antares (Map, p. [illegible]), is a double star, but, save under the most exceptional atmospheric circumstances, beyond the power of a three-inch object glass. Nevertheless, on a superlatively fine evening, and with the highest power at his disposal, the student *may* pick up the companion as a minute green speck, or wen, attached horizontally to the left of the blazing red disc of Antares itself. ν Scorpii will be seen at first sight as a wide double star, but a little attention will show that the smaller star is not single. β Scorpii is a pretty and easy pair, the contrast of colouring in its components being very pleasing. It is represented in Fig. 46. Half-way between this and Antares, the cluster

Fig. 46.

β Scorpii.

Fig. 47.



μ¹ Sagittarii.

Fig. 48.

π Aquilæ.

80 Messier may be picked up. In the instrument we are employing, however, it will be seen as a nebulous object, strongly resembling a telescopic comet. σ is a pretty pair, but terribly near the horizon. If the student will draw a line from Antares to η Ophiuchi, and travel 10 along it from α Scorpii, he will come upon 236 of Piazzi's hour XVI., a pretty little pair, which will repay scrutiny. Closely following 36 Ophiuchi lies 31 Scorpii (this ought really to be 38 Ophiuchi) a pretty severe test for a three-inch telescope at any time, and, at present, beyond its power.

Adjoining Scorpio to the east is Sagittarius, but this need not detain us long, as only two suitable objects are to be found in the Map on p. 211, which we are employing. These are μ 1, a striking triple star represented in Fig. 47; and 22 Messier, a pale nebulous mass half-way between [illegible] and σ Sagittarii. This (like 80 M. described above) is really a cluster, but is irresolvable with the means at our disposal.

Aquila, to the north of Sagittarius, is the next constellation we shall examine. Forming an equilateral triangle with ε and ζ Aquila is 11, a severe test for the instrument we are employing. The minute companion 19″ above and to the left of the larger star will require the highest power at the observer's disposal to see it at all. At the right hand extremity of the base of an isosceles triangle, whereof [illegible] Aquilæ forms the other end, and ε Aquilæ the apex, 23 Aquilæ will be found. The comes of this is also a star that is invisible with any power less than 250 or so.

π Aquilæ is a very good test indeed. Fig. 48 shows it as seen at moments of the best definition.

In that pretty little constellation, Delphinus, the only star which need detain us is γ, depicted in Fig. 49. The

Fig. 49.

γ Delphini.

Fig. 50.

Vega.

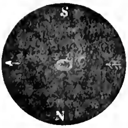
contrasted colours of the components will at once strike the observer's eye.

And next Lyra will claim our attention, and, as is only natural, we shall begin by directing our telescope to its brilliant leader Vega. Here, again, is a severe test, a fine night and a pretty high power being needed to glimpse the comes at all. In Fig. 50 we give something of the appearance of this object, but it is impossible to reproduce in black and white the vivid blue blaze and the mouldings and twirlings of the diffraction rings which surround the great star. Moreover, the size of the minute comparison is exaggerated, or it could not print at all. Not far off we shall find another most interesting object. We refer to the double-double system ϵ^1 and ϵ^2 Lyræ, shown in Fig. 51.

Fig. 51.

ϵ^1 and ϵ^2 Lyræ.

Fig. 52.



57 M. Lyræ.

Fig. 53.

β Cygni.

Between the two pairs lies another minute star, shown in our sketch. There are two others smaller still; they, however, require a larger aperture than ours to see them at all. ζ Lyræ is a wider pair, but pretty from the contrasted colours of its components. Between β and γ Lyræ, but nearer to the former star, will be found that astonishing object, 57 Messier Lyræ, the so-called "Ring-Nebula." Fig. 52 is an attempt to give some idea of its aspect as seen with a power of 70, but wood-engraving does not lend itself well to the delineation of nebulæ. η Lyræ is a widish double, but interesting from the contrasted colours of its components.

We now turn to that glorious region occupied by Cygnus, in which the merest vague sweeping cannot fail to reveal innumerable objects of beauty and interest. We shall, though, select a few of the most striking ones in it for detailed description, as the student can easily wander over the constellation when he has examined them. We will begin, then, with β, the lovely colours of whose components have always rendered it a favourite with the juvenile observer. Fig. 53 gives an idea of the general aspect of this star. 1¼° North of χ lies another wide, but beautifully coloured pair, 278 of Piazzi's hour XIX. Nor is χ itself less beautiful and interesting, contrasted colours again forming its chief

* The first [illegible] paragraphs of this paper relate to objects well placed when the paper was written by my friend F.R.A.S.; but now [illegible] is mine.—R. A. P.

charm. ψ Cygni, a close and unequal pair, will require a high power to see it. 2° South-west of ϵ is 49 Cygni, shown in Fig. 54; while 3° south of ϵ lies 52, in which the com-

Fig. 54.

49 Cygni.

Fig. 55.

61 Cygni.

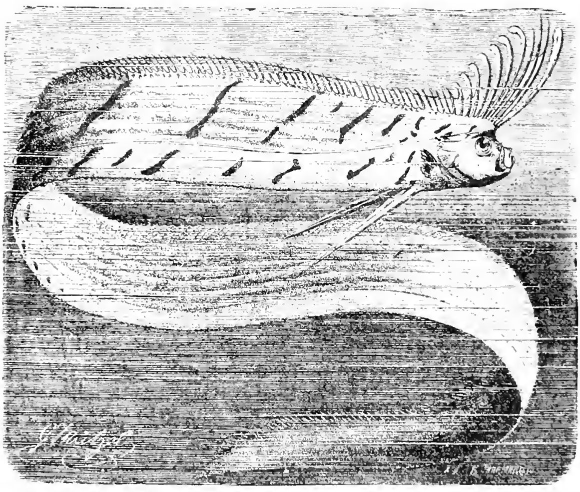
ponents are a little more widely separated. In both cases, as is common in this constellation, the diversity of colours is very beautiful. If we draw an imaginary line from α through ν Cygni, we shall come upon a star (marked, but not numbered, in the Map on p. 214) which must always possess the highest interest for all astronomical students. This is 61 Cygni, the very first of those suns which fill the universe, whose distance from the earth was determined by the illustrious Bessel. We need occupy no further space in a purely practical paper like this, than to say that, so stupendous is the interval separating our solar system from this object, that light (travelling 186,380 miles a second) takes something like six years to pass across it; so that the student whom our description may tempt to look at this interesting object, will see it (not as it is to-night but) as it was six years ago, when the light which enters his telescope left it! 61 Cygni is shown in Fig. 55. Cygnus is so crowded with beautiful fields of stars as to render any selection of them for description difficult; but the beginner may hunt up M. 39 (roughly, half-way between α and ω Cygni) to commence with. μ Cygni is a very pretty triple, the colour of the close pair presenting a pleasing contrast.

(*To be continued.*)

THE HERRING KING.

THE attention of scientists has frequently been called to the band fishes (*Tænioidei*), more on account of their odd form than for their value as a food fish. Their body is of an extraordinary length, and is flat, like a band or ribbon, and is covered throughout with small, beautiful, bright and shining scales. The dorsal fin extends over the entire back, and the ventral fin is missing altogether, or consists of a few long, thin, or fragile bone spurs, which are in the front part of the body near the pectoral fins.

Among the band fishes, the herring king, which is found in the northern seas, always creates more or less of a sensation every time one is caught, and that is seldom and far between. As this fish lives in the greatest depths of the ocean, it very rarely occurs that one is washed ashore. It was first discovered on the Norwegian coast in the neighbourhood of Bergen, in 1776, and as the herring were passing along the coast at the time, the new fish was named the Herring King. Later this fish was observed on the Scandinavian and Scotch coast, and lately a specimen was caught at Stavanger, and was preserved in an almost perfect condition. The most striking feature is the exceedingly great length, as most of the specimens caught measured from 9 to 18 feet in length. The head is



THE HERRING KING.

relatively very small, and provided with minute teeth. The bright, silvery, ribbon-shaped body is provided with dark spots and stripes, and the dorsal fin is of a mild pink colour. The first spines or ossicles are of an uncommon length, and form a fan-shaped and exceedingly fragile head ornament, which was not found in a perfect condition in any of the specimens.—*Scientific American.*

ANIMAL VACCINE.

DR. DRYSDALE, of London, in a paper read before the Sanitary Congress, said that he had previously recommended that the State, "if it made vaccination obligatory, should give a choice to all to have recourse to animal vaccine instead of humanised. As time passed, however, it began to be ascertained that animal vaccination had far higher recommendation. It was stated by Martin, in 1877, that erysipelas, one of the dangers in arm-to-arm vaccination, was unknown when animal vaccine was used; and latterly, in 1880, it had been given in evidence by Dr. Warlomont, of Brussels, Dr. Martin, of Boston, and Dr. Meares, of San Francisco, that animal vaccination was a perfect preservative against small-pox. Of 80,000 vaccinations made by Dr. Meares, not one was taken with small-pox in the epidemics which attacked so many, and proved fatal to so many of those who were supposed to be protected by having been vaccinated with long-humanised lymph. Dr. Drysdale remarked that he himself had witnessed the great difference in the appearance of the scab when humanised and animal lymph were used. In the former case, the crusts fill before the fifteenth day, and the scar was often extremely slight; in the latter, the crusts often remained on for four weeks, and the scar was like that described by Jenner in his early cases. Humanised lymph was not now nearly so protective as it was at the commencement of the century. Then it was supposed to protect for life. Now, one-tenth of the vaccinated when attacked with small-pox died. He concluded that there was no longer any doubt on this question, and that humanised lymph should be entirely abandoned, as it had been in Belgium, Holland, and the United States, in favour of calf lymph. The State should as soon as possible have stations in the United Kingdom, and dispense gratuitously animal vaccine, as it now does humanised."

Reviews.

AUTUMN LEAVES.*

WE can imagine no more suitable or charming present, at this season, than the beautiful work before us. It has always seemed to us that if an answer is needed to the gloomy question, "Is life worth living?" which some in these days have thought fit to ask, the answer is to be found in the sky and in the woods. Life is always worth living for those who have eyes to see and sense to feel the glory of the clear or cloud-drifted sky, the infinitely varied beauties of woodland scenery. No writer of our day has done more than Mr. Heath to open men's eyes to the grace and charm of forest scenes. Pictorially and poetically, he has brought before us the varied wealth of our woods, our hedgerows, and our pleasant tree-strewn meadows. He has caught, also, with true poetic feeling, that aspect of the woods in which their beauty is combined with the far-off splendour of the sunlit sky. Here, for instance, in the book before us is a passage in which the peculiar loveliness of the blue sky as seen through the foliage of trees is admirably depicted: "Oaks where we stand, growing from either bank, fling their branches from side to side, and meet and interlace midway. But at one spot there is an opening in the leafy shroud, and through the 'vignette' thus woven by the natural and untrained garlands of oak foliage we see the blue sky, and though it is but a patch of uniform colour, and we cannot now see as we could at night the contrasting beauty of the stars 'golden nails' as a pretty fancy loves to consider them, 'of the floor of heaven'—the sunny blue serves to throw out in strong relief the autumnal colouring of the oak leaves." In this work Mr. Heath describes and pictures the tints of autumn foliage, not only as we see them displayed in great masses in forest scenery, but (with special care) as they are seen in detail. In a former work he has illustrated the leaves of our trees in the summer months. Here he has undertaken the more difficult task of depicting them as they appear when the changes begin to take place on which the exquisite tinting of the trees in autumn depends. He shows us, in fact, the touches by which the great artist Nature produces those charming effects which our painters love to copy, so far as their less masterly touch permits. It is singular, by-the-way, that with Nature teaching them in our woods the beauty of soft tints and gentle contrasts, our British tastes should be chiefly for glaring contrasts and the primary colours, whereas in America, where the woods in autumn actually glow with rich colours and splendid but ever beautiful contrasts, the prevalent national tastes should be in favour of tertiary tints, and associated rather than contrasted colours. In Australia, on the other hand, where the autumn colours are much brighter than in England, the taste for bright and gaudy colouring is more marked even than in this country.

It has been proved that the tissues of plants contain a number of different colouring substances, to which the pleasing name *chromophyll* has been given, to distinguish these colouring matters considered collectively from *chlorophyll*, the substance which, when present in the superficial cells of leaves, causes them to assume, under the action of light, their characteristic green colour. "At night," writes Mr. Heath, "oxygen is largely absorbed by the green parts of leaves. When these are performing healthy functions and are in full vigour, the action of sunlight causes them to part with their oxygen. But as they approach the season for their fall, the active functions of assimilation and exhalation become retarded. The oxygen absorbed at night is not freely given off during the daytime, and its retention in the cellular tissues causes, under the sun's rays, the exquisite tints of autumn. How much," he adds, "these striking effects may be partly dependent upon chemical substances other than oxygen, absorbed into the tissues of plants from their roots, towards the approach of the season for the fall of the leaf, and how much on the action of light upon all these substances, science has not yet been able to accurately determine."

Mr. Heath gives us many specimens in this work of the actual colouring of autumn leaves, the "blossoms of autumn" as they have been poetically called. These pictures show with singular accuracy the outlines of form, the characteristic venation, and the tinting of the leaves. The method by which these beautiful pictures have been obtained is described in the text, though not, perhaps, quite so fully as many readers might wish. There are

* [illegible] *L*[illegible] By Fran[illegible] G[illegible] H[illegible], with twelve [illegible] M[illegible] [illegible] Rivingtons. Lon[illegible]

eighteen delightful engravings of New Forest scenery, executed from drawings by Mr. Short, who, living amidst the lovely scenery of the forest, "has learned his art from the great book of Nature."

Mr. Heath's work is one which we can thoroughly recommend as well to the lover of nature as to the student of art and science. It is a most enjoyable book. Moreover, it is as handsome in paper, type, and binding as book can well be. Its price (considering the nature of its contents, and, in particular, its twelve charmingly coloured plates, is very moderate.

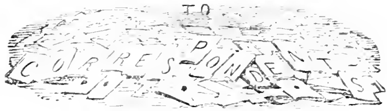
PHOTOGRAPHY AT HOME.*

Of late years there has been a revolution in the art of photography, through which not only has a great change been brought about in the rate at which pictures can be taken, but they can be obtained under much more pleasant conditions. Instead of a dirty, messy, and half-poisonous operation, it has become one which a lady can perform without soiling her fingers. The little book before us shows how the new methods can easily be learned and applied. It gives a brief sketch of the history of photography, describes the wet and dry processes, and gives a number of useful hints about the practical details. The writer points out that the constant study of pictorial effects, the lights and shadows cast by clouds, the changing tints of foliage, and other phenomena of nature, cannot but raise the artistic tone of the mind which practises them. He would even advise parents to let their boys and girls pay some attention to photography, which, if it be only looked upon in the light of a hobby, is at once harmless, healthful, and inexpensive.

THE POLYTECHNIC Y. M. C. INSTITUTE.

Last Christmas the Polytechnic was purchased by Mr. Quintin-Hogg, and adapted to the purposes of the Young Men's Christian Institute, at the sole expense of Mr. Quintin-Hogg, the cost being more than £25,000. The Institute devotes itself almost entirely to the requirements of apprentices, young mechanics, carpenters, bricklayers, cabinet-makers, engineers, plumbers, and so forth—workshops being prominent features in its system. The portion of the Polytechnic which was formerly occupied by the Small Theatre has been entirely rebuilt, and formed into a fine suite of rooms, which are devoted to the classes in the science, art, and technical schools. Adjoining is a well-fitted and well-furnished chemical laboratory. The Central Hall—the home of the old diving bell has been converted into a magnificent gymnasium, which is said to be the best in London. The Lecture Hall will accommodate 1,500 persons. There is a fine library and reading-room, with first-class lavatories, fitted with everything a mechanic might require to avoid the necessity of going home before attending the Institute or the classes. The applications for admission are already largely in excess of what had been anticipated. We have looked through the syllabus of the evening classes in science, art, technical and general subjects, with constantly-growing wonder at the wide range and admirable selection of the subjects dealt with.

* *Photography at Home: its Appliances and Apparatus for Amateurs.* (Marion & Co., London.)



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

*** *All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

SIZE OF RISING MOON.

[579]—Your late articles on "Forms of Clouds" remind me of a theory I have long since arrived at as to the cause of the magnified appearance of the full moon at or near the horizon. It is briefly this:—There are two skies with which the eye is familiar—the *cloud* sky and the *star* sky, differing remarkably in shape and in the objects they present to observation. The star sky is hemispherical, and may be represented by a semicircle. All objects belonging to it are apparently equidistant from the observer, and each is of the same size, whether seen overhead or near the horizon. Thus, sun, moon, and stars have no appreciable difference of size, and when the atmosphere is clear, but little of distinctness, in whatever part of the sky they are seen. The cloud sky, on the other hand, as shown by your diagrams, may be represented as resembling a small segment of a very large circle. The objects in it are comparatively near when overhead, and very remote when at its extreme parts. Thus a large bird in its flight becomes gradually smaller, and at length is lost in the distance, and, similarly, the largest balloon, though clearly visible when overhead, diminishes as it recedes, and becomes but a point at the horizon, even though, all the while, it may preserve the same vertical distance from the earth's surface. Now if in this cloud sky a second balloon were to be seen near the horizon beyond the clouds and other intervening objects, and having its outline clearly distinguishable and its angular diameter equal to that of the balloon overhead, the observer would instantly feel conscious that such balloon must be enormously larger than the other, and it would scarcely require any further reasoning process to convince him that this must be so.

A precisely similar, though momentary, mental impression is experienced when the clear broad surface of the rising moon looms up behind the clouds and other intervening objects, such as distant houses trees, ships, &c., seeming, from its apparent proximity and relative position to those objects, to be moving in the same atmosphere which encloses them. Instantaneously the observer's mind refers the great luminous mass to the cloud sky, and, as he suddenly recalls the well-remembered dimensions of the same orb when seen overhead, the comparison, just as in the supposed case of the balloon, flashes on his perception and produces the curious illusion referred to. If the observer now turns his back, and, by means of a small mirror, throws the reflected moon upward into her proper sky, she resumes, at once, her wonted size, and the illusion disappears.

G. E.

LOCAL WEATHER LORE.

[580]—In reply to your letter on the above-mentioned subject, I send you three apothegms, &c., &c., not, indeed, quite local, but which you may not have heard of. They are:—

First: "Saturday's Moon comes seven years too soon."

Now, I remember hearing that "saw" from my father one very wild Saturday evening in early summer that we had a walk together. He was a man of limited education, but of considerable sense, tinged, however, with a little superstition, it might be. I, a young lad, in my assumed superior knowledge, ridiculed the notion; but I recollect that many years after, and father had joined the "great majority," taking up an issue of a respectable local newspaper, the *Cork Constitution*, I observed in it a lengthy article, [illegible] However it comes about, a Satur- [illegible] rring upon that day of the week [illegible] welcome visitant.

[illegible] with in the *Family Herald*, and it ran [illegible]

> [illegible] descat Maria Purificante,
> [illegible] quam fuit ante."

[illegible] slated thus. –

> [illegible] Day be cloudy and dark
> [illegible] winter away on its back;
> [illegible] Day be dry and clear,
> [illegible] the winter's to come this year.

[illegible] I have observed that adage to be a correct [illegible] and as often the reverse. Ed.]

[illegible] constitutes my repertory. I should have [illegible] hands on them. The third, then, would be [illegible] of Pulchenelli—St. Swithin's. This has [illegible] superstition too, but here is what is said about him [illegible] Mater," vol. II., p. 132. —"There is not any occasion to [illegible] to account for such a phenomenon. Ex- [illegible] shown that whenever a wet season sets in about [illegible] the middle of July, when the heat of the sun is [illegible], it generally continues to nearly the end of [illegible]. W[illegible] action of that orb has considerably abated, the [illegible] affording matter for exhalation, always naturally the strongest at the hottest period of the year, and these exhalations yielding in return matter for rain."

[illegible] speaks a much higher authority—Howard on "Clouds."

The following excerpt I have taken from Mather's "Drug Circular":—

"WEATHER WISDOM.

"When you wish to know what the weather is to be, go out and select the smallest cloud you see. Keep your eye upon it, and if it decreases and disappears, it shows a state of air which will be sure to be followed by fine weather. But if it increases in size, take your greatcoat with you, if you are going from home, for falling weather will not be far off. The reason is this: when the air is becoming charged with electricity, you will see every cloud attracting all lesser ones towards it, until it gathers into a shower; and on the contrary, when the fluid is passing off or diffusing itself, then a large cloud will be seen breaking into pieces and dissolving."

"Evening red and next morning grey, are certain signs of a beautiful day."

"When the glow-worm lights her lamp, the air is always damp."

"If the [illegible] going to bed, he'll certainly rise with a watery head."

"When the peacock loudly bawls, then we'll soon have rain and squalls."

"When ducks are driving thro' the burn, that night the weather will take a turn."

"If the moon shines with a silver shield, be not afraid to reap your field."

"When rooks [illegible] sporting high in air, it shows that windy storms are near." — *Notes and Queries.*

Hoping [illegible] above contribution may be useful, I remain, sir, yours [illegible],

Michael Rearden.

SINGULAR MENTAL ILLUSION.

[584]—[illegible] kindly allow me to supplement the terrible ghost [illegible] of Knowledge with some remarks upon an [illegible] which happened to myself, and which comes, perhaps, under [illegible] mental illusions, though differing from yours as [illegible] character, and less encumbered by exciting antece- [illegible] apparent alarm. The scene was my sleeping-room, and [illegible] in height. I do not quite know when, only that it was [illegible]. My bed stood in a corner, a wall being close [illegible] parallel with it, on my right as I lay in bed, at [illegible] two and a half feet distance. One night, while peace- [illegible] I woke up to perfect consciousness. The w[illegible] of the room on my right, near my head, appeared full of light [illegible] bright and clear as to perplex me. I reasoned with myself, "There is no window there, no fire, lamp, candle, or other artificial light of any kind, and yet it's nearly as light as day." [illegible] narrowly, I saw a pillow end to end with my own, the [illegible] bed intervening, upon which, and also upon the [illegible] bedclothes, I distinctly saw every neat plait and fold. This state of things continued three or four minutes, and then [illegible] faded off into darkness. I was not conscious of any [illegible] mental disturbance, for the vision rather interested me. I thought it singular, of course, but I fully understood it to be a dyspeptic action of my erratic brain, for my temperament is nervous in the extreme.

I am perfectly sure that no one entered or left the room during the continuance of the phenomenon.

It is clear that the objects I saw might have been of distressing character, in which case I might have produced a story fellow to your own. I am thankful they were no more than passive and tranquil sheets and pillow cases, and light in which to see them.

For the simple truth of my narrative I vouch.

W. H. Perkins.

THE USE OF DRUNKENNESS.

[582]—Such a vice as this can never burn itself out, or it would have disappeared long ago; it is ever drawing fresh victims into its grasp to supply the places of those whom it destroys. Hence, a nation, such as the North American Indians, which does not possess the moral principles necessary to combat its influence, speedily disappears; and we may rest assured that the hope of England lies entirely in those humanitarian feelings, which have been the mainspring of the Temperance Reformation, now happily beginning to bring about a diminution in the quantity of alcoholic liquors consumed.

Surely Mr. Williams is wrong in assuming that to nearly every drunkard belongs a base and vicious disposition when sober! How many tens of thousands of our countrymen are there of whom it is a proverbial saying that they are the kindest of fathers and the best of husbands until "the drink gets in them?" How many are there in their sober moments who are goaded by the qualms of conscience, and the thought of the misery they are entailing, knowing that in a few hours the despotic thirst will again be all-clamorous, blunting the conscience, until the saturnalia is once more over, when again conscience will speak, it may be, however, in a fainter voice? So much for the process, "enjoyable in their own estimation." If Mr. Williams is sceptical of the reality of this picture, he should give the subject consideration.

Race-development is attained by a nation—as strength by an individual—not by the growth of an unhealthy tendency, which, so far from killing the impure parts, will pollute the lamp, but by the elimination, as far as possible, of every taint, and consequently the production of a healthier field for the natural forces to work upon.

J. Ralph.

THE NEW USE OF ALCOHOL.

[583]—I cannot help thinking that Mephisto (who gives his experience of alcohol in Knowledge, Sept. 8) would find a cold bath at night, followed by a few minutes' dumb-bell exercise, as efficient for inducing sleep as alcohol, and preferable to it in its after effects. Would he be so good as to tell us if he has tried it, and if so, with what effects?

J. S.

JORDAN-GLYCERINE BAROMETER.

[584]—Will any correspondent kindly give a description of the principle of, and mode of making, the "Jordan-Glycerine Barometer?"

C. J. W.

MONKEY AND MIRROR.

[585]—I was in a monkey-house near Manchester, some time ago, when one of the monkeys, having got hold of the cover belonging to a shaving-box, in which was inlaid a small looking-glass, caused very much amusement by holding the glass in one hand, and, whilst looking straight into it, feeling behind it with the other hand for the monkey it thought it saw, which I think was a very intelligent proceeding, and exceedingly practical.

Deo Fido.

THE "NEW METHOD" OF PRESERVING ORGANIC BODIES.

[586]—The galvanoplastic preservation of organic bodies exhibited by Professor Christian at Berlin, and described in Knowledge, page 223, is nearly forty years old. I practised it myself in 1845-6. If I remember rightly, it was Parkes, of Birmingham, who invented the process, which was to dip the object in a solution of phosphorus, in bisulphide of carbon, and then into a dilute solution of nitrate of silver. Or the object was first dipped in the silver solution and then exposed to phosphorus vapour. A coating of silver was thereby deposited on its surface.

I improved the original process by diluting the phosphorus solution with turpentine, and adding a little boiled linseed-oil to this. The result was a thin adherent varnish, containing sufficient phosphorus to precipitate the silver as a continuous film. I found that this precipitation was still further assisted by adding ammonia to the silver solution. Being then engaged in electro-depositing as a business, and these improvements economising the process considerably, I kept them secret for awhile, and sold my phosphorus solution at a good profit, as bisulphide of carbon then cost 2s. per ounce retail, and with one ounce I could make above twenty ounces of the "improved" solution by merely adding the cheap oil and turpentine. I sent a considerable quantity to St. Petersburg.

Practically, however, the method is of very little value. The crab, butterfly, and beetle shown by Prof. Christian may be better preserved by simple drying; and the brain of a rabbit, or other soft putrescent object, only show all their details, as described, when the film of metal is too thin to preserve the object in its original form. If made thicker, it becomes rough and warty, as all who are practically versed in electro depositing well know, and the object is thus defaced.

But for this, works of art in plaster of Paris might be converted into bronzes by simply coating them with copper. I worked at this for some time and made such bronzes, but they were very unsatisfactory. The artistic finish of the original was marred by the coating of metal, just as such things are too often spoiled by successive coats of paint.

The prettiest application is for the silvering or gilding of skeleton leaves, or similar light objects requiring only an immeasurably thin film of metal. This has survived, and is, I believe, still practised.

There is another and far more practical use of the silver precipitation of phosphorus — viz., that of forming a conducting surface on wax moulds and other matrices. I used it largely in conjunction with plumbago, depositing the silver first, and then brushing over with the plumbago. My solution was thus used in St. Petersburg, and may now be useful to some of the readers of Knowledge. W. Mattieu Williams.

DEFECTS OF BICYCLES.

[587]—All riders capable of forming a judgment, and free from prejudice, will agree with your excellent correspondent, Caleb Adams, in the opinion he expresses respecting the defects of the modern bicycle, but what makes his letter of such especial value at the present time is that a determined effort is now being made to import the defects of the modern bicycle into the tricycle. A number of gentlemen, principally racing bicyclists, have been endeavouring for months past to introduce path racing for the tricycle, alleging, as the principal value of such races, the great improvement that will result from proper machines for racing purposes being built by the manufacturers, and thus great alterations being made in the tricycles which have to be ridden on the road. Doubtless the result of this would be much smaller springs, with less elasticity, and, to reduce weight, much smaller steering-wheels. Such alterations would produce little effect that could be felt either on the asphalte track or cinder path, but would be destructive of the good qualities of the tricycle for riding over ordinary roads or touring purposes. John Browning.

[588]—I should like to add a few words to the letter of Mr. Caleb Adams (No. 531, page 235). With the general tenor of his experience my own experiments agree, but surely Mr. Adams has overlooked the efforts of the best modern makers to supply a spring which shall be at once neat and efficacious. The "Arab" and Hillman's "gig" spring will readily occur to the practised rider as samples of what I mean.

The small back wheel adds greatly to the appearance of the machine, and its ill effects may be almost entirely counteracted by using a large-size rubber tyre on it. So far as the comfort of the rider goes, the thicker tyre should be on the back wheel, instead of on the front.

As to large saddles, this is entirely within the personal control of every rider. Lamplugh, the great saddle maker, supplies all sizes, from immense tricycle saddles, suitable for sixteen-stone riders, to the smallest racing saddle, and any size is readily affixed to any bicycle. I have this season used a very large size with the best results. H. T. Round.

Letters in Type.—Physiological Experiment, by Z.; Talking Canary, &c., by Charles L. Cane; Dr. Hunter's Experiments, by Mathilde Van Eys; Coincidences, by A. R. W.; Lapidaries and Deception, by H. M. W.; Figure Training by Corsets, by Alfred Chadwick, M.D.; The Fifteen Puzzle, by A. B.; Flint Jack, by E. T. C. W.; Long Tricycle Ride, by J. F. P.; Spiritualism, by E. P. W.

Answers to Correspondents.

. *All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* Knowledge, *the increasing circulation of which compels us to go to press early in the week.*

Hints to Correspondents.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded, nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

J. H. W. L. Fancy many would not like portraits. It struck me at the British Association that the insides of scientific heads are, as a rule, better than the outsides.—T. H. Thanks. That subject (the seas) is full of interest. Have dealt with it in the first paper of my "Poetry of Astronomy," "When the Seas were Young," but will try to find room for a paper on the subject in Knowledge soon.—Jas. Pearson: Will notice it soon.—W. C. Thomas, T. H., P. Bosworth Smith, D. R. C. J. Caswell, A. J., H. J. Watson, J. W. Williams, E. H. Leeney, J. H. W. L., Eben. Jones, wish the weather chart discontinued.—Ex. Wy., Lionel T. Waller, J. Roundhead, M. Meres, and others, would prefer some weekly weather record, but are content, if the majority are, that Knowledge should be without it.—An Old Subscriber tells us that a highly scientific friend approved highly of the Charts—John Greenfield thinks that as we still recognise the mark of Balaam's rod on the ass's back, and the impression of Peter's thumb on the haddock (also on the John Dory), so may we find in the earth's tilt a mark of "its having been moved to prevent the sun's setting when Joshua wanted more light to defeat the Amalekites." Science raises its hat to Mr. Greenfield, and bowing, passes on.—C. J. Caswell. I liked the tables myself; but they were denounced lustily. Fear your friend will hardly enjoy the joke so much as you do.—D. R. Effects of interference too complex, I fear, for discussion here. But two persons not near each other, and both at a considerable relative distance from an orchestra, should hear similar sounds, just as two ships tolerably far from the region where various causes have troubled a sea, are similarly affected, though not near each other. At any given moment, the undulatory conditions are, of course, unlike; but the general effect is the same.—Rendrag. Will find space for the balloon extract if possible. G. S. Silent lightning is common when the air is moist; it indicates less electric tension than is present in ordinary thunderstorms. You say it seems to leap from the ground: and in books we often see the statement that lightning is generally seen to pass from the clouds to the earth, though occasionally the other way. But it is demonstrable that no eye can tell which way the lightning travels.—D. Davies. An obvious misprint—probably tables stereotyped. Do not know the ballad about half-crown and run-over boy. H. A. Bulley. It seems to me, as a layman, that there is much truth in your remarks; but I fear readers of Knowledge would object to a discussion in these columns of the relative merits of homœopathy and allopathy.—E. D. Warfing. (1) What do you understand by salt water? If you mean simply a solution of common salt in water, the easiest way of distinguishing salt water from sea water would be by tasting. But if you wish to know how sea water may be distinguished from other kinds of salt water, the answer would depend on their nature. In ordinary sea water common salt forms only about two-thirds of the solid matter, of the rest the chief constituents are chloride of magnesium and sulphate of soda (about $5\frac{1}{2}$ parts and $4\frac{1}{2}$ parts, respectively, in a thousand). Carbonate of lime and silica are also present. (2) I do not know how sulphate of iron stains can be removed from white marble. Perhaps some reader can inform us.—E. Brunetti. I fear it is hopeless to try to move the M.C.C. to any change. F. C. S. Your letter about smoking and growth is, unfortunately, too long. I think it is only smoking by young lads which is supposed to interfere with growth. But, for my own part, I look with great distrust on statistics of that sort. On the other subject (alcohol and brainwork), space is a little overcrowded just now. I want that list of letters in type to be shortened quickly. M. G. Oldham. The difficulty is that it is Edward, not Henry, in *Les Mondes*, the Abbé's own paper. A "slip of the pen" would hardly account for such a mistake. Many thanks for your kindly expression of opinion about Knowledge.—E. R. More astronomy now, since some readers are so pressing. I was so bashful, you perceive. J. H. W. L. Fear, without the specimens our zoological and geological contributors could hardly decide. The geological question would be especially difficult. Of course, the dental formula, in the other case, is not right for the dog, the likeliest animal otherwise. Are you sure about the molars?

Ignoramus No. II. (1) *Do "objects at a distance look smaller than they really are?"* If your question means why do objects look [illegible] (1) [illegible] Harland's [illegible] [illegible] her you push [illegible]. There is no [illegible] Cetewayo [illegible]. I think I remarked [illegible] right in their own [illegible] on any matter [illegible] expressed yet [illegible] who, because these [illegible] round them, stare at them, bow down [illegible]. [illegible] intended to be either sar- [illegible] different from [illegible].—W. G. Woollcombe. (1) I do not know [illegible] of these [illegible] by Negretti & Zambra. But [illegible] Mr. Browning's own estimate of the [illegible] you mention. (2) There is no complete [illegible] Advance of Science within the last forty or fifty [illegible] are so numerous that it is impos- [illegible]. (4) I do not know of any work in which all [illegible] invented improvements are described.—J. Hargrave. [illegible] make a mistake. The child cannot have fallen [illegible] lips of a near relative; relatives near or far off, do not [illegible] in their mouths. I have referred to the *Referee*, and [illegible] is relieved. "Bayonet" does not say that the child fell [illegible] what he says might be so interpreted. What he [illegible] had heard the account of the child "which fell out [illegible], from the lips of a near relative."—A Briton. [illegible] The Americans are always shooting each other. [illegible] difficult to make yourself heard on Broadway, by [illegible] firing of revolvers. It is equally true that [illegible] to walk beyond the suburbs of New York, lest an [illegible] tomahawk you. Seriously, you should read a little [illegible] better books; you would not then believe such [illegible]. I have been, altogether, two years in America, and [illegible] I only once heard a pistol fired in anger, and [illegible] was fired by a lunatic.—Jas. Nicholson. Book received. [illegible] shall be reviewed shortly.—M. G. Wells would like to [illegible] information about emigration. But the information he [illegible] his friend who wishes to emigrate is not very full. This [illegible] has £500, is strong, and intelligent. If that is enough to [illegible] where he had better go, perhaps some correspondent will [illegible].—Charles James. The account you give of the meteor [illegible] enough to be of use. For instance, what is "the velo- [illegible] which a body seems to move from a state of rest?" A [illegible]. Thanks. Will shortly start the monthly astronomical [illegible] you wish for.—R. A. Law. Yes; there were many remark- able [illegible] meteors in 1783. Gilbert White writes: "The summer of 1783 was [illegible] amazing and portentous one, and full of horrible phenomena; [illegible] besides the alarming meteors and tremendous thunder-storms that affrighted and distressed the different counties of this king- dom, the peculiar haze or fog that prevailed for many weeks in this [illegible], and in every part of Europe, and even beyond its limits, was [illegible] most extraordinary appearance, unlike anything known [illegible] the memory of man." This agrees well with Cowper's lines:—

> "Fires from beneath, and meteors from above,
> Portentous, unexampled, unexplained,
> Have kindled beacons in the skies."

[illegible] Thanks; you will see that we have already used [illegible] subject [illegible] name.—E. R. Cowley. Neither [illegible] now a trustworthy guide. In my book on [illegible] of the earth and sun are dealt with rather fully. [illegible] Many thanks, but articles of the same kind have [illegible].—H. A. Bulley. You mistake; Sir W. Thomson's [illegible] of lunar influence, as understood by seleno- [illegible]. His way of expressing himself was simply a sort of [illegible] rejection.—J. A. Ollard. 1. [illegible] detect any incorrectness in the [illegible] method? 2. Have you done so large a share [illegible] an opinion on the particular question [illegible] friend? I have myself tried the non- [illegible] for the purpose indicated [illegible] may be quite exceptional. 3. [illegible].—T. D. W. M. Mr. Proctor does [illegible] after his work is done. [illegible] me to say that the [illegible] tides are very [illegible] depend on the relative dis- [illegible], and the earth's [illegible] which increases [illegible] Mr. Proctor, in [illegible] on the tides [illegible] questions. You [illegible] feel about any- [illegible] "the nasty oxygen."

Surely oxygen cannot be altogether nasty and destructive.—W. Hicks. The idea that nothing can be destroyed—that "when the brains are out the man is" yet not "dead," but his thoughts go about in the ether, affecting men in some way we cannot understand—is pleasant, but it can hardly be said to represent as yet any esta- blished truth. I do not know of any trustworthy authority about thought-reading. Sufferer desires to hear of some remedy for stam- mering.—A Perplexed Student. The reviewer is, to put it mildly, mistaken. If 0 ÷ 2 is not equal to 0, by what does it differ from 0? I suggested, in answer to another correspondent that that reviewer should be rewarded by the sum of £1,000,000 multiplied by 0 ÷ 2. I would now suggest a different reward for him. Let him receive the sum of £10,000,000, multiplied by the difference between 0 and 0 ÷ 2.—Yale. Yenth Ruthra. Yes, there is a way of making up one hundred out of the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9. Try again.

ELECTRICAL.

H. Williams. The platinum wire passing through the glass of an incandescent lamp, to which the filament is attached, does not be- come incandescent, because it is comparatively thick, and does not therefore offer the necessary amount of resistance. The best way to regulate the intensity of a current is to regulate the speed at which the dynamo is driven. Where there is a large installation, it is usual to have a lamp or two in the engine-room, which, by the light emitted, form a kind of gauge.—A. H. Keeling. A Daniell cell is easily made. Get an earthenware jar of about quart capacity, costing 6d. to 9d., a porous pot sufficiently high to stand half to three- quarters of an inch above the level of the jar. For the plates get a piece of thin sheet-copper (say about 6 inches by 4 or 5 inches), the thinner the better, for cheapness. Bend it into a cylindrical form to go inside the porous pot. Get also a sheet of zinc one-eighth of an inch thick, and about 6 inches by 9 or 10 inches, and bend it into a cylinder to stand inside the earthenware jar, and outside the porous pot. The zinc should be amalgamated (see answer to J. N. Frazer, Knowledge, No. 43). To charge the cell put crystals of sulphate of copper (in buying it ask for *electrical*) into the porous pot, so as to half fill it, then fill up with water. Fill the outer portion up with water acidulated with about one-twentieth its volume of sulphuric acid. Then get a couple of binding screws or terminals, one for the zinc, the other for the copper. If you can use a soldering iron you may save the shilling or so for terminals by attaching pieces of copper wire direct on to the plates. The metal plates, although directed to be six inches high, should stand half-an-inch or so above the porous pot and earthenware jar respectively.

Our Mathematical Column.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

No. X.

By Richard A. Proctor.

We will consider a few more applications of the differential calculus to problems of maxima and minima.

A B, Fig. 1, is the section of a plane horizontal surface; L, a light vertically above A. If A B = 1 ft., at what height should L be, that the illumination at the point B may be as great as possible?

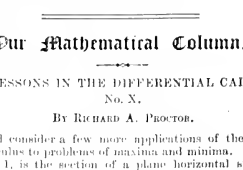


Fig. 1.

It is clear there is a maximum here; for, if L is in the same level as B, the illumination is zero, and so also the illumination is zero if L is at an infinite height.

Let A L = x. (The light is supposed to be a point, or, at any rate, to act as if collected at a point.)

$$\text{Then B L} = \sqrt{AB^2 + AL^2}$$
$$= \sqrt{1 + x^2}$$

And, according to the known laws of illumination, the illumination at B varies inversely as the square of the distance B L, and directly as the sine of the angle L B A. Hence, taking m (which will not eventually trouble us) as a suitable constant, we may represent the illumination at B by the expression

$$\frac{m}{(\text{B L})^2} \cdot \frac{\text{A L}}{\text{B L}} = \frac{m \cdot \text{A L}}{\text{B L}^3}.$$

Call this illumination y; then

$$y = \frac{m\,x}{(1+x^2)^{\frac{3}{2}}} \qquad \text{(i.)}$$

Now, to differentiate this expression, we take first the differential coefficient of the numerator and multiply it into the denominator. This gives

$$m\,(1+x^2)^{\frac{3}{2}}$$

Then we take negatively the differential coefficient of the denominator and multiply it into the numerator. This gives

$$-\frac{3}{2}(1+x^2)^{\frac{1}{2}} \cdot 2\,x \times m\,x, \text{ or } 3\,(1+x^2)^{\frac{1}{2}}\,m\,x^2$$

We have only to put the square of the denominator under these two expressions, thus

$$\frac{m\,(1+x^2)^{\frac{3}{2}} - 3\,(1+x^2)^{\frac{1}{2}}\,m\,x^2}{(1+x^2)^3}$$

to get the differential coefficient of y, and we could reduce and simplify this expression considerably. But observe, we only want to equate the coefficient to zero (that being, as in former cases, the way of getting the required value of x). So that we have no occasion to write out the differential coefficient as above, or to reduce it. We need only write its *numerator* and equate *that* to zero. This gives

$$m\,(1+x^2)^{\frac{3}{2}} - 3\,(1+x^2)^{\frac{1}{2}}\,m\,x^2 = 0 \qquad \text{(iii.)}$$

or, $(1+x^2) = 3x^2$ [dividing out by $m\,(1+x^2)^{\frac{1}{2}}$]

That is $2x^2 = 1$

$$x = \frac{1}{\sqrt{2}}$$

Hence A L should be about $8\frac{3}{5}$ in.

If we had taken A B $= a$ instead of 1, we should have obtained the result:—

$$a^2 + x^2 = 3x^2$$

i.e., $2x^2 = a^2$

or, $$x = \frac{a}{\sqrt{2}}$$

Note that the writing of this problem would be very short in practice. In fact, after expressing y in terms of x, as at (i.), the student would write down equation (ii.) at once; and solve as above.

Observe, again, that we can vary our method of attacking these problems by varying the relation whose change is to give our maximum. For instance, suppose we attacked the above problem **in this wise**:—

Let the angle L B A, Fig. 2, be called x. Then we know that B L = B A sec x. And the illumination at B may be represented by

$$\frac{m}{\text{B A}^2 \sec^2 x} \cdot \sin x$$

Putting this equal to y, we have,

$$y = m \cos^2 x \cdot \sin x.$$

Hence $$\frac{dy}{dx} = m\left[-2\cos x \sin^2 x + \cos^2 x \cos x\right]$$

[I leave the reader to see how this is obtained by applying the rules given in preceding papers, noting that a very moderate degree of practice will enable him to write down such a result at **once**.]

Equating this expression to zero, we have

$$\cos^2 x \cos x = 2 \cos x \sin^2 x.$$

Hence $$\frac{\sin^2 x}{\cos^2 x} = \frac{1}{2}$$

or, $$\tan x = \frac{1}{\sqrt{2}}$$

i.e., $$\frac{\text{A L}}{\text{B A}} = \frac{1}{\sqrt{2}}$$

Hence $$\text{A L} = \frac{\text{B A}}{\sqrt{2}} = \frac{1}{\sqrt{2}} \text{ as before}$$

Neither method has the advantage in this instance, but often a good deal depends on a proper choice of the method to be followed. For example, suppose B is a point on a desk (Fig. 2) sloped at an angle a to the horizon, and that we require the height A L which will give the maximum illumination in this case. Then the first method would be very inconvenient; but, on applying the second, the value of y is little altered. We only have to put, instead of the factor sin x (*i.e.*, sin L B A), the value sin $(x-a)$ (*i.e.*, sin L B M), giving

$$y = m \cos^2 x \sin (x - a).$$

And this is differentiated quite as easily as the other expression, giving

$$\frac{1}{m} \cdot \frac{dy}{dx} = -2 \cos x \sin x \sin (x-a) + \cos^2 x \cos (x-a).$$

Equating this to zero, we have,

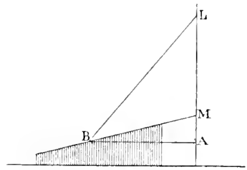


Fig. 2.

$$2 \cos x \sin x \sin (x-a) = \cos^2 x \cos (x-a)$$

or, $$2 \sin x \sin (x-a) = \cos x \cos (x-a). \qquad \text{(iii.)}$$

Here we want only a moderate familiarity with trigonometrical processes to get out our result, for equation (iii.) is the same as

$$2 \cos a - 2 \cos (2x - a) = \cos a + \cos (2x - a),$$

that is $$3 \cos (2x - a) = \cos a,$$

or, $$\cos (2x - a) = \frac{\cos a}{3}$$

This is sufficient for finding x, because a is supposed to be known. Suppose, for example, a is equal to eight degrees, *the slope of my desk*, for I have taken the notion of *working out this particular problem with the practical design of determining how high I should set the moderator which illuminates the paper I am writing upon*; we have then,

$$\cos (2x - 8^\circ) = \tfrac{1}{3} \cos 8^\circ$$
$$= \tfrac{1}{3}\,(\cdot 99027) \text{ from a table of natural cosines}$$
$$= \cdot 33009$$
$$= \cos (70^\circ\ 43') \text{ nearly enough}$$
$$\therefore\ 2x - 8^\circ = 70^\circ\ 44'$$
$$2x = 78^\circ\ 44'$$
$$x = 39^\circ\ 22'$$

And A L, Fig. 2, is equal to B A tan x. Now, in the case of my desk and light, B A is equal to 18 in., and B, the part of the desk where I actually write (shifting the paper to this point as I write on line by line) is about 4 in. above level of table, so that the height of the light should be (4 + 18 tan 39° 22′) in.

I take out the log tan of 39° 22′, which is $\bar{1}$·91401, and add to it the logarithm of 18, which is 1·25527, getting 1·16931, which is the logarithm of 14·768. Adding 4 to this, I find that the best height for the light of the moderator (above surface of table) is as nearly as possible $18\frac{3}{4}$ in.*

Russians employ petroleum successfully upon some of their railways for driving locomotives, using for this purpose the crude naphtha as it comes from the wells. Most of the steamers that ply the Caspian Sea use the liquid fuel, which is very much cheaper than coal. It is consumed with injectors such as are used in this country, and the combustion is regulated with the greatest ease.

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* The reader well up in his "Gulliver" may be reminded here of the tailors of Laputa, who applied mathematical methods in taking their customers' measure, and were led sometimes by errors in calculation to make ill-fitting garments. An error in the working of the above problem might easily (for instance) have given 1·87in., or 187 in., instead of $18\frac{3}{4}$ in.; and the care necessary to secure a true result might well seem greater than the problem, practically viewed, is worth. I have indeed merely taken the problem as a convenient illustration of the fact that the differential calculus may often be applied to practical matters, without desiring to insist on the special value of the result obtained in this particular instance; though, be it noted, that as the light of my lamp stood but $16\frac{1}{4}$ in. high, I set the lamp $2\frac{1}{2}$ in. higher after I had worked out the above result.

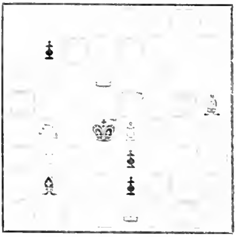
Our Chess Column.

By Mephisto.

PROBLEM No. 56.

By A. [illegible] B. Pa[illegible].

Black.



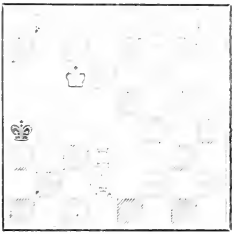
White.

White to play and mate in three moves.

PROBLEM No. 57.

By Leonard P. Rees.

Black.



White.

White to play and mate in three moves.

The following game was played at Manchester between Mr. A. A. [illegible] and Mr. Kay-Leather:—

Two Knights' Defence.

	White. A. A. B.	Black. K-L.		White. A. A. B.	Black. K-L.
1.	P to K4	P to K4	16.	Kt to B3	KR to K sq
2.	Kt to KB3	Kt to QB3	17.	Kt to K5 (d)	B takes Kt
3.	B to B4	Kt to B3	18.	P takes B	R takes P (e)
4.	Kt to Kt5	P to Q4	19.	R takes RP	QR to K sq
5.	P takes P	Kt to QR4	20.	K to R sq (f)	Q to B sq (g)
6.	B to Kt5 (ch)	P to B3	21.	B to KB4	KR to K2 (h)
7.	P takes P	P takes P	22.	B to Q3	P to Kt3 (i)
8.	B to K2	P to KR3	23.	B to KKt5	Kt to R4
9.	Kt to KB3	P to K5	24.	Q to B3 (j)	P to B3
10.	Kt to K5	Q to B2	25.	B takes KtP	P takes B
11.	P to KB4	P tk P en pas (a)	26.	B to B7 ch (k)	K to Kt2
12.	Kt takes P	B to KKt5	27.	Q takes Kt	R to K3
13.	Castles	B to Q3	28.	Q tks P (ch)	K to R sq
14.	P to KR3	B to Q2 (b)	29.	B tks R (K3)	B takes B
15.	P to Q4	Castles (KR) (c)	30.	R to B6	resigns (l)

NOTES.

(a) The moves so far are book moves. We should favour B to Q3 instead of taking the Pawn, as the Black Pawn is well posted on K5.

(b) As can be seen, Black has lost time by his eleventh and twelfth move, and White obtains a superior development.

(c) In this opening Black must attack, as otherwise the sacrifice of a Pawn would be useless. Instead of Castling, he might have ventured upon P to KKt4. Black has always the option of Castling QR for safety.

(d) White is now taking advantage of the position in an ingenious manner. He offers a bait which Black takes.

(e) This capture involves Black in difficulties; he ought to have retired his Knight to R2, and subsequently he might have made the advanced and isolated White Pawn the subject of his attack, for which purpose he ought to have brought his QKt over to his King's side.

(f) Necessary to enable White to play B to KB4, and deprive Black of the escape by Q to Kt3 (ch).

(g) Avoiding the threatened loss of the exchange, and also threatening B takes RP, which might be dangerous.

(h) It will be seen that besides losing his Rook's Pawn by his eighteenth move, Black's Rook is awkwardly placed, which is always the case when a Rook enters the game early.

(i) This move loses, but Black had hardly a good move.

(j) Acting coolly, White prevents Kt to Kt6 (ch) and Black cannot move his Rook from K2 on account of Q takes BP (ch).

(k) A powerful move, which speedily wins the game.

(l) It would have made no difference had Black played 29. R takes B, White would have won by 30. R to B7.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Problem No. 54 has proved a difficult one for our solvers, some of whom have failed to hit upon the pretty idea, in spite of repeated efforts. We believe there is some similarity between this problem and one published many years ago by Staunton, in the *Illustrated London News*; nevertheless, the idea is neatly worked out. We have received the most varied answers, thus: Y. Naylor gives 1. Q to Kt2; John O'Keeffe, 1. Q to B sq.; Kit, F. W. Cooper, Le Cavalier Noir, Novice, and several others, 1. Q to R5 (ch); R. Collins, 1. Q. to B5; G. A. Pearson and R. J. P., 1. Kt to Kt4 (ch), all of which are incorrect. We have received correct solutions from Squire, G. H. Bonner, Berrow. Problem No. 55.—To this pretty end position we have received several answers, all of which begin with 1. B to Q5 (ch). This, no doubt, is correct, and wins; but there is also another and prettier first move, which as yet none of our readers have found out.

KNOWLEDGE

AN ILLUSTRATED MAGAZINE OF SCIENCE

PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, OCTOBER 13, 1882.

CONTENTS OF No. 50.

Science and Art Gossip.

THE comet which came to perihelion on Sept. 17 last seems to be a return of the comet of 1668, which is probably the same as the comet of 1843 and the comet of 1880. If so, there seems every reason to believe that a few months will see the comet back yet again, and that the end then will not be far off,—the end of the comet, we mean, not that of the earth, as some seem to imagine.

THE orbit of the comet of 1843 is shown elsewhere. Dr. Hind's elements of the new comet differ considerably from this orbit, but they do not agree well with the observations. He infers that the elements were much affected during perihelion passage on Sept. 17. His elements are as follows:—

Perihelion passage, Sept. 17·1047, M.T. at Greenwich. (This means about half-past two in the afternoon of Sept. 17):—

	°	′
Longitude of Perihelion	271	39·5
„ „ Ascending node	347	44·6
Inclination	37	9·6
Logarithm of Perihelion Distance	8·09201	

Motion—retrograde.

THE comet was first seen by Mr. Finlay, First Assistant at the Government Observatory, Cape of Good Hope, at 5 a.m., on Sept. 8. He gives its place thus at 5 h. 14 m. a.m. on the 9th:—

Cape M. T.	R. A. °	′	″	Dec. °	′	″
Sept. 8, at 17 h. 13 m. 58 s.	144	59	51·4	−0	45	30·0

The following observations have been made on the dates named:—

		R. A. h.	m.	s.	Dec. °	′	″
Sept. 18·01062	Greenwich M. T.	11	30	58	+1	22	24
„ 19·001666	Greenwich M. T.	11	21	59	+0	24	38
„ 19·99437	Greenwich M. T.	11	15	24	−0	25	32
„ 22, noon, Palermo		11	5	39	−1	51	—
„ 28, 17h. 15m. Vienna M.T.		10	45	52	−5	51	—

A NOTE from Mr. Proctor, explaining his mistake as to the possible identity of the new comet and the comet of 1843 (a mistake which appeared in a portion of our last issue) was published in the *Daily News*, *Standard*, *Morning Post*, *Daily Chronicle*, and *Daily Telegraph* of Saturday last. The correction was sent to the *Times* also, but did not appear there. It was not to be expected that it would: the *Times* does not correct its own mistakes, whether in science or politics. Why should it help to correct other folks'?

THE *Daily News*, in an article on "whistling," which it argues is done only, as the poet says, "for want of thought," remarks that Athene threw away the flute (probably the Indian nosepipe), because it distorted *his* features. Athene is generally supposed to have been a lady. Alcibiades said no man of sense would play the flute, because his best friend would not know him when he was performing on that instrument, with which, therefore, he would have nothing to do.

BUT "Cosmopolitan," in the *Globe*, points out that the fishermen of Ceylon whistle for their bait. The fisherman runs down some yards to meet an advancing wave, agitates the water, and probably some sand also, with the fingers of one hand, and then runs backwards, whistling all the time. When the wave retires he follows its retreat, and almost invariably finds a long worm on the sand at the point where he had agitated the water. The opinion of the natives is that the whistling acts as a charm to the worm, and causes it to rise to the surface.

MR. PERCY RUSSELL has discussed in these columns the meat supplies of the world, and has shown that in Australasia there is abundant provision for our present wants. But Dr. Drysdale, as reported by the *Squire*, gives much fuller promise; for he says there is a never-failing supply in Australia and "several other hemispheres"—possibly in Venus, Mars, or Mercury.

CONSIDERING the high tides which we have recently had, it is not much to be wondered at that the inhabitants of South Belgravia should have been considerably alarmed about the risk of inundation, for there are parts of the river wall, at the end of the wharves in the Grosvenor-road and at the bottom of St. George's-square, where, should the river rise a few inches higher than it did last September, a very serious inundation would take place. A public meeting of the inhabitants of South Belgravia will before long, we understand, be convened to urge on the Government the necessity for the immediate raising of the river wall in these places.

AN electric launch named the *Electricity* has made a trial trip on the Thames, propelled by forty-five accumulators. The trial is considered to have been a successful one, and we shall doubtless soon hear more of this application of electrical power.

THE first Golden Eagle which has been seen in Argyleshire for many years appeared last week. It was seen by a keeper on the Strachur estates near Loch Fyne. Is it necessary to ask what that keeper did? The bird was a rare and interesting specimen; so, of course, he shot it.

AND yet they doubt whether modern so-called civilised nations are descended from savage races.

The quantity of gas used in London last year, according to the analysis of the London gas companies' accounts, prepared by Mr John Field, was, in round numbers, 20,230,000,000 cubic feet, which is equal to a bulk of one mile square by 726 ft. high, and its cost to the public was £2,911,000.

The proposition to hand over Kew Eyot to a speculator is, of course, an atrocity of which only such beings as Commissioners of Woods and Forests or Thames Conservators could be guilty. But a counter proposition to hand it over to Sir Joseph Hooker's tender mercies is infinitely worse. Judging from the development of Kew Gardens under his suave administration, the eyot would presently be surrounded by a wall 15 ft. high, with one gate (6 ft. by 2 ft.) to admit visitors between two and five p.m., subject to the courteous admonitions of a red-striped functionary, apparently selected for his fitness to terrify children. Walking-sticks and reticules rigorously excluded.

M. Fonsegrive discusses, in the *Revue Philosophique*, the various meanings which have been assigned to the words analysis and synthesis. He shows that Newton, who said analysis means passing from effects to their causes, was right, —"that is *comprehensive analysis*"; but Hooke, who said that analysis consists in passing from causes to their effects, was not wrong—for the comprehensive analysis of Newton is also *extensive synthesis*. It is, however, more important to make correct analysis or synthesis than rightly to define either.

M. P. de Tchihatcheff contends that the great deserts of Africa and Asia are not sea-beds, recently laid dry, but have been upraised at remote geological epochs, their sands being not of marine origin, but the product of rocks disaggregated by winds, changes of temperature, and so forth. The Asiatic deserts are far older than Sahara.

The Telephone in America.—According to a report presented to the recent telephone convention held in Boston, there are about 60,000 to 70,000 subscribers in the United States. In New York there are 2,873, and the smallest number in any one place is 10. There is a steady and continued growth all over the country.

The sugar beets on the Continent have been attacked by a new disease.

The female woodcock in America has been observed by Mr F. L. Harvey to carry away her young from danger between her feet.

The author of "Insect Variety" is preparing for publication a Table of Sun spots and Earthquake Phenomena, "by means of which many public calamities may be predicted. Public institutions or private individuals desirous to assist are invited to subscribe. Address—but no, our advertising columns are open. Zadkiel's Almanac also predicts public calamities, price 6d., and is likely to be equally trustworthy.

A joint annual meeting of the two Anti-Vivisection Societies took place, says the *Quarterly Journal of Science*, at the end of August. There were present, "besides the Rev. Mr. Grove and the inevitable Mr. Jesse, no fewer than three men, four women, a small girl, and four reporters." The A. V. S. Societies are looking up.

At Princeton, N.J., a splendid new equatorial has been set up at the Halsted Observatory. Its object-glass is 23 in. in diameter, and it has a focal length of 30 ft. Professor Young, one of the most skilful astronomers of the day, has charge of the observatory.

Search Lights for the Navy.—The British Electric Light Company have received an order from the Admiralty to supply the following search-light apparatus for war vessels:—Eight large 10,000 candle-power Gramme machines, eight projectors, and eight hand-lamps, as used in the late war.

At a meeting of the Birmingham School Board last week, the Education Committee submitted a memorial to the Privy Council seeking the power for School Boards to establish training colleges for teachers owing to the insufficient accommodation in the present training colleges. The memorial was generally approved, but referred back to the Education Committee for a slight alteration, after which the Board will appoint a deputation to wait upon the Education Department.

During the last voyage of the steamship *Kirkheaton*, Captain Cook, from Goole to Bruges, when she was but a few miles from the mouth of the Humber, bearing towards the Newark lightship, a violent thunderstorm broke over the ship. In the course of it a violent shock was experienced, as if she had been in collision with another vessel. The portion of the crew who were below ran on deck to see what had happened. It is believed that, though no damage was done, the vessel must have been struck in some way or other by a flash of lightning.

Fatal Accident.—The *Standard's* New York correspondent says:—"A workman who was repairing a lofty Brush light here received the electric current which was supplying forty lights. It passed through the man, who fell dead, the body dangling among the telegraph wires below. The hands were seared, and the face bore the expression of intense agony."

Electric Railways.—The number of railways to be worked by electricity is now considerable. Those which are working, authorised, or in course of construction, show a total length of about 100 miles. The lines actually at work are those of Lichterfelde, 1·56 miles, and that from the Spandeur Bock to Charlottenberg, near Berlin; the Port Rush to Bush Mills, in the North of Ireland, about 6·5 miles; and also in Holland, one from Zandvoort to Kostverloren about 1·3 miles long. Among lines authorised or in construction, the following are noted:—In Austria, the Mœdling line, near Vienna, 1·5 miles, to be constructed by the Southern Railway Company there. In Germany, the line from Wiesbaden to Nurnberg, 1·3 miles, and that from the Royal mines of Saxony to Zankerode. The line under the Thames connecting Charing-cross and Waterloo stations will be about three-fourths of a mile; also a line in South Wales thirty-seven miles, for which the power will be derived from fall of water. In Italy, Turin, and Milan will soon begin the construction of electric tramways. In America, the Edison Company have arranged for the working of 80 kilomètres on one of the great lines from New York. Another small line, 1·1 miles, is to be made at St. Louis, in Missouri, by Mr. Heisler.

THE SUN AND THE BROOK.

By Richard Jefferies.

Author of "The Gamekeeper at Home."

THE sun first sees the brook in the meadow where some roach swim under a bulging root of ash. Leaning against the tree, and looking down into the water, there is a picture of the sky. Its brightness hides the sandy floor of the stream as a picture conceals the wall where it hangs, but, as if the water cooled the rays, the eye can bear to gaze on the image of the sun. Over its circle thin threads of summer cloud are drawn; it is only the reflection, yet the sun seems closer seen in the brook, more to do with us, like the grass, and the tree, and the flowing stream. In the sky it is so far, it cannot be approached, nor even gazed at, so that by the very virtue and power of its own brilliance it forces us to ignore, and almost forget it. The summer days go on, and no one notices the sun. The sweet water slipping past the green flags, with every now and then a rushing sound of eager haste, receives the sky, and it becomes a part of the earth and of life. No one can see his own face without a glass; no one can sit down and deliberately think of the soul till it appears a visible thing. It eludes—the mind cannot grasp it. But hold a flower in the hand—a rose, this later honeysuckle, or this the first harebell—and in its beauty you can recognise your own soul reflected as the sun in the brook. For the soul finds itself in beautiful things.

Between the bulging root and the bank there is a tiny oval pool, on the surface of which the light does not fall. There the eye can see deep down into the stream, which scarcely moves in the hollow it has worn for itself as its weight swings into the concave of the bend. The hollow is illumined by the light which sinks through the stream outside the root; and beneath, in the green depth, five or six roach face the current. Every now and then a tiny curl appears on the surface inside the root, and must rise up to come there. Unwinding as it goes, its raised edge lowers and becomes lost in the level. Dark moss on the base of the ash darkens the water under. The light green leaves overhead yield gently to the passing air; there are but few leaves on the tree, and these scarcely make a shadow on the grass beyond that of the trunk. As the branch swings, the gnats are driven further away to avoid it. Over the verge of the bank, bending down almost to the root in the water, droop the heavily-seeded heads of tall grasses which, growing there, have escaped the scythe.

These are the days of the convolvulus, of ripening berry, and dropping nut. In the gateways, ears of wheat hang from the hawthorn boughs, which seized them from the passing load. The broad aftermath is without flowers; the flowers are gone to the uplands and the untilled wastes. Curving opposite the south, the hollow side of the brook has received the sunlight like a silvered speculum every day that the sun has shone. Since the first violet of the meadow, till now that the berries are ripening, through all the long drama of the summer, the rays have visited the stream. The long, loving touch of the sun has left some of its own mystic attraction in the brook. Resting here, and gazing down into it, thoughts and dreams come flowing as the water flows. Thoughts without words, mobile like the stream, nothing compact that can be grasped and stayed: dreams that slip silently as water slips through the fingers. The grass is not grass alone; the leaves of the ash above are not leaves only. From tree, and earth, and soft air moving, there comes an invisible touch which arranges the senses to its waves as the ripples of the lake set the sand in parallel lines. The grass sways and fans the reposing mind; the leaves sway and stroke it, till it can feel beyond itself and with them, using each grass blade, each leaf, to abstract life from earth and ether. These then become new organs, fresh nerves and veins running afar out into the field, along the winding brook, up through the leaves, bringing a larger existence. The arms of the mind open wide to the broad sky.

Some sense of the meaning of the grass, and leaves of the tree, and sweet waters hovers on the confines of thought, and seems ready to be resolved into definite form. There is a meaning in these things, a meaning in all that exists, and it comes near to declare itself. Not yet, not fully, nor in such shape that it may be formulated—if ever it will be—but sufficiently so to leave, as it were, an unwritten impression that will remain when the glamour is gone, and grass is but grass, and a tree a tree.

HOW TO GET STRONG.

(*Continued from page 233.*)

TO STRENGTHEN THE UPPER BACK AND SHOULDERS.

IN our last, we considered the muscles in front of the chest—or, technically, the pectoral muscles. We have now to consider how the muscles of the upper back and shoulder—the dorsal muscles—may be strengthened.

Here, for the first time in these papers, we are considering muscles which are more apt to be over-developed, relatively, than to have insufficient amount of exercise. It is much more common to see men round-shouldered in consequence of undue development of the muscles of the upper back, than to see the muscles of the arms or legs, or of the front of the chest or abdomen, too fully developed. The deformity—for such it unquestionably is—may, indeed, generally arise rather from insufficient development of other muscles than from excessive use of the dorsal muscles. Still, it remains the case that probably of all the muscles of the body those which in this country are generally attended to best are the muscles of the upper back and shoulders.

The reason of this is that the favourite forms of exercise in this country are such as encourage the development chiefly of these muscles. "Rowing," says Maclaren, "is the chief of all our recreative exercises; no other can enter the lists against it; in fact, it has collected and concentrated in itself all the attractions and all the emulative distinctions of all others." Next to rowing, boxing used to be a favourite exercise, and it still holds a place in our gymnastic system. Now, boxing is good for the chest and pectoral muscles, and in rowing the muscles of the legs *may* be very actively employed. But in both exercises, and in others which are in high esteem in this country, the dorsal muscles are actively used. In rowing especially this is the case—insomuch that you can tell any rowing-man when his shoulders are stripped, and some rowing men even when they wear their usual clothing, by the way in which the muscles of the upper back and shoulders outweigh, so to speak, the muscles of the front of the chest.

The idea that rowing expands the chest is as absurd in reality as the cognate mistake that it specially strengthens the biceps muscles. Yet both mistakes are so common that if you tell most rowing men that their exercise is better for the shoulders than for the chest, better for the forearm than for the upper arm, and better (if properly managed) for the legs than for the arms, they will think you are laughing at them. Yet it has been demonstrated by actual measurement that this is the true state of the case. "Rowing," says Maclaren, "gives employment to a portion of the back, more to the loins and hips, and most of all to the legs, but it gives little to the arms, and that little chiefly to the forearm; and least of all to the chest." He was speaking, however, of rowing in light racing-boats. In ordinary river boats, the forearms get a good share of work, and the dorsal muscles probably get more work than the legs. As for the chest, it gets so little work that it seems, in the case of many persons who devote a great deal of their time to rowing, actually to shrink.

We cannot direct attention too strongly to what Maclaren has said on this point, because what he says is true of every kind of rowing, from pulling a heavy, "inrigged tub," to rowing in the lightest outrigged craft which has ever yet been constructed. "*The part of the body which receives the smallest share of the exercise in rowing is the chest,*" he says; "it has little or no employment in the muscular effort required for the propulsion of the boat; and *this is impressively evident in the results. Not only does the chest make no advance in development in this exercise, but if it be exclusively practised, an absolutely depressing effect is produced.*" No single result of recreative or systematical exercise may be more fully substantiated than this. Take any crew in the University, just as it stands, and at any stage of its practice, and it is possible, in a given space of time, by varied systematised exercise, to increase the chest of every man by a given number of inches, with a proportionate development of power; let this cease, and exclusive rowing exercise be resumed, and the progressive development of the chest will also cease; nay, its muscles will lose their condition, and their power will decline, in obedience to the organic law that power is in relation to employment, for here they have virtually none. I could at this moment point to men who have had rowing for exclusive exercise since they came to the University,—men endowed with an organisation capable of the finest development, whose chests have been almost stationary for years, the years during which they should have made the greatest advancement—who have now, in fact, the same development in this region which they brought from school, lingering at thirty-six or thirty-seven inches, when forty or forty-one was fairly within their reach.

We shall illustrate our next article with two pictures, one from a photograph of a successful oarsman, the other showing what properly-proportioned chest, arms, and shoulders should be like.

(To be continued.)

SECONDARY BATTERIES OR ACCUMULATORS.

ONE of the greatest marvels of the age is the immense interest attaching to this series of apparatus. In a sense, the excitement consequent on the demonstration of the practicability of electric lighting is less, inasmuch as for several decades past that subject has been periodically revived in the minds of scientific men. Notwithstanding the fact, however, that secondary batteries are now before the general public for the first time, it must not by any means be supposed that they are novelties to the better-informed physicists.

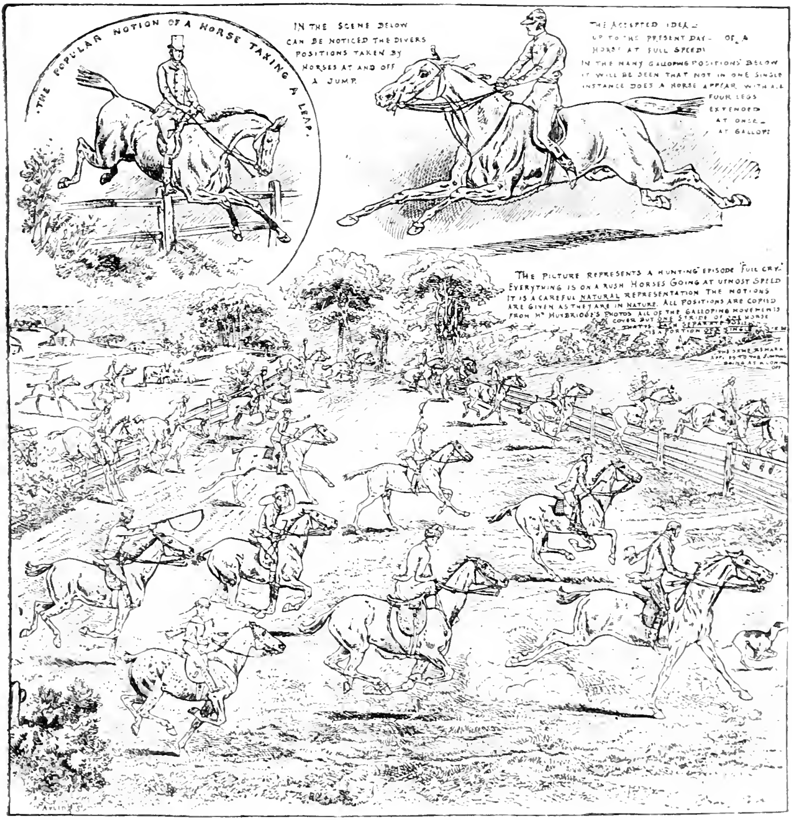
It is not necessary, nor would it be advisable, for us to go back eighty or more years to lay before our readers the history of the secondary battery and the principles that govern it. We will pass over the preliminary but important work of Galvani, Volta, Ritter, and a number of other devotees, pausing to say a word or two about the celebrated gas battery of Sir William Grove, which may be said to embrace the fundamental principles of secondary batteries.

"In this battery each cell consists of a vessel containing acidulated water, in which the lower portions of two platinum plates are immersed, their upper portions being surrounded, one by oxygen and the other by hydrogen, enclosed in inverted tubes. Each tube has a platinum wire passing through its upper end and connected with the enclosed plate. These wires are the terminals of the separate cells, and in combining a number of cells into a battery, the oxygen tube of one cell must be connected with the hydrogen tube of the next. When the circuit is completed a current circulates, opposite to that which would have evolved the gases from the acidulated water, and the quantity of gas in the tubes diminishes. Chemical combination, in fact, goes on between the two gases of any one cell through the intervention of the acidulated water. The plates employed in this battery are usually covered with a deposit of finely-divided platinum, which increases the rapidity of the action."* This lato feature is somewhat important. With a gas battery of fifty pairs, Grove produced electric lights, effected various chemical decompositions, &c.

To M. Gaston Planté, however, more than to any other man, justly belongs the first place of honour in this branch of scientific labour. It is a most remarkable fact that the very thing which the general body of practical workers regard as an obstacle other men take up, and by its means confer an immeasurable boon on humanity. It was so in the case of M. Planté. Electricians had striven very hard to rid themselves of the troubles arising from what is called the "polarisation of the battery." For this purpose the Daniell cell was invented, which to this day stands forward as pre-eminently the best for the ordinary requirements of telegraphy. Polarisation results in the deposition of one or more of the constituents of the liquid in the cell on one of the plates. In the simple cell, with zinc and copper immersed in acidulated water, the zinc is oxidised, and converted into zincic sulphate, while hydrogen gas is deposited on the copper plate. In a short time this hydrogen becomes a powerful source of an opposing current, the cell being then useless. Substituting a simple metallic salt for the acid, the metal is, generally speaking, deposited on the copper, or whatever substance may constitute the negative plate; the acid portion of the salt combining with the zinc, or positive plate. But the same thing which takes place in the battery cell may be made to occur in any part of a battery circuit. Here, then, lies a part at least of the action of Grove's Gas Battery. A current, in passing through the water, decomposed it, the two constituent gases—oxygen and hydrogen—accumulating, the former at the positive electrode, or point of entry of the current, and the latter at the negative electrode, or point of exit.

This principle may be seen elsewhere, for wherever we pass electricity through a compound liquid, a change in the chemical relationship may be found, and this change will always be such as will tend to generate an electric force opposite in direction to that which brought about its existence. Such, then, is "polarisation." Briefly defined, we may say that "polarisation is the electric re-action at the poles or electrodes of a cell, and is of the nature of a counter-electromotive force." How M. Planté made use of this polarisation, we will say in our next.

* Deschanel's "Natural Philosophy."



SCIENCE OF THE HORSE'S MOTION.

THE remarkable pictures of the horse in motion, as revealed by Mr. Muybridge's instantaneous photographs, taken in California, at the instance of Governor Stanford, show that the impressions produced upon the human mind through the eyes, in closely watching the motions of a horse when running a certain distance, are very different from the impressions which will be made during the same run upon a highly sensitive photographic plate.

In a recent number of the *American Queen*, we find a peculiar drawing, which is of value as illustrating at one view these extraordinary differences of impressions.

The two upper figures show the impressions ordinarily made upon the mind's eye by the horse and rider in the acts of running and leaping. Here we have grace, vigour, and strength very well exemplified. The smaller figures below are mostly made from the instantaneous photographic pictures before mentioned, with this important qualification, however, that while many of the positions of the horses are correctly taken from the photographs, the positions of the riders are, we suppose, the work of the fancy of the artist. There is an old adage, that things are not what they seem to be; and it is proverbial that the eye of man is an organ that is easily deceived. It is certainly, at present, an agreeable kind of illusion which makes us see the horse as we do see it, and not as the photo plate sees and records it.

It is possible, however, that in the future, now that the photograph points out so many forms and motions that have escaped our attention, we may be able to sharpen our eyes, and hereafter to see things about the horse to which heretofore we have been blind. And it may come to pass that all those singular attitudes shown in the lower part of our illustration, which now seem so absurd and awkward, will become endowed with grace and beauty in our minds, while the old forms will be dismissed as untruthful and therefore ugly.—*Scientific American Supplement.*

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

By Amelia B. Edwards.

XI.—PA-RAMESES (*Continued*).

The letter last quoted, announcing the advent of Menephthah at Pa Rameses, was addressed by the Scribe Amenemapt to the Scribe Panbesa. We are now about to read a letter from the Scribe Panbesa to the Scribe Amenemapt. This document also forms part of No. III. of the Anastasi papyri. It has been translated into French by MM. Chabas (1864) and Maspero (1872); and more recently into English by the late C. W. Goodwin (see "Records of the Past," vol. vi., 1876). It was also in part deciphered by the Rev. J. Dunbar Heath as far back as 1855.

The letter of Panbesa is a very remarkable production. It is, in the Egyptian sense, a poem. That is to say, it is phrased and divided into short lines like the Hebrew Psalms. Red dots are placed above certain words to show where the lines begin. The style is thoroughly Oriental; and, notwithstanding the ages which separate us from the literary public of the XIXth Dynasty, we are yet able to appreciate its florid and somewhat hyperbolical beauty. By the Egyptians of that time, it was evidently regarded as a classic; the document in the Anastasi papyri forming part of a transcribed collection of choice pieces. Also, it was not a *bonâ-fide* letter, in the sense of a private communication. It was a literary letter; a composition addressed, by way of dedication, to a superior, and intended for circulation among people of culture. It is not, however, as a specimen of Egyptian style, but as a topographical document, that the letter of Panbesa is especially valuable to our inquiry.

The document, I should observe, is greatly mutilated; and most of the fruits, flowers, and fishes mentioned in the course of the poem are unknown to us under their Egyptian names. Where these are explained, the explanations are chiefly borrowed from Dr. Birch's foot-notes to Mr. Goodwin's translation. The text is based principally on Mr. Goodwin's version, with some aid from that of Professor Maspero. The date of the composition may be confidently assigned to the reign of Rameses II.; probably towards the end of his long career, the writer being the same scribe, Panbesa, with whom the same scribe, Amenemapt, was in correspondence during the reign of Menephthah, the successor of Rameses II. The poem would seem to have been composed in celebration of the Royal visit to Pa Rameses.

The Letter of Panbesa.

The Scribe Panbesa greets his Lord, the Scribe Amenemapt, to whom be life, health, and strength!
This is sent for the information of my Lord.
This is for my Lord's pleasure.
When I arrived at Pa-Rameses Mer-Amen
I found all in good order, beautiful, peerless;
Like the foundations of Thebes,
Where to live is happiness.
Its fields are filled with delicious things;
It is provisioned daily (a) with good food;
Its tanks are stocked with fish, and its
Ponds with water-fowl;
Its meadows are fat with pasture;
With the tufted *Ates* (b) blossom,
And the *Tenraka* (c) plant, sweet like honey,
Which grows in the fields of the water-wheels.
Its threshing-floors are piled to the skies
With wheat and barley.
Leeks grow in the beds;
Gourds on the trellis;
Grapes, and olives, and figs in the orchard.
There is sweet wine of Khemi (d)
Far above honey.
There are red Utu (b) fish from the river of lilies;
Speckled mullet from the tanks;
X'eprun (b) fish from the river Puharta (Euphrates);
Hanata (b) fish from the canals of Aanekht (e).
The Pool of Horus gives salt;
Lake Pahura (f) gives nitre.
Its galleys come and go in the port.
Riches and provisions abound daily therein.
Gladness abides with those who dwell in it;
None dispraise it.
The lesser folk are there equal with the great folk.
Come, let us celebrate its heavenly festivals
And its season-holidays!
The papyrus-marsh is gay with *Menhu* (g) blossoms.
The Pool of Horus is covered with flowers of *Asi* (h);
There are *Sabora* (b) flowers from the Arboretum;
Garlands from the vineyards;
Wild-fowl from the inundated lands.
The coast-men of the sea bring eels, and the fish *Atu* (b).
The maidens of Aanekht (i) are in holiday attire every day.
Their locks are redolent of perfumed oil;
They stand in their doorways,
Their hands full of nosegays
And of green boughs of Pa-Hathor (j),
And garlands of Lake Pahura,
On the day of the entry of
Ra-user-ma Sotep-en-Ra,
The Mentu (k) of the Two Lands (l),
The morning of the Feast of Choiak (m)!
And every man is like his neighbour,
Making his petition.
Oh, the sweet drinks of Aanekht!
Its pomegranate-wine is like flame;
Its syrups are flavoured with
Carob-fruit surpassing honey.
Beer of Kati is brought to the port;
Wine comes from the vineyards;
Sweet oil from Sakabaui; (n)
Garlands from the arbours.
The sweet singers of Aanekht
Are of the school of Memphis. (o)
Joy reigns and prevails there
Uninterruptedly.
Ra-user-ma Sotep-en-Ra
(To whom life, health, and strength!),
The Mentu of the two Lands,
Rameses Mer-Amen
Is its God!

Notes.—(a) Meaning that it had a daily market. (b) Unknown. (c) Probably cucumber, or melon. (d) Egypt. (e) The canals of the neighbourhood; Aanekht being one of the names of Pa-Rameses. (f) One of the Bitter (or natron) lakes in the Isthmus of Suez. (g) A flower with red and violet petals. (h) Apparently a kind of water-plant. (i) Aanekht, *i.e.*, Pa-Rameses. See above. (j) The abode, or temple, of Hathor; meaning, probably, boughs from the sacred enclosure of that temple. (k) *Mentu*, the Mars, or war-god, of Egypt. (l) Upper and Lower Egypt. (m) Choiak, the fourth month of the season of inundation. (n) Unknown locality. (o) The *Memphitides puellæ* of the Latin authors.

Now the important points to be noted in this little poem are :—

1. That if Pa-Rameses was supplied with rare fish from the Euphrates, it must have been in some kind of communication with the Red Sea.

2. That it was in the neighbourhood of a piece of water called *Shet-Hor*, or the Pool of Horus.

3. That it was also near one of the bitter lakes, the water of which is impregnated with nitre (Natron).

4. That it was a place accessible to shipping.

5. That the local deity of the town was Rameses II.

This last point—and it is a strong one—coincides with all the former evidence. There were temples in Pa-Rameses to other gods ; but the supreme deity of the place was its royal founder.

The mention of Shet-Hor is also very important, when taken in connection with another mention of this piece of water which occurs in a celebrated stone-cut inscription on the walls of a small court on the south side of the Great Temple at Karnak. This inscription (which I shall have occasion to examine more particularly by-and-by) records how a great invasion of the Mediterranean races took place soon after the accession of Menephthah, and how the king fortified Heliopolis and Memphis, and "established outposts before *Pa-Baris* (Bubastis), in the vicinity of the canal *Shakana*, to the north of *Shet-Hor*."*

I may here observe in passing that I have not quoted all the instances in which Pa-Rameses is mentioned in the papyri of this period ; but I have quoted all that are noteworthy. The remainder are mere incidental allusions, invocations to the gods of the place, addresses upon letters, and the like.

Of Pa-Tûm, or Pa-Toom—which was, both strategically and historically, a much less important place than Pa-Rameses—we find but one unmistakable mention in the papyri of the period. The document in which this mention occurs also forms part of the Anastasi collection (No. VI.). It dates from the VIIIth year of Menephthah, and purports to be a report written by some captain of the frontier guard, relating how certain Shasu (Bedaween) had sought and received permission to graze their herds in the well-watered pastures about Pa-Tûm.

"We have done all that was needful in suffering the Shasu tribes of Adumah (Edom) to pass the fortress of Menephthah Hotepherma (to whom be life, health, and strength !) on their way to the Pools of Pa-Tûm of Takou, that they may feed their cattle in the great pasture-lands belonging to the king (to whom be life, health, and strength !), the Sun of all Countries, in the year VIII. . . . their names have been entered on the list. . . " &c., &c.

To this I may add (not having Mariette's "Denderah" at hand, and relying on the authority of M. l'Abbé Vigoureux), that the name of *Pa-Tûm*, designated as a town on the Eastern frontier, appears in the great geographical lists of the Temple of Denderah.

Lastly, Herodotus—who is always to be relied upon when speaking from personal observation, and not repeating tales told to him by *cicerones* and priests—not only names the town of Pa-Tûm, but with great precision describes its position in relation to the city of Bubastis and the canal mentioned in connection with Bubastis in the great lapidary inscription at Karnak before referred to. He is writing about the canal, which he mistakenly attributes to Nekau, the son of Psammetichus, whereas it was actually begun and carried to a considerable distance by Seti I. "This prince (Nekau)," he says, "was the first to attempt the construction of the canal to the Red Sea—a work completed afterwards by Darius the Persian—the length of which is four days' journeys, and the width such as to admit of two triremes being rowed along it abreast. The water is derived from the Nile, which the canal leaves a little above the city of Bubastis, near Patûmus, the Arabian town, being continued thence until it joins the Red Sea." (See Rawlinson's "Herodotus," book ii., chap. 158.)

That the Patûmus of Herodotus was the Egyptian Pa-Tûm, and that the canal here described is the canal of the Karnak inscription, are facts which admit of no shadow of doubt ; and that Pa-Tûm and Patûmus are the Pithom of the Bible is, I think, equally certain. Sir Gardner Wilkinson, in his foot-note to Rawlinson's translation of this passage, remarks :—"Herodotus calls Patûmus an Arabian town, as lying on the East side of the Nile" (vol. ii. p. 206) ; and, in point of fact, every Nile tourist to this day follows the example of Herodotus in thus loosely describing sites to the east of the river. The desert on the right bank is always the Arabian desert, and the desert on the left bank is always the Libyan desert. Also, this part of the frontier-land, including the old Nome of Kosem, or land of Goshen, was called in the time of Herodotus by the mere modern name of the Arabian Nome—meaning the Nome farthest east, in the direction of Arabia. Neither Patûmus, nor Bubastis, nor the canal was Arabian in any other sense.

* For translations of this inscription, see "The Invasion of Egypt by the Greeks," by Dr. Birch, "Records of the Past," vol. iv., and Chabas's "Antiquité Historique." Paris. 1873.

Mr. Stephen S. Haight says that last year he saw a house struck by lightning, and the eave plates completely destroyed. No other damage was done, and, beyond a slight shock, the family sustained no harm. At both ends of the house there was a lightning conductor, but neither of them bore any mark of the discharge. In front of the house was the pole of a telegraph line, stayed by a wire to the gate-post. The stay wire was melted, and the gate and gate-post damaged. A deep furrow also ran from the gate to the brick sidewalks, where it terminated in a hole. A tree in the course of the furrow was killed. He (the speaker) had no doubt that the damage was due to the stay wire, and, moreover, that the attractive power of the hemlock tree is greater than that of the deciduous trees.

Camels live from forty to fifty years ; horses average from twenty-five to thirty ; oxen, about twenty ; sheep, eight or nine ; and dogs, twelve to fourteen. Concerning the ages attained by non-domesticated animals, only a few isolated facts are known. The East Indians believe that the life period of the elephant is about 300 years, instances being recorded of these animals having lived 130 years in confinement after capture at an unknown age. Whales are estimated to reach the age of 400 years. Some reptiles are very long-lived, an instance being furnished by a tortoise which was confined in 1633 and existed until 1753, when he perished by accident. Birds sometimes reach a great age, the eagle and the swan having been known to live one hundred years. The longevity of fishes is often remarkable. The carp has been known to live 200 years ; common river trout, fifty years ; and the pike, ninety years, while Gesner—a Swiss naturalist—relates that a pike caught in 1497 bore a ring recording the capture of the same fish 267 years before. Insects are very short-lived, usually completing the term of their existence in a few weeks or months. Some even die upon the very day of entering on their new life. As a general rule not to be applied too closely, larger types of animals live longer than smaller.

CLOUDS IN THE AIR.

By the Editor.

(Continued from page 279.)

In our last we considered the effect of foreshortening on rounded clouds; we have now to consider how those clouds which are really long, parallel bands appear, as seen from different points of view. As before, we imagine clouds and arrangements of clouds altogether more regular than in nature. In fact, it is only thus that the problems we have to deal with can be effectually treated; for if we gave to the clouds we considered peculiarities of shape such as actually exist in nature, it would be impossible to distinguish properly the effects of such peculiarities from the effects due to the position of the clouds, or cloud-bands, with respect to the observer.

Let us suppose, in the first place, that the clouds are arranged in a series of parallel bands, as shown in Fig. 1. These clouds may be supposed to be roughly circular in section athwart their length. The portion of sky supposed to be shown in the figure may be regarded as about the

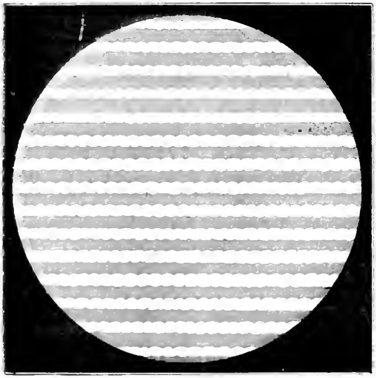


Fig. 1.

same as is shown in the three last figures of the last article (pp. 278 and 279), or about forty-five degrees from the zenith, all round. [But later, when we have to consider the effects produced by foreshortening near the horizon, we may also regard the picture as showing the whole atmosphere above a place.]

In Fig. 2 the cloud-bands, shown in Fig. 1 as they actually are, are shown as they appear to an eye placed immediately beneath the region represented. In other words, the centre of the figure represents the point over head, while the circumference represents a circle on the sky about forty-five degrees above the horizon. We see that the bands, which are really straight, appear to the eye to be curved. It may be noticed here that this figure enables us also to recognise the real meaning of the curved outline often seen in the case of a cloud covering the region over head. Such a cloud will often be seen to have an outline like an arch, drawing close to the horizon on either side, and rising high above the horizon in the middle—having, in fact, the same form as the outline of one of the bands shown in Fig. 2, about midway been the centre and the edge. We see from Fig. 1 that this does not really show, as it seems to do, that the cloud is higher in the middle than at either side, but that the part of the edge which seems highest is nearer than the part which looks lower. Thus when a part of the under edge of a cloud-bank which we are approaching seems higher than the rest, we may infer that that part is nearer than the rest, and that

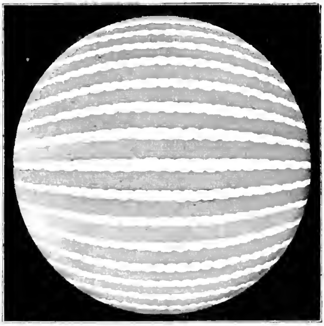


Fig. 2.

the sky overhead will soon (if we continue our advance) be free from clouds.

But while the parallel bands of clouds in the region overhead are thus modified in form, a much more marked change affects parallel bands lying near the horizon. Of course, the nature of the change depends in part on the direction of the bands. If we look towards that part of the horizon where the length of the cloud-bands is at right angles with the line of sight, we see the bands all brought together by foreshortening, so as to form a mass of stratus

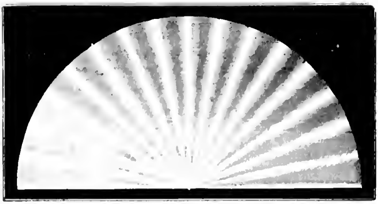


Fig. 3.

cloud, marked by a series of striations parallel to the horizon. If, on the other hand, we look towards the horizon in a direction parallel to the cloud-bands, a very different effect is produced. For then, by a well-known effect of perspective, the vanishing point of the parallel bands is on the horizon, and the clouds appear to radiate from the horizon, as shown in Fig. 3. It is obvious that the same effect will be produced whether we look in either of the two directions parallel to the cloud-bands—so that, when the whole of the visible sky is occupied by parallel cloud-bands, there are two opposite points of the horizon, whence the clouds seem to radiate as shown in Fig. 3.

This, by-the-way, may help to explain a phenomenon which is often seen in tropical and sub-tropical regions, and which many observers seem to find perplexing—the existence at the same time of two sets of radiations from the setting or rising sun: for it is clear that if there are a series of straight and parallel rays from the sun near the horizon, these, like the parallel cloud-bands, would appear as a series of radiating beams, not only around the sun, but around the point of the horizon opposite to him.

(To be continued)

THE MENACING COMET.

By R. A. Proctor.

In my last I promised to show that this comet was seen where the comet of 1843 and 1880 could not have been seen—within two degrees. I am unable to do this, simply because there is every reason to believe that the comet which circled close around the sun on Sept. 17 is no other than our friend the Menacing Comet, come back not in fifteen years, as the *Spectator* said I said it might, but in less than two years and eight months.

I had corrected the proof of Prof. Smyth's letter on the comet, when it occurred to me (for my sins, no doubt) to make a rough calculation to see whether the orbit of the comet of 1843, seen from the earth's place on Sept. 18, crossed the position occupied by the comet on that day. I turned to my comet portfolio for my diagram of the orbit of comet 1843—or rather of the part of the orbit near the sun. Unfortunately, the arrow put in to represent the direction of motion had been carelessly drawn the wrong way, making the comet's course direct instead of retrograde, and thus altering the rising node into the descending node, and *vice versâ*. Having occasion for dealing rather quickly with the matter, I did not notice the error, and naturally came to an erroneous conclusion. The Editor of Knowledge remarks on this, that as I have no hesitation in pointing out the mistakes of others, I ought not to hesitate to point out my own mistake here. I tell him that the mistake arose from an exuberant anxiety to find out the truth, and tell it to readers of Knowledge. To this he replies, "That's all right, and now's your chance."

Seriously, I doubt whether many readers of Knowledge could have found out my mistake if I had chosen to leave it alone, but it is a clear duty to correct it. I wrote so soon as I had detected it (which was within an hour of my receiving first copy of Knowledge) to the six leading daily papers, to correct it, and, with one exception, they kindly gave me the opportunity.

Now to give a more correct account of matters:—

In Fig. 1, *c*, *p*, *g*, represents the perihelion portion of the orbit of the comet of 1843 around the sun S, ☊ being the rising node, ☋ the descending node. B D *i* is the orbit of the earth near the time of the vernal equinox, the position of which is indicated by the line S ♈. The places of the earth on Sept. 12, 17, 18, 19, 24, and 28, are shown at Q, A, B, C, D, and E respectively, and the direction lines from the earth on those days to the new comet are shown. (The last was added after the block had been already cut.) The plane of the paper is supposed, for convenience of reference, to correspond with the plane of the comet's orbit (the comet of 1843 is here referred to), and as the inclination of this plane to the ecliptic is about 35½ degrees, we must suppose *i* D *i'* to be inclined at this angle to the plane of the paper, *i* being above that plane by the distance *k l*, and *i'* below it by the equal distance *k' l'*. So much understood, the real direction of the lines Q*q*, A*a*, B*b*, C*c*, D*d*, E*e*, can be at once recognised. It will be seen that they agree with the observations recorded elsewhere for these respective dates.

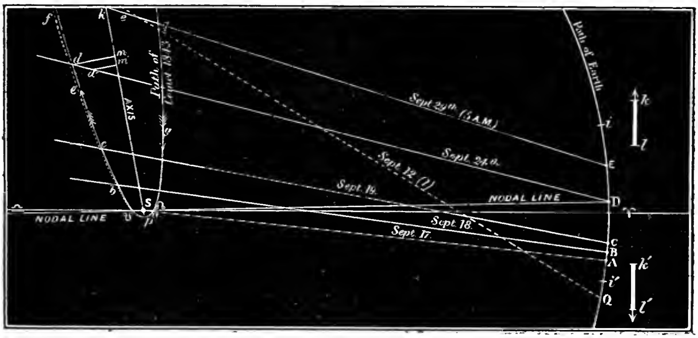


Fig. 1.

These direction lines are so situated that they cut the plane of the orbit of the comet of 1843, in the points *a*, *b*, *c*, and *d*, lying on or very near the orbit of that comet. About the line Q*q* there is room for doubt, the telegram from M. Cruls at Rio Janeiro, having probably been incorrectly rendered.

The other observations (which are given in detail at p. 319) agree so well with the theory that the comet is moving in the orbit of the comets of 1843 and 1880 (at least in the part of the orbit near the sun, for at aphelion the orbit has been entirely changed) as to leave scarcely room for any doubt that the comet has come back again long before it was expected—how soon to return yet again, and how soon to be finally absorbed by the sun, it were at present somewhat rash to say. But in another paper I have given some evidence which makes it *look* very much as though the end of the comet were not many *months* off.

In the next number I shall consider at length *how* that destruction of the comet, which now seems certain, is likely to be brought about, and with what probable effects on the sun and on this earth.

(To be continued.)

WHEN WILL THE COMET RETURN?

THE following, besides dealing with the comet, shows how the motion of a body moving in a very eccentric orbit in a given period may be conveniently dealt with.

I have shown in my "Geometry of Cycloids," that the common cycloid may be used for measuring the motion of a body in a very eccentric orbit around the sun—at least, this follows directly from what is illustrated there in the plate facing p. 209, where the curves for all orders of motion, from motion in a circle to motion in a straight line, under gravity, are given together. We see in that picture a certain curve for an eccentricity of nine-tenths, and this curve lies very close to the common cycloid representing the time-curve for motion in a straight line (eccentricity unity). How much nearer (in fact, not distinguishable from the cycloid), would be the curve for an eccentricity of ·99989 such as the comet of 1843 had! Supposing the period of the comet reduced to one year, the eccentricity, assuming the perihelion distance 500,000 miles, would be

$$\frac{92{,}500{,}000 - 500{,}000}{92{,}500{,}000} = \frac{920}{925} = \frac{184}{185}$$

Or the distance of focus from perihelion less than one-eighteenth part of that shown in the plate above mentioned. Thus the time-curve would lie only at one-eighteenth part of the distance from the cycloid at which the curve for eccentricity 9÷10 is placed, which yet lies so near the cycloid that, if drawn by itself, the eye could not recognise any difference from the true cycloidal figure.

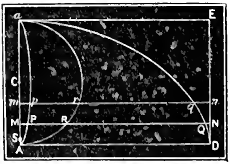
We may, then, for the purpose of a rough calculation such as I am about to make, take the cycloid for our time-curve after the manner described in Section VII. of my treatise on the Cycloid (the section explaining my "Graphical Use of the Cycloid and its Companion to determine the Motion of Planets and Comets").

The particular problem I wish now to deal with is this:—

Supposing the comet of 1843, which had been before moving in a period of more than 100 years, moved after 1843 in a period of 37 years, and after 1880 in a period of less than 3 years, so as to be back at perihelion on September 17th last, we might fairly infer it would not be at all unreasonable to infer that its next circuit would be accomplished in a year. Let us see, then, in what time, roughly, it would accomplish any distance from the sun on its elongated orbit.

Let APa represent the orbit of a comet, C its centre, AC = earth's distance, or 92,500,000, S the sun (AS = about 500,000 miles), AQD a half cycloid having aA for axis. Then, as I have shown in my "Cycloidal Geometry," if MPQN is drawn parallel to the base AD, the time in which the comet moves from A to P is to the time from A to a as QN is to MN.

Now, instead of drawing a cycloid aQD, with special care, to give us the times we want, suppose we make the calculations suggested by this construction. They are very easy.



Draw the circle aRA cutting MPQN in R. Then we know from the properties of the cycloid that

$$QN = \text{arc } AR - MR.$$

Suppose now AM = a third of AC; that being about the distance traversed by the new comet from S, as observed on Sept. 24.

Then CM = $\frac{2}{3}$ CA = ·66666 . . . if CA = 1; then from a table of natural cosines we find that arc AR, whose cosine is ·666 . . . is one of 48° 12′; and (this we take out at the same time) the sine of this arc is ·745476. Turning next to a table of lengths of circular arcs, we find that the arc AR of 48° 12′ has a length of ·841249. Hence

$$QN = ·841249 - ·745476 = ·095773$$

$$\text{And AD} = \text{semi-circumference} = 3·141593.$$

$$\text{Thus the time from A to P} = \frac{95773}{1570796} \text{ of half a year}$$

$$= \frac{95773 \times 182·625}{3141593} \text{ days.}$$

log.	95773 =	4·9812431
log.	182·625 =	2·2615602
		7·2428033
log.	3141592 =	6·4971499
		0·7456534 = log. 5·5674.

So that on this supposition as to the period, 5 days 13 hours 37 minutes would have been required to carry the comet over the distance actually traversed between Sept. 17 and Sept. 24, or in 7 days.

Let us try an orbit of different dimensions:—

Suppose Aa, the major axis, to be only one-half the earth's, so that by Kepler's Third Law the period, instead of being one year would be 1 year ÷ $2^{\frac{3}{2}}$, or 1 ÷ $\sqrt{8}$ (we need not work out this value—as we shall obviously want the logarithm of the number of days in this new period, and this will be obtained by subtracting the logarithm of $\sqrt{8}$ from the logarithm of 182·625 already in use).

If now Am represent about a third of the earth's mean distance on this new scale, where AC represents half the earth's distance, then obviously $Am = \frac{2}{3}$AC; and

$\frac{Cm}{AC} = \frac{1}{3} = ·3333.$ . . . . Hence Ar is an arc of 70° 32′; rm = ·942835 (using table of natural sines as before); and arc rA = 1·231039. Thus

$$qn = 1·231039 - ·942835 = ·288204.$$

or time

$$\text{from A to } p = \frac{288204}{3141593} \text{ of } \frac{1}{\sqrt{8}} \text{ of } 365·25 \text{ days.}$$

Now,—

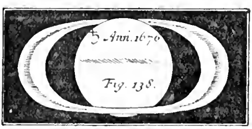
log 288204 = 5·4597000		$\frac{1}{2}$ log 8 = 0·4515450
log 182·625 = 2·2615602		log 3141593 = 6·4971499
7·7212602		6·9486949
substract 6·9486949		
0·7725653 = log 5·9233		

This is still too small; so that if we are right in concluding from the observation at Vienna on September 24, that on that day at noon the comet had reached the position shown at d, Fig. 1, p. 327, the projection of which, Sm, on the axis, pk, is about one-third of SD, then the period in which the comet will return to perihelion is certainly less than half a year. It is, however, to be noted that in that case the orbit has been reduced in width (minor axis), so that some such point as d' would be the true position of the comet on September 24, the projection of which, Sm', on kp is rather less than Sm.

For my own part—so far as observations hitherto made enable me to judge—I expect the comet back in less than half a year.

WHO DISCOVERED THE DIVISION IN SATURN'S RING? *

EVERY one interested in the chronology of the discovery of Saturnian detail must thank you for your verbatim extract from the "Philosophical Transactions" at large on p. 307. My own quotation, on p. 295, was from the well-known abridgment of the "Philosophical Transactions," by Lowthorp, published in 1716, which is to be found in so many libraries. Reading the original article now, *in extenso*, it seems practically certain that your own interpretation of Ball's meaning (foot-note, p. 294) must be the correct one; and that both he and Wallis (who was, presumably, "the person to whom notice was sent hereof"), regarded the "Notches or Hollownesses, as at A and B," as evidence that there was a separate ring, or perhaps two veritable ansæ, on each side of the body of the planet. I have seen an engraving from a drawing by Huyghens, in which this form of duplication is considerably exaggerated in comparison with that shown in the figure you reproduce on p. 307. Certainly, if Ball had the slightest notion that two concentric rings surrounded Saturn, it is odd that he gave no indication of the division in his sketch.



If the accompanying *fac-simile* of Cassini's sketch of the planet, taken from Lowthorp, be worth reproduction, it will show at once how unmistakably the French astronomer saw the real interval separating the two rings, and, consequently, I would submit how truly he is entitled to the entire credit of the discovery. "Ball's division" is certainly a solecism, and should be banished from all future astronomical works, as descriptive of the space separating the two bright rings of Saturn. [Readers of the original and new editions of my "Saturn and its System," please notice this point: Cassini and not Ball discovered the division in Saturn's ring.] WILLIAM NOBLE.

* A note which should have preceded the title of the extract referred to, was accidentally omitted. It mentioned that the extract had been sent to us by Mr. J. Ward, and seemed entirely to dispose of the claim made on Ball's behalf. Then the title (which read rather strangely) should have followed in small capitals, being really a sub-title only. We are glad to notice that a writer in the *Athenæum* has followed Captain Noble's lead, and seems on his way to the same solution and conclusion.

OXYGEN AND DISEASE GERMS.

MR. F. J. FARADAY calls attention in the *Times* to certain remarkable facts communicated by M. Pasteur to the recent Hygienic Congress at Geneva. Starting with the suggestion by Dr. William Roberts, F.R.S., that disease germs might be "sports" from harmless saprophytes which had acquired a parasitic habit, it has been argued that such "sports" might be developed by cultivation in the presence of noxious gases, or in confined places in which the proportion of free oxygen present in good air did not exist. The hypothesis has been specially applied to the evolution of the tubercle bacillus, but it is obvious that it is equally applicable to the evolution of the germs of other diseases, such as typhoid fever. The process described by M. Pasteur at Geneva, as having enabled him to convert the virus of the form of typhoid fever which caused great mortality among horses last year in Paris into its own vaccine, has a noteworthy bearing upon this hypothesis. M. Pasteur first tried to "attenuate" the virus by cultivating the specific microbe, which he had already discovered as associated with the disease, in contact with air. But experiments showed that the culture retained its fatal attributes for a certain period, when it suddenly became absolutely sterile, or, in other words, the microbe died. M. Pasteur then adopted a method which can only be adequately described as a process of nursing the microbe, so as gradually to adapt it to a new mode of life, or, in other words, to modify it without destroying its fertility. Taking a virulent culture from the blood of a rabbit which, through inoculation, had died of the disease, he sowed fresh portions of this culture in veal broth on successive days, and kept the series in contact with air. He had thus a graduated series of cultures from virulent stock in process, each of these cultures having been subjected to the modifying influence of oxygen for a different period. M. Pasteur was thus able to seize the moment when the culture which had been exposed the longest to aeration became sterile, and to select a culture on the eve of sterility, which he transferred to a fresh infusion already found to be specially suitable to the microbes, and which consisted of two parts of veal broth with one part of pure rabbit's blood. Having, in fact, reduced the microbe to the verge of sterility, or death, he subjected it at this critical moment to an invigorating regimen, and thus protracted its vitality and made it the stock of a new series of cultures. By repeating this process again and again in all its details, M. Pasteur ultimately evolved a race capable of serving as the vaccine of the original virus, oxygen having been the modifying influence throughout.

There is a striking analogy between the treatment thus described and that by means of which, about six years ago, Fraulein Marie von Chauvin evolved *amblystoma*, a land salamander, from the water-breathing Mexican axolotl. She selected healthy animals, and first kept them in shallow water, so that they were not quite covered by the water. When their health declined she restored them to deep water. Gradually she accustomed them to shallow water, and eventually kept them on land in damp moss. She was obliged to force them to eat by compelling earth-worms to wriggle down their throats; and feeding them well at the critical stage of metamorphosis seems to have been the main condition of success. When the change from gills to lungs was perfected, they fed themselves with avidity. But Nature herself, notwithstanding the difficulties experienced by Fraulein von Chauvin in transforming her axolotls (some of which died under the treatment), apparently succeeds sometimes in evolving *amblystoma* from the Mexican newt; therefore, assuming the variability of specific microbes under the influence of oxygen, there is nothing unusual in the idea of the parasitic germs of epidemics being spontaneously evolved from harmless saprophytes under peculiar conditions of culture, such as the presence of various gases instead of free oxygen. In that case, ill ventilated sewers, stagnant pools, and other places where aeration is not efficiently carried on, may continually evolve new crops of specific disease germs. Moreover, no embryologist will object to the attribution of the characteristics of species to the infinitely little, and the resistance to re-transformation under artificial conditions displayed by M. Pasteur's typhoid microbe is only what we might expect, on the assumption that it is a confirmed new species. Fraulein von Chauvin's axolotls had to be forced to eat under the new conditions which she provided for them, and they would certainly have died if they had been left to themselves.

The behaviour of M. Pasteur's typhoid microbe, which retained its specific or virulent character even under the influence of oxygen, until it suddenly died, is singularly like that of the axolotls. Does it not also explain the often sudden disappearance of epidemics? The typhoid germs, having acquired a parasitic or virulent habit, say in the sewer, are conveyed to the bodies of human beings. Though subsequently exposed even to the abundant oxygen of a healthy locality, they resist its influence for a certain period, spreading death meanwhile, and then, under the influence of sanitary conditions, they suddenly become sterile and the epidemic disappears.

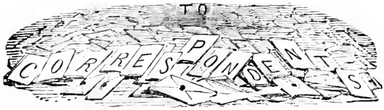
Reviews.

"TALKS ABOUT SCIENCE."*

WE have been anxious to speak very favourably of this book, for reasons which will suggest themselves to our readers; but we cannot speak of it altogether so favourably as we could wish. The duty we owe to our readers conflicts with our wishes. It is but fair to mention, however, that Mr. Welsh, in the preface, says the volume has been prepared "rather as a slight memento of one whose method of teaching endeared him to a wide circle of students, than as containing any original contributions to the general knowledge of the subjects of which it treats." Many, doubtless, will like to possess this little book as a memorial of Mr. Dunman's life and labours. Here, however, we are concerned only to inquire how far the papers before us present the true facts of science, and what are its qualities as a literary production. Unfortunately it falls short in many important respects. We could pass over the facile way in which space is wasted, though we have little liking for the style of condescending badinage which has been introduced by some South Kensington writers and lecturers, a style which the author of this book seems to have borrowed rather than independently adopted. When Mr. Lockyer tells us, for instance, that rays, after passing into the spectroscope, "tie themselves into a true lover's knot, before they come out again" we do not feel that the image, however familiar, is either explanatory or poetical. Nor are the phenomena of solar atmospheric absorption explained by saying that certain rays "are gobbled up on their way to the earth, and come to us with a balance on the wrong side of the account." But apart from faults of style which Mr. Dunman has copied from his exemplars, there are many serious errors as to matters of fact in the papers before us. There is no reason, for instance, if readers like that style, that a writer should not explain in a condescending manner why we wear dark clothes in winter; but the explanation should be correct. In a single paragraph, the book before us tells us that dark clothes conduct heat better than light ones; that they keep in the heat better than light ones; that light clothes radiate the heat instead of absorbing it: all which statements are quite incorrect. Mr. Dunman's explanation of the way of finding the latitude at sea is open to exception. "Supposing," he says, "a sailor wants to find out his latitude—in other words, his distance from the equator—this is what he does. Certain bright stars are well known to him; he knows exactly how far off they are from the North or South pole, as the case may be; he turns his telescope to a star which he knows to be 10° from the north or south, but he finds out that that star is 30° away from the point over his head—that is to say, 30° away from him; thirty and ten are forty, he knows that he is 40° from the North Pole. Now, the distance from the Equator to the North Pole is 90°, and forty from ninety, any boy in the first standard will tell you, leaves fifty; and therefore the sailor knows that he is in 50° north latitude by such an observation as the one I have supposed. So, you see, the finding your latitude is simply noticing your distance from certain stars, the position of which is well known." The explanation is very plainly worded, but unfortunately it is entirely erroneous. Such parts of it as are, we suppose, intended correctly, are unmeaning. It is just such explanations as these which send an audience away from a lecture with the feeling, "Dear me, how easy it all is!" A feeling which changes presently to the thought that nothing has been really explained. After all, it is easy to explain nothing (our public men do that for us every day). It is also easy to understand nothing. Naturally, in treating the much more difficult subject of the longitude more mistakes are made. Mr. Lockyer's mistake, which makes noon observations at sea do duty for determining time, which of course they are quite unable to do, is repeated. The lunar method, which Mr. Dunman calls the lunar theory of finding the longitude, is then tackled, which would have been a daring feat for Sir John Herschel. "I don't know of any one having attempted to make that most abstruse subject clear to a popular audience" Mr. Dunman admits. This is how the difficult task is achieved. "There is published in London a wonderful almanac, called the 'Nautical Almanac,' which is published every year five years in advance, and in that almanac there is laid down the exact Greenwich time for every possible position of the moon among the stars. Consequently, all that the sailor has to do is to find the exact position of the moon among the stars, and to turn to his 'Nautical Almanac,' and having found that position against it he will see marked the Greenwich time." It would be well, indeed, for sailors if the matter were as simple as it is here described.

There is much pleasant reading in this work; but we are afraid we cannot honestly say it is a trustworthy guide on any subject of which it treats.

* *Talks about Science.* By the late Thos. Dunman, with a biographical notice by Charles Welsh. (London: Griffith & Farran.)



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of KNOWLEDGE: *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday*.

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig*.

THE SCHOOL OF TELEGRAPHY AND ELECTRICAL ENGINEERING.

[589]—The more critical portions of the article on Electrical Engineering which appeared in your issue of September 22—an article which, rendering unsolicited justice to the endeavours we have made for many years past, goes far to repay us for the labour and sacrifices which have accompanied them—has received very careful consideration on our part. This has confirmed us in our determination, to which we had already nearly arrived, to increase from six to nine months, the period in which we undertake to qualify for useful electrical work, any youth possessed of a fair educational training, and a taste for some of the applications of science. But we feel called upon to give some explanation of the method by means of which we have obtained a most encouraging measure of success—in some cases even beyond our expectations—within the smaller minimum period of tuition, and of the reasons which induce us to think that the longer period above-mentioned—which might still be regarded as inadequate—will be ample for our purposes under our system of tuition. We have already intimated that we do not accept as students those who have not in themselves some foundation upon which we can build a superstructure of useful and extensible theoretical and practical knowledge. And, as we have also intimated, we are sometimes surprised at the amount of natural talent we find, only waiting for development under a proper system. A capacity for somewhat severe work is a primary qualification we do not lose sight of. Then it is part of our system to make practical and experimental work a recreation in respect to theoretical studies, and *vice versâ*. We may claim also that it has been our good fortune to secure the best available talent and knowledge for technical tuition; in some cases from quarters in which, by reason of pressing demands upon time, co-operation in this direction would ordinarily be declined. For instance, some of the editors and members of the editorial staff of more than one of our foremost technical journals take charge of certain branches of tuition. It should be mentioned also that endeavours are always made to discover the particular or most prominent aptitude of each student, so that his energies may be directed into the right channel. To this course we, in great measure, ascribe the fact that so many of our men, shortly after leaving the school, find themselves, *facile principes*, virtually, if not ostensibly, at the head of some important branch of some large commercial undertaking.

In regard to the theoretical training: this may be considered under the two broad headings of electro-statics and electro-dynamics, each being interlinked with certain kindred studies. Ordinarily, the former of these two branches would be neglected, and attention would be given almost exclusively to the latter of them, since they have been considered as two very distinct sciences, of which the latter is practically the more important. But it may safely be stated that no electrician can have any real mastery over his work who is deficient in electro-statics. Now the main characteristic of the theoretical training at the school is that the student is not called upon to wade through two totally distinct sciences. The perfect analogy between the two branches of electrical science, the almost absolute identity of the theoretical and practical formulæ involved in them, is not only pointed out, but acted upon to the extent of making the two branches mutually elucidate each other. It is not too much to say that if the analogy in question were ignored—as too frequently it is—nine months' tuition would be altogether insufficient for the theoretical training alone; whilst its recognition throws such a light upon the science that within six months the student may feel that he already has mastered its essential principles, and holds the clue to its more recondite details.

In regard to mechanical work, we may mention that the students are encouraged to take to pieces and reconstruct the instruments and apparatus, dynamo-machines, lamps, &c., used for their daily practical instruction. They receive information also as to the construction and working of steam and gas-engines, economy of fuel, &c.

We have hitherto taken no notice whatever of the statements, more or less unjust, if not injurious, to ourselves, which have recently been put forward in advertisements issued by the new establishments which have sprung up in various directions; but we may without offence point out that the real requirements and difficulties of tuition in the direction aimed at are as yet unknown, and have not only to be discovered, but also overcome by the promoters of these undertakings. T. J. Jones.

12, Princes-street, Hanover-square, W.

EFFECTS OF ALCOHOL.

[590]—After feeling nearly exhausted by a long and fatiguing day's work, which terminates at 10.30 p.m., with, perhaps, a stiff North-easter and a shower, as a finish-up on the way home, J. S., in letter 583, p. 314, advises me, as an improvement on my habit of taking a small quantity of alcohol mixed with light food, "to have a cold bath, followed by dumb-bell exercise." He also wishes to have my opinion of his proposition.

Well, I think his remedy incomplete. A slight touch on the head with a poleaxe would give the requisite finish. Mephisto.

FIGURE-TRAINING BY CORSET.

[591]—From time to time the advocates of stays or no stays give forth their extreme notions, most of them crude in nature and physiologically wrong. It is difficult to tell in what light some of them view the matter, for the conclusions to which they are led indicate that they have been jumped at without thinking.

The letter No. 560, on page 267, is a step in the right direction, showing an inclination on the part of the writer to adopt moderate views and express a reasonable opinion. I do not believe for one moment with F. U. H. that fully 90 per cent. of women are deformed by stays; it would be extremely difficult to arrive at a safe statistical conclusion at all. If such were the case, I should not hesitate to say that 90 per cent. of women know nothing of lacing, for if lacing the figure is practised in a judicious manner, instead of deformity would come elegance and health. If such a statement be taken as true, then 90 per cent. do not know how to apply the corset.

A well-applied corset leaves the upper part of the chest perfectly free, and developes the capacity of the lungs in that situation—the most important situation, by-the-by, especially in the female sex. Tubercular consumption usually attacks the apices of the lungs, a part far removed from the pressure of a corset, however tight—in fact, the tighter the corset in the lower part of the chest, the greater amount of work and expansion in the upper part, but this would not lead to consumption. A similar state exists during pregnancy, when the uterus encroaches upon the lung space.

There appears to be only one way in which tight-lacing directly can bring about consumption, and that is by so compressing the lung in its lower part that no fresh air can enter it, a sort of collapse and carnification ensuing, a diminished use leading to degeneration of lung tissue. Such a state of affairs would only take place when tight lacing has been suddenly performed and persisted in at an age when the figure has become somewhat set.

A woman is better in health, and certainly far more elegant in figure, when wearing a proper-fitting corset; nor is she so liable to suffer from such diseases as consumption, dyspepsia, or spinal curvature. I quite deprecate, however, beginning tight-lacing suddenly or violently with the simple object of reducing the figure quickly to genteel proportions, or for fashion's sake.

What I consider to be perfection in the application of the corset to the female figure or to the male is to begin early in life, say at the age of seven or ten years, and then only with very yielding materials, permitting the corset simply to touch the contour of the body, though a little firmer at the waist. As the girl grows up the chest expands, the bust of the corset may be very properly made larger, the waist at the same time being kept within bounds, I do not doubt some would advocate it being kept at its original measurement. If such a system be carefully carried out, there never would [illegible] and the girl who reaches woman[illegible] a figure with its round and taper waist [illegible] well developed chest. She will be [illegible] stooping gait which is the natural [illegible] stays imperfectly or injudiciously [illegible] necessary to restrain, limit and [illegible] With [illegible] nature seldom forms a good [illegible], instead of violent and sudden [illegible] way to achieve success—no evil effects [illegible]. Parents should see to this matter, and take as [illegible] with and proportion of figure of [illegible] mental development.

[illegible] the degree of comfort with which it [illegible] test of utility. Early care and judicious [illegible] every case succeed in attaining elegance and [illegible]. ALFRED CHADWICK, M.D.

[illegible] Physiological Experiment, by Z.; Talking [illegible] Charles L. Cane; Dr. Hunter's Experiments, by [illegible] Coincidences, by A. R. W.; Lapidaries and [illegible] H. M. W.; Wollaston & Fairy Rings, by A. W. [illegible] Fifteen Puzzle, by A. B.; Flint Jack, by E. T. C. W. [illegible] Rule, by J. F. P.; Spiritualism, by E. P. W.

Answers to Correspondents.

[illegible] the Editor requiring early attention should reach the [illegible] the Saturday preceding the current issue of KNOWLEDGE, *the [illegible] to press early in the week.*

[illegible] No questions asking for scientific information [illegible]. 2. Letters sent [illegible] the names or addresses of correspondents [illegible]. 3. Correspondents should write on one side only of the [illegible] letter should have a title, and in referring to [illegible] letter, reference should be made to its number, the page on which it appears, and its title.

NEWTON CROSLAND. What Professor Smyth says is in perfect agreement with what I said. Observe, he says, "moderates the excesses," meaning that the water vapour causes the difference between the temperature of the day and night to be less; it does [illegible] diminishing the heat received from the sun [illegible] to any perceptible degree in fact, while it very largely [illegible] the radiation from the earth at night in fact most [illegible]. C. C. C. Your method of dealing with sums [illegible] of three is good, but we have not space for it. I [illegible] of putting the matter which I have found very [illegible]. It will occupy less space than yours, and I may [illegible] a short note about it. STANLEY BALDWIN. Some of [illegible] fairy rings given by correspondents cannot be [illegible], that they grow over the roots or [illegible]. E. J. HOLLOWAY. Glad you are pleased. E. C. D. [illegible] called the best books of geometrical [illegible] the names of several books on squaring the [illegible] the triangle in De Morgan's "Budget of Paradoxes." [illegible] WOOD, JUN. I should have said a few weeks ago, [illegible] were more readers like you;" but since I asked [illegible] the weather charts, I have received so many [illegible] letters, that I now quite recognise what a [illegible] readers the grumblers represented.—[illegible] recognise the misery produced by excessive [illegible] I know so well how many there are who cannot [illegible] therefore should abstain altogether from [illegible] sympathise with your views. But I [illegible] have not the slightest temptation to [illegible] should be expected to give [illegible] theory that everyone ought to be a [illegible] seek safety in such resources, and [illegible] our own way. In fact, let the Blue [illegible] of those who cannot trust them[illegible], to be worn only by [illegible] rather hard on the Blue Ribbonists.—[illegible] ten years ago, my own experience, [illegible] reason to agree with my "learned [illegible] and the sun is caused by [illegible], therefore, not [illegible].—J. M. G. Do not know the price or [illegible] you name. G. GLASGOW. (1.) The star [illegible] the second magnitude. (2.) The map of [illegible], a bright star between the Pole star [illegible] existence as such in the heavens. Then [illegible] to Draco are shown as belonging to the Little Bear. (3.) I think the Nebula in Andromeda may as well be shown, though there is no absolute necessity for so doing. (4.) The stars you name τ, μ 15, and π are all of the fifth magnitude.—PLONI ALMONI informs "Constant Reader" that there is a Microscopical Society in Liverpool, and that Mr. Thompson, of 6, Lord-street, might be able to tell him the Secretary's name. Best book probably Nicholson's, but Cornish, of Piccadilly, and Owens College, Manchester, would send him a list to choose from. He further recommends Stanley Jevons' elementary book on Logic. I intended my reply to "T. A." to mean only that in several explosions there has been the out-rush to which he had referred. THOMAS KIMBER. Time-differences between various places seem so easily dealt with when the longitude is known, that I cannot see the advantage of any of the plans you mention. C. FRANCIS. (1.) I do not know of any scent that will "make a person light," nor of any that will "set him right when he has been made light;" I cannot say that I quite know what you mean, either. (2.) Doubtless some correspondent will tell you a way of making silk air-tight. H. F. The *Intellectual Observer* is not now in existence, worse luck. It was one of the very best science magazines ever published.—G. CAIRD desires information about Royal Exhibitions at the Normal School of Science. He asks if Todhunter's Trigonometry for Beginners is sufficient for Honours third stage or for ordinary third stage.—WILLIAM DAVIES. The magnets would keep the pendulum in motion, at least for a time; friction would soon bring it to rest.—HARVARD GRAHAME points out that Mr. Ackroyd's results, instead of being in opposition to those in the *Chemical News*, are in perfect agreement with them, and, in fact, might be deduced from them. In one case there is a scale of colour reflected from substances at different temperatures, while in the other we have a scale given out by bodies raised to temperatures at which they become luminous.—A. J. HAYNES desires information about American universities. In reply to his query about the absence of mathematics, we note that no less than eight sections of the articles on the Differential Calculus are now in the printer's hands; four are in type. E. C. H. Your questions are worthy of a fuller notice than we could give you in these short answers. Will try to deal with them soon. AND. AITKEN. Many thanks for your suggestions, with which I quite agree. As to the Differential Calculus, I think Todhunter's as good a book of its kind as you can readily use.—E. T. C. W. (1.) Vol. II. will close, as you say, with No. 61. (2.) Pages v. (No. 33), vi. (No. 43) not to be bound up. (3.) No particular results followed from the Hippocampus controversy; both the disputants considered that they had the best of it. (4.) I have not been specially informed on the subject, but—at a venture—I should say that when the moon was commanded to stand still over Ajalon by Joshua, this did *not* "make any difference in its motion," and the moon *could* and did "turn exactly the same face towards the earth before and after." I was not there at the time, however, and should not care to speak positively as to what did or did not happen in that encounter. Can you, in turn, tell me whether Scamander flowed as before after Vulcan "breathed" that "fiery blast around," which caused the river to "rear his languid head," and appeal, "short panting," for a rest? But possibly you were not present on that occasion.—S. J. There is ample room for you in the waste-paper basket; send some more.—B. M. You could not find any cyclopaedia without omissions or imperfections. It would be unfair to note those of one in particular. TRIFLER. If you insist that $0^{-2} = 0$ (or, if you like it better, that $0^{-1} = 0$), there is an end of the matter. You begin with a mistake and naturally obtain an erroneous result, which you call a sophism. You can explain it your own way,—with great ease, I should imagine. A. P. S. Thanks: this world enough for the present; the "occult" does not specially interest me.—HALLYARDS. Your letter would raise discussion which would be out of place in KNOWLEDGE.—R. LEIGH. Thanks, but correspondents prefer we should make no attempt at weather-charting in any way.—J. STACE. I agree with you that medical aid which simply keeps life in a used-up and depraved body is not an unmixed blessing. But your views might be misunderstood, and so offend. J. J. RUBIE. The elastic recoil would suffice if you breathed out into a perfectly elastic bag; but how is the energy in the moving air, as it leaves the lungs, to bring air back again?—J. B. Possibly some correspondent can tell you the best way of destroying crickets. The following acted well "in our house at home," some three years back:—A careless servant (first provide your careless servant) left two or three used tins which had once held condensed milk, and were still wet and sticky, inside the kitchen fender. Next morning they were full of cockroaches and crickets, which were forthwith consigned to a watery (boiling watery) grave. Next night no insects appeared on the scene. Soon after some young ones began to be seen, which were caught in like manner. For months afterwards the kitchen was clear of these nuisances. If you should try the method and it succeeds, please let me know.—A. A. MURDOCH. No room for Draughts or Billiards, though undoubtedly, like Whist and Chess, scientific games.—H. M. Thanks, but no space for your story. It shows that trout clearly recognise the difference between "the free and the constrained motion of a rigid body;" yet, I dare say not one of them has studied Routh's "Rigid Dynamics."—A. McD. Mr. W. M. Williams's theory is not open to the objections you make. According to it, as he explains it in his "Fuel of the Sun," our oceans could not be diminished by evaporation, for he supposes interplanetary space to be "saturated"—that is, whatever amount of aqueous vapour would saturate the interplanetary atmosphere at any point, at the temperature and pressure there existing, is actually present. This answers the first three questions. As to the fourth, it is impossible to say what the weight of the vapour of water is, unless you say where, and under what conditions, it exists at the moment.

LETTERS RECEIVED.—J. Munroe, F. Gardener, J. Searson, F. W. Richardson, Hallyards, J. M. L., Young Chemist, F. C., Wood, Opifer, B. Lingwood, Taranaki, W. H., Bansall, Newton Crosland, S. Spicers, Dentist, H. B. Richardson, G. Griffith, H. G. White, W. P., E. Brown, H. A., T. A., Surgeon, J. B., F. W. Lambley, F. R. M., J. Greenfield, A. W. Soward, I. Probert, Vega, A. G. Haynes, Matriculating Student, J. Fraser, Malcolm Douglas, Subscriber, E. Irving, J. H. Ward, Odontalgia, Excelsior, G. Massie, C. Carus-Wilson, E. T. C. W., A. Leluem, J. T. B, T. N. A., M. E. L., C. Witham, J. E. S., C. S., L. Dobbin, Naus Solanum, E. D. G., J. Spiller, Grateful, C. E. S., W. B. Wicken, H. H. Newton, C. H. Romanes, Ignoramus, F. Keith, D. Illingworth, A Highlander, J. P. K., Upsala, G. R. W., M. B. A.

Our Mathematical Column.

To determine the time in which a body leaving the sun's surface vertically, with a velocity of 380 miles per second—being that with which a body travelling to the sun's surface from rest at an indefinitely great distance would reach that surface under the influence of his attractive force—it is required to determine how long that body would be in reaching a distance of thirty millions of miles from the centre of the sun.

Let O be the sun's centre, R the point on his surface from which the body is projected; OR = 430,000 miles, OP = 30,000,000; but put OR = r, OP = a. Also let OP = x, $pq = dx$, and velocity at R = v. Then we know that the velocity of the body varies inversely as the square root of the distance from O. Hence velocity at $p = v\sqrt{\frac{r}{x}}$, and time of traversing $pq = \frac{1}{v}\sqrt{\frac{x}{r}}dx$. Hence time of traversing the distance RP

$$= \frac{1}{v\sqrt{r}}\int_r^a \sqrt{x}\, dx$$

$$= \frac{2}{3v\sqrt{r}}\left[a^{\frac{3}{2}} - r^{\frac{3}{2}}\right]$$

$$= \frac{2}{3v}\left[\sqrt{\frac{a^3}{r}} - r\right]$$

Now $\frac{3v}{2} = \frac{1140}{2} = 570$; and $\sqrt{\frac{a^3}{r}} = \sqrt{\frac{270}{43}} \cdot 100000000$, the mile being the unit of length and the unit of time.

Whence the quantity within square brackets = 250,000,000 nearly enough. And the time required

$$= \frac{25,000,000}{57} \text{ seconds}$$

$$= \frac{25,000,000}{57 \times 3600 \times 24} \text{ days}$$

$$= \frac{25,000}{4925} \text{ days (approximately)},$$

$$= \frac{1000}{196} = 5\tfrac{5}{49} \text{ days.}$$

This is also very nearly the time in which a comet, moving in exceedingly eccentric orbit, with perihelion close to sun, would take in reaching the same distance from his centre.

Our Whist Column.

BY "FIVE OF CLUBS."

THE evenings are closing in again, and Whist begins to resume its place in the day's recreations. We propose, therefore, to continue our discussion of the principles of Whist play, with occasional illustrative games, problems, Whist gossip, and so forth.

But as some of our readers may have forgotten what we have already written, we propose to give a very brief summary of the chief rules, those rules which every Whist-player ought to have constantly in his memory, the breach of them being, in fact, Whist atrocities. For details the reader can consult our former papers.

THE LEAD (from strength in plain suits),

See preceding numbers, especially No. 14.

Lead *Ace*

(1.) From Ace and four others at least, following with small one; or (2) from Ace, Queen, Knave, with or without others, following with Queen if there were not more than four in the suit originally, otherwise with Knave.

Lead *King*—

(1) From Ace, King, and others; following with King. (2) From King, Queen, and others; following with small one if King makes.

Lead *Queen*—

From Queen, Knave, Ten; following with Knave, if Queen makes, unless you were more than four in suit originally, when follow with lowest of head sequence.

Lead *Knave*—

(1) From King, Queen, Knave, two others or more. (2) From Knave, Ten, Nine, with or without small ones. Sequent play will depend on the fall of cards in the first round. The trick will not probably fall to leader in either case, as either adversary or partner, holding Ace, would generally play it.

Lead *Ten*—

(1) From King, Queen, Knave, Ten, and (2) from King, Knave, Ten, with or without others.

Lead *Nine*—

From King, Knave, Ten, Nine.

In other cases lead *lowest* if you have only four cards; lowest but one (the *penultimate*) if you have five or more; some play lowest but two (the *ante-penultimate*) when holding six or more.

THE LEAD IN TRUMPS (from strength).

Note the trump card, and only lead up to an honour turned on your right when very strong. Do not hesitate to do so, however, when you have strength in trumps, and either you or your partner has a good suit. Play a waiting game in trumps, your object being rather to get the command than to win the earlier rounds. From King, Queen, and small ones, it is generally better to lead the lowest.

LEADING FROM A WEAK SUIT.

From Ace, King, or Queen, with two small ones, it is best to lead the lowest, unless you have reason to believe your partner has strength in the suit. (Some, however, from Queen two small ones, lead Queen.) In other cases, when obliged to lead from a three-card suit, lead the highest. From two cards, if driven to such a lead, invariably lead the highest.

N.B.—Note the inferences from these rules. Your own hand will often serve to tell you precisely what the lead means. Thus, suppose Ace is led and you hold King, Knave, you then know the lead is from Ace four others. Again, Knave is led by your partner first round, and you hold King, Ten; you know that the lead is not from strength (see leads from strength above); hence, that your partner holds four trumps, and three three-card suits, all weak, the best being headed by the Knave played. So in multitudes of other cases.

PLAY SECOND HAND.

With King, Queen, one other, or Queen, Knave, one other, or Knave, Ten, one other, or Ten, Nine, one other, play lowest of head sequence; but with same head sequence and two others or more, play lowest. With King, one other, or Queen, one other, in plain suits play the lowest, unless you specially want the lead.

Of course, there are other rules for play second in hand, see Part 21 and several preceding parts; but these are the most elementary rules—though often neglected.

In our next we shall summarise the rules for play third and fourth hand, and repeat some of those general rules which form the elementary language of the game. We shall then resume our more complete analysis of Whist principles.

Our Chess Column.

By Mephisto.

SOLUTIONS.

Problem No. 54, by John Simpson (p. 286).

1. Q to QB4	1. B to Q3
2. R to R8 (ch)	2. K to Kt8
3. Q to B sq mate	
1. (a)	1. K to Kt6
2. Q to R4 (ch)	2. K takes Q
3. Kt to B5 mate	
1. (b)	1. K to Kt8
2. Kt (B2) to Kt4	2. Anything
3. Q to B sq mate.	

End Position, No. 55, by Leonard P. Rees (p. 302).

Sir,—I have been trying to solve Mr. L. P. Rees's "End Position from Actual Play" (Position No. 55), and the following is the result of my labours:—

1. B to Q5 (ch)	K to K sq, or
2. Q takes RP	R takes Q (a)
3. R to Kt8 (ch)	K to K2
4. Kt to B5 mate, or	
2. (a) if Kt tks P (b)	
3. B tks Kt (ch)	K to B sq
4. Q tks R (ch)	K to K2
5. Q to K8 (ch)	K to Q3
6. Q to Q7 or Kt to B5 mate	
2. (b) if Q or B takes Kt or B to R3	
3. Q to B7 (ch)	K moves
4. R to Kt8 (ch)	R takes R
5. Q tks R (ch)	K to K2
6. Q to B7 (ch)	K to Q1 or 3
7. Q mates	

1.	K to K2
2. Kt to B5 (ch)	K to K sq (a)
3. Q takes RP	Kt takes P.
4. B tks Kt (ch)	K to B sq
5. Q mates	
2. (a)	K to Q sq
3. Q takes RP	Kt takes P
4. R to Kt8 (ch)	R takes R
5. Q tks R (ch)	K to Q2
6. B to K6 mate	

These appear to me to be the principal variations, as the others are mostly but transpositions of some of the above moves. It seems too good for an "End Position from Actual Play." I mean there is too much variation, or at any rate, more than one would expect.—G. Woodcock.

Another version

1. R to Kt8

(If B moves K takes R or B takes Q, White mates on the move by B to Q5.)

1. R takes R (best)

2. Q tks P (ch) and wins

(Any other move for Black leads to a similar result.)

A pretty end position, which one would scarcely have expected in actual play.—H. Seward.

After 1. R to Kt8, R takes R. 2. Q takes P (ch) if Black plays 2. R to Kt2 then 3. B to Q5 (ch), K to B sq. 4. Q to R8 (ch), K to K2. 5. Kt to B5 mate. Or, if in reply to 2. Q takes P (ch), Black plays K to B sq, then 3. B to Q5 wins in a similar manner. Ed.

Herbert Jacobs sends the following solution:

1. Q takes P (ch)	1. R takes Q.
2. B to Q5 (ch)	2. K to B sq
3. R to Kt8 (ch)	3. K to K2
4. Kt to B5 mate	

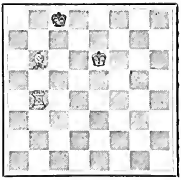
If in reply to 1. Q takes P Black does not take the Queen, but plays K to K3, then White wins by 2. Q takes R, for if Black replies with 2. Q takes Kt, then 3. Q to K8 (ch), K to Q3. 4. Q to B8 (ch), K to K3. 5. P to Q5 mate. Again, if Black plays 2. P takes P, then 3. Q to K8 (ch), K to Q3. 4. Q to B8 (ch), K to K3. 5. B to Q5 (ch), K to K4. 6. Q to K7 mate. Or if 2. Kt takes BP then White plays 3. Q to K8 (ch), Kt to K2. 4. B to B5 (ch), K to Q3. 5. Q to Q7 mate. Ed.

The study of this position ought to convince the most inveterate critic that the problems presented by actual play, unlike those artificially made, are capable of various solutions, and that there may be different ways of accomplishing the desired end, and finally that different views from that taken by ourselves ought not to be condemned rashly.

Problem No. 56.—We regret to say this problem is incorrect, a White Pawn placed either on KKt4 or KKt6 would render it sound. It can be solved by 1. B to Kt6, also by 1. B to B3.

Sir,—In your issue of last week, you published a problem (No. 57) by Leonard P. Rees. On glancing over it I immediately recognised the solution, and remembered having seen it several years ago. On reference I find the enclosed problem (the solution of which is identical with Mr. Rees's) was composed by Mr. Chas. Spray, of Nottingham, and was published in the *Nottingham Daily Express*, in 1878. As I, of course, concluded that Mr. Rees has never seen the enclosed, I simply call your attention to this curious and extraordinary coincidence of ideas. The problem is neat and simple.—Yours very truly, A. Marriott.

Black.



White.

White to play and mate in three moves.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.***

Leonard P. Rees.—See solution.

E. P. W.—The variation is weak for the first player, but in the position arrived at after 9. Q to B3 White will obtain a good game by 10. P to Q4, followed if QKt to B3 or KKt to K2 by 11. B to B4 or P to K5 respectively.

John Simpson.—Problem received with thanks. Solutions correct.

Squire.—You are right. The game was probably played at the odds of a Rook. You are too good for that. We gave the ending as it actually occurred.

Herbert Jacobs.—Thanks for problem. Hope soon to deal with the subject.

Lovesmith.—Cook's Synopsis of the openings.

H. A. L. S.—Thanks for good opinion.

G. W.—Game received.

Problems No. 56 and 57 solved by H. A. L. S., H. V. T., W. C. Thomas, H. Seward, Herbert Jacobs. Solutions of No. 54 received from Herbert Jacobs, H. V. T., Belmont, G. H. Bonner, H. A. N. No. 55, Berrow, G. H. Bonner. No. 56 and 57, T. T. Dorrington, H. A. N., R. J. P., Evelyn, H. S. Squire, John O'Keeffe, Samuel Jordan, Kit, G. H. Bonner, Berrow, Helmont, John Watson, H. A. D., Novice, A. J. H., W. J. D. No. 56, J. P., Schmucke. No. 57, T. H. Jeaps, Chas. Palmer.

Berrow.—Problems received with thanks.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, OCTOBER 20, 1882.

Contents of No. 51.

Science and Art Gossip.

An observation, unprecedented in the history of comets, was made at the Cape Town Observatory, on Sept. 17, at 4 h. 50 min. 58 sec. Cape mean time, corresponding to 3 h. 37 min. 3 sec. Greenwich time. "The comet was followed," writes Mr. Gill, "by two observers with separate instruments, right up to the sun's limb, where it suddenly disappeared," at the hour named. To be seen under these conditions the comet must at the time have been intensely brilliant—partly, no doubt, the effect of solar heat and light, but partly also, we conceive, on account of the resistance it experienced in its onward rush at the rate of certainly not less than 340 miles per *second*.' The time when Mr. Gill's assistants saw the comet reach the sun's limb, preceded by 1 h. 35 min. the time of perihelion passage as given below.

The Emperor of Brazil telegraphs to the Academy of Sciences that the comet was visible in full daylight on the 18th, 19th, and 20th September. The spectroscope showed the presence of sodium and carbon. On the 26th, from 4 h. 10 min. to 5 h. 40 min. in the morning, it was a splendid object.

Dr. Hind finds now for the comet the following elements: Perihelion Passage, Sept. 17·2169 Greenwich M.T.=Sept. 17, 5 h. 12 m. p.m., instead of Sept. 17 about 2 h. 30 m. p.m.

	New estimate. °	′	Comet, 1668. °	′	Comet, 1843. °	′
Longitude of Perihelion	276	14·5	277	2	278	39
,, ,, Ascending node	346	7	357	17	361	12
Inclination	37	59	35	58	35	41
Logarithm of Perihelion Distance	7·90653		7·67210		7·74036	

(We have added 360 to the Long. of Asc. node of comet 1843 to make the comparison easier.)

We publish elsewhere an interesting letter (which appeared in last Saturday's *Times*) about the comet. But what a pity it is people will not learn enough of elementary matters in astronomy to write correctly. The letter, for want of such knowledge, is full of absurdities. The comet is "appearing in latitude 10° N," it "rises almost perpendicular to the sun," and "travels the length of its tail (45°) in less than an hour" (which would involve a real motion among the stars at the rate of 30 in less than an hour, or twice round the star sphere in less than a day!); it "measures some 3,000 miles to the naked eye from its corona," and at such and such a time "the great flame was in an apparent flutter," which is all just impossible nonsense.

The Isle of Wight will be raised to white heat by the too rapid motion of its trains. A rate of fourteen miles in an hour and a quarter is advertised. Luckily for the island this terrific speed is not always attained.

The Peterhead Police Commissioners have resolved that the electric light shall not be supplied to their town by any company. They are the owners of the gas-works. There appears to be on the part of the various corporations, &c., throughout the country, a determination to resist the introduction of the electric light into their respective districts by the companies owning the patents. However, many of these local bodies contemplate introducing the light on their own account. If this spirit is maintained, the concessions for which so many thousands have been paid will be scarcely worth the paper they are written on.

The Telephone and Ballooning.—Last week several ascents were made by members of the Academie d'Aérostation Météorologique, from the Place Saint Jacques, Paris. Amongst other things, conversation was carried on with people on the earth by means of a telephone line suspended from the balloon. The height at which the balloon is said to have been was 500 ft.

A mine has been found in a mountain near Salzburg, Austria, which, it is considered, gives indications of having been occupied and abandoned at least two thousand years ago. It contains a large and confused mass of timbers, which were used for support, and a number of miners' implements. The timbers were notched and sharpened, but were subject to an inundation, and left in confused heaps. The implements were mainly wooden shovels, axe-handles, &c. Among the relics, also, was a basket made of untanned raw hide, a piece of cloth woven of coarse wool, the fibre of which is very even and still in good preservation, and a torch, bound together with flax-fibre. The probabilities are that the ancient salt miners were overtaken by the flooding of the mine, as mummified bodies have been discovered also. The find seems to have belonged to the pre-Roman times, as the axe-handles were evidently used for bronze axes, specimens of which have been found upon the surface of the mountain. The relics are of a high order, the basket being superior even to some that were used in the early historic times.

Iron chessboards and chessmen, with concealed magnets to steady them on the board, are sold to travellers in Berlin.

The recent Imperial decree relating to the precautions to be taken against fire in the Vienna theatres enacts that all theatres built from this date are to be completely detached. The stage is to be divided from the auditorium by a wall not less than 20 in. high and 18 in. thick above the roof, so that in case of fire the stage may be isolated from the rest of the house. The stage must be of sufficient height for the curtain to be raised without being rolled. No one is to be allowed to live in the theatre, and the stage carpenter's shops, the stage appliances, and the refreshment bars are to be outside the theatre, this latter regulation to be applied to theatres already in existence. All the dresses worn by the actors and actresses are to be dipped in a preparation which makes them more or less fireproof, and no explosive matter is, under any pretence, to be left in the theatre. Very strict provisions are made with regard to the seating of the theatre, so that there may be plenty of room for easy exit, and the prefect of police is to have the power of deciding how many firemen shall be allotted to each theatre. The manager of the theatre is to be held personally responsible for the carrying out of all these regulations down to the smallest detail, and he will be severely punished if, upon the very first alarm of fire, he fails to give the public notice.

We note elsewhere that a deputation waited on Mr. Shaw-Lefevre, on Monday, with respect to the present disgraceful condition of Kew Gardens. The English, truly, are a patient people, or they would long since have put an emphatic end to what amounts to the appropriation of a valuable portion of the national property by the Hooker family. The gardens are bricked out of sight by a mile-long wall, and during the best hours of the twenty-four for gardens every the real owners of the gardens are excluded by a system of administration which we should call boorish, if that were not altogether too mild a term to apply to what (when we consider how many thousands of our people are injured and robbed of their rights by it) can only properly be termed cruel and brutal. We shall return to this subject next week.

Bismarck objects to the displacement of German characters by the Roman letters used by other European nations. He would even stand by the ingeniously mysterious written characters which have apparently been invented to prevent foreigners from reading German letters or MS. One cannot well wonder that Germany has turned out so many excellent readers of hieroglyphic and cuneiform inscriptions. Germans are trained in such work from their childhood upward.

Professor Tyndall, referring to our triumphs in Egypt (shades of Pitt and Fox!), says, after Tennyson, "Thank God, we are a people still!" This national feeling is an important factor in human progress, though science [illegible] it rather doubtfully. Our nation has had, perhaps, worthier cause of pride ere now as Tel-el-Kebir gives. But was this the people's war? If it was, then the people should give their thanks. A journey to Balmoral may be [illegible] to our men (or, say, the men are not [illegible] [illegible] commended) to our officers, after their return from Egypt. But a review in the park, with thousands to [illegible] applause [illegible], would look more like a people's praise.

London College of Practical Engineering.—This college has just been opened at 162, Great Portland-street, London, W., to afford practical and systematic instruction in engineering. Actual workshop practice is to be its main feature, though not to the exclusion of theory. The college is under the superintendence of Mr. F. S. Pichler, C.E., formerly assistant to Sir Charles Wheatstone, and afterwards for many years the deviser of the mechanical novelties which distinguished the late Royal Polytechnic, including the famous life-size automata of Leotard and Blondin.

The Owens College, Manchester.—Professor Arthur Schuster, assisted by Mr. Gee, is announced to give a theoretical and practical course on the technical applications of electricity on Thursday evenings, in the Physical Laboratory. The syllabus is comprehensive, and embraces:—Current producers, current measures, telegraph construction, duplex and submarine telegraphy, telephony, magneto and dynamo-electric machines—description and comparison of different systems; electrical lighting, testing of strong currents and electro-motive forces, different systems of lamps, photometers, electromotors, electric railways, &c.

"The *Times*," says the *Photographic News*, "is acquiring quite a reputation for being behindhand with its news. Photographing from a train in motion is a feat it has just heard of, and probably next year we shall be told the operation can be performed on board a steamer as well. Our contemporary also speaks of a shutter moving so rapidly that 'only 1-100th of a second' exposure is given by it. Apparently the *Times* is incapable of conceiving anything faster than itself just now." Considering that five years ago Janssen claimed to give only the 1200th of a second exposure in his solar photographic operations at Meudon, the *Times* does seem rather behind the time.

Messrs. Sampson Low, Marston, & Co. are about to publish a cheap edition of the illustrated re-issue of Gilpin's "Forest Scenery," edited, with notes bringing it up to date, by Mr. F. G. Heath, author of "Autumnal Leaves." It is a curious fact that the existence of the third edition of "Forest Scenery," which was revised by Gilpin himself, and which forms the text of Mr. Heath's reprint, was unknown to Sir T. D. Lander, first editor of this famous work, and there is no copy of it even in the British Museum.

The National Portrait Gallery is to be re-arranged, the portraits now at the British Museum being added to the collection. The Gallery needs another change in the way of subtraction. It is an insult to every lady and gentleman in the country, to every Englishman and every English woman, that a National Portrait Gallery should include portraits of the female associates of royal iniquity. No man who has any respect for wife, or sister, or mother, or daughter, should cross the threshold of the National Portrait Gallery till these offensive pictures have been either removed or put in a room by themselves—a Bad Gallery, so to speak. Whoever put these women among our national "celebrities" might be duly honoured by being pictured in the same room. That persons descended from their brood should be in the House of Lords is an offence not now easily corrected; but we need not have pictures thrust before us (as *national*, save the mark) of those to whom the British nation owes this legislative insult. It is understood that the queen's sympathies are with those among the women of this country who are good and pure. She possesses influence. She should get the jades removed.

Mrs. Langtry sailed for New York on the 14th. American ladies did not welcome Mrs. Rousby very warmly at their "receptions." Yet she was not the worst actress England has sent across the Atlantic. One wonders how they will receive Mrs. Langtry.

Our space having been somewhat encroached upon this week, we shall have next week a thirty-two page number.

GEOLOGY OF LLANDUDNO AND RHYL.

By W. Jerome Harrison, F.G.S.

(*Continued from page 306.*)

The Carboniferous Formation.—Beds of the *Mountain* or *Carboniferous Limestone*, preserved by their position at the base of a synclinal curve, form Great Orme's Head: the change of dip from northerly to horizontal, and then to southerly, is well seen while taking a drive along the magnificent road of five miles in length which encircles the "Head." Little Orme's Head is a continuation of the same rock, while Llandudno lies in the gap between the two Heads, produced by the forces of denudation acting on strata thrown into an *anticlinal* curve, and thereby specially laid open to the atmospheric and marine forces.

Striking out to sea from Little Orme's Head and the corresponding headland on the south side of Rhos Bay, the Mountain Limestone curves round southwards beneath the water, and strikes the coast again at Colwyn Bay, forming the picturesque heights west of Abergele. From this point the limestone strata extend southwards in a long narrow line past Denbigh to the extremity of the Vale of Clwyd. But while the *strike* of the limestone beds is north and south, their *dip* is to the east. In this direction they disappear under the New Red Sandstone which forms the level surface of the Vale of Clwyd, to be brought up again by a fault which ranges along the eastern side of the valley and exposes the Limestone in several patches, as near Bodfari and Llan Vedr. At the north-east end of the Vale, the Mountain Limestone forms the hill called Moel Hiraddug, whence a line of hills runs eastwards to Prestatyn, and thence southwards, forming the hills that lie west of Holywell and Mold.

Everywhere the Mountain Limestone presents a similar appearance, as a thick bed of compact grey stone, the central portion being lighter in colour, or nearly white. Fossils are plentiful, especially in the higher beds, chiefly such marine shells as *Productus*, *Rhynchonella*, and *Spirifera*, branching corals called *Syringopora*, and the little cup-coral (*Cyathophyllum*); while the rings which were the joints of sea-lilies (*Crinoids*), lie thickly on almost every slab. In the quarries above Prestatyn I obtained many formidable-looking fish-teeth belonging to the genus *Rhizodus*. In the Minera district, further south, Mr. Morton has recognized four zones—Lower Grey, Lower White, Upper White, and Upper Grey—each characterised by certain fossils, in the Mountain Limestone, and any geologist who makes a stay at Llandudno or Rhyl should bear this fact in mind, and endeavour to trace these zones in his neighbourhood.

Many *lodes*, or fissures filled with metallic ores, are known. The most important of these is worked at Talargoch, about three miles south-east of Rhyl; it yields about 2,700 tons of zinc ore (value £12,000) and 900 tons of lead ore richly impregnated with silver (value £9,200), annually. The limestone itself is largely quarried for burning, for road-metal, and for building purposes.

Certain beds of red sandstone and conglomerate underlie the Mountain Limestone on the west side of the Vale of Clwyd; they occur in Ffernant Dingle, about one mile south of Llysfaen, also near Henllan. These beds have been mapped as *Old Red Sandstone* by the Survey, but I believe they are identical with similar strata known in the Lake District and in the Isle of Man, and that they form the base of, and belong to, the Carboniferous Limestone.

The Millstone Grit is well seen resting upon the Limestone at Gronant, Gwespyr, Holywell, and at many points west and south of Mold. There is a small patch of it in the valley south of Little Orme's Head, and another round St. Asaph. The lower beds are black and flinty-looking; they are a kind of *chert*, and are quarried at Gronant to be used in the Staffordshire Potteries; above these cherty bed come sandstones, not very coarse in texture, worked at Gwespyr and other places for building-stones, mill-stones, scythe-sharpeners, &c. Fossils, with the exception of plant-markings, are scarce. Further south, near Oswestry, the marine shells of the Mountain Limestone have been found to range high up into the Millstone Grit, and it would be a most interesting task for any geologist residing in the neighbourhood of Holywell or Prestatyn to endeavour to determine whether the same thing occurs further north.

The Coal-measures form a little coal-field along the Dee, at Flint and Bagillt: dipping under the river, the beds rise again on the Cheshire side, where there is a colliery at Neston. The possibility of the occurrence of coal-seams underneath the Vale of Clwyd has been considered, and in 1860 a bore-hole was made near the Foryd, close to Rhyl, which passed through the following beds:—

Alluvial Deposits, 54 ft.: Gravel and Clay.
Glacial Beds, 44 ft.: Red Clay and Sand.
New Red Sandstone, 500 ft.: Red Sandstones and S[illegible].
Carboniferous? 150 ft.: Red Marls and Shales.

Although it is a pity that the boring was not continued to a greater depth than 748 feet, yet the probability is *against* the occurrence of useful coal-seams in this district.

The Trias or New Red Sandstone.—The soft red sandstone which forms the level floor of the Vale of Clwyd represents the *Lower Bunter Sandstone* of the Midlands. Here, as elsewhere, it is quite unfossiliferous.

Glacial Deposits.—Nearly all the low ground of north-east Wales has a coating of what is called *Boulder C[illegible]* which is a reddish unstratified clay, containing an abundance of scratched stones of all sizes. This deposit creeps up the hill-sides to a considerable height, while higher still beds of gravel and sand are met with, also referable to glacial times. Many travelled blocks of granite are found along the coast, some of which can be identified with Lake-district rocks, having been carried southwards during the glacial period by glaciers or icebergs. The smoothed and rounded (*moutonnée*) outlines of the hills (best seen from a distance), clearly tell of the passage of a heavy mass of ice over the district. Considered in this light, a study of the pebbles on the beach will be found interesting: at Rhyl, since the town stands on a dead alluvial flat, this will be the only use to which a geologist can put his hammer; an examination of the low sand-hills which here fringe the coast will, however, show him the geological phenomenon known as "false-bedding" in perfection.

Pre-historic Man.—Owing to the absence of flint, the hills are not so productive of weapons fashioned out of that (to savage tribes) favourite material as the Downs of Yorkshire or Sussex. There are, however, numerous well preserved remains of tumuli, camps, and hut dwellings. Caves are not unfrequent: the best known is situated at Cefn, about two miles south-west of St. Asaph, half-way up a vertical limestone cliff 300 ft. high, overlooking a grand ravine cut by the river Elwy. Here flint and stone implements, with many teeth and bones of certain extinct animals, have been found embedded in the stalagmitic floor.

From these brief notes it will be seen that in this region there is much for the beginner to learn, and many problems which an experienced geologist might render aid in solving. My difficulty has been to compress a notice of even the principal facts into the necessarily restricted limits of this article.

THE AMATEUR ELECTRICIAN.

ELECTRICAL MEASUREMENT.—IV.

HAVING explained the Volt and the Ohm, we now come to a question equally important, but perhaps a little more intricate, viz., the *strength of the current.* The unit strength is called an Ampere, and is that amount of current resulting from an electro-motive force of one Volt passing through a total resistance of one Ohm. By the total resistance is meant the resistance of the battery as well as the wire, and whatever instruments may be in the circuit, so that the ordinary Daniell cell, while it has an E.M.F. (electro-motive force) of about one Volt, will not produce a current of one Ampère, because the resistance of the cell is more than one Ohm; it is, in fact, about ten Ohms. Such a cell, having its poles connected by a short thick strap of copper, would give a current equal to one tenth of an Ampere. This is best seen by reference to the world-famed Ohm's Law. By some mysterious means this law, doubted and denied for half a-century, now fully borne out by experiment and accepted by every electrician, is by the tyro or the student regarded with feelings somewhat akin to awe, whereas it is in reality one of the simplest, most beautiful, and most universally applicable in the whole range of scientific inquiry. This great law is expressed by the equation

$$\frac{E}{R} = C.$$

or, in other words, the electro-motive force (in Volts) divided by the resistance (in Ohms) gives us the strength of the current (in Ampères). The resistance embraces, as we said, all resistances in the circuit.

We will endeavour to simplify matters by taking a few examples. The resistance of a Daniell cell being 10 Ohms, 10 cells will offer 100 Ohms, 50 cells 500 Ohms, and so on. By joining the two ends of our battery together by means of a short piece of thick wire, so as to offer practically no external resistance, we shall get

with one cell $\quad \frac{E}{R} = \frac{1}{10} = \cdot 1$

with 10 cells $\quad \frac{E}{R} = \frac{10}{100} = \cdot 1$

with 50 cells $\quad \frac{E}{R} = \frac{50}{500} = \cdot 1$

and so on, showing that we get in each case ·1 of an Ampère, and that to all intents and purposes one cell is as good as 100 cells. If, however, we insert resistance in the external circuit, in the form of a telegraph wire and instruments, the result will be very different. Suppose we take a line offering 100 Ohms. Then, letting R = the resistance of the battery and R′ = the resistance of the line, we get

with one cell $\quad \frac{E}{R + R'} = \frac{1}{10 + 100} = \cdot 009$

with 10 cells $\quad \frac{E}{R + R'} = \frac{10}{100 + 100} = \cdot 050$

with 20 cells $\quad \frac{E}{R + R'} = \frac{20}{200 + 100} = \cdot 066$

with 50 cells $\quad \frac{E}{R + R'} = \frac{50}{500 + 100} = \cdot 086$

In the first two instances the strength of the resulting current increases considerably with the number of cells employed, but in the two latter cases this proportion is not maintained, owing to the relative reduction in the value or importance of the line resistance. Taking a longer line, say London to Newcastle, offering 5,000 Ohms, including 300 Ohms for the resistance of the receiving apparatus, we get

with 10 cells $\quad \frac{10}{5000 + 100} = \cdot 00196$

with 20 cells $\quad \frac{20}{5000 + 200} = \cdot 00384$

with 50 cells $\quad \frac{50}{5000 + 500} = \cdot 00909$

with 100 cells $\quad \frac{100}{5000 + 1000} = \cdot 01666$

The increase in the strength of the current is now seen to be advancing nearly in proportion to the number of cells. The ratio would be more striking if we were to take the cells actually in use for long telegraph lines, offering only 2 Ohms resistance per cell. Thus we get

with 10 cells $\quad \frac{10}{5000 + 20} = \cdot 00199$

with 100 cells $\quad \frac{100}{5000 + 200} = \cdot 01923$

These simple calculations demonstrate, then, that so long as the external resistance exceeds that of the battery, it is economically advantageous to increase the number of cells joined in succession or series.

We come next to consider the case in which we have a low external resistance, but our electrical effect being too small, we want to increase the current. How shall we do it? Our first examples demonstrated that we could not advantageously increase the cells in series. It is clear that the only way by which we can accomplish this is to reduce the denominator of $\frac{E}{R}$, or, in other words, reduce the resistance of the battery. This can be done by increasing the size of the plates, and so bringing a larger amount of surface into action. That this should be so, will be apparent if we can bring ourselves to look upon the cylinder of water between the plates as a wire. Then if we double the area of the plates we double the sectional area of the cylinder of water between them, and "the resistance of a conductor varies in the inverse proportion to its sectional area." Supposing the 10 Ohms cell to have plates offering 6 square inches of surface to the liquid, a cell with 12 square inches will offer only 5 Ohms. Here, instead of getting a current

$$\frac{E}{R} = \frac{1}{10} = \cdot 1$$

we should get $\quad \frac{E}{R} = \frac{1}{5} = \cdot 2$

that is to say, twice as strong. It would, however, be very inconvenient in many ways, were it necessary to resort to such a process. The same result can be obtained much more easily by the process generally known as joining up for "quantity." It consists in connecting the zinc or positive plate of one cell to the zinc of another, and likewise joining the two negative plates together. Fig. 2 will illustrates this. B′ and B″ are two batteries, each consisting of 5 cells, the short thick strokes representing the zinc plates, and the long thin ones the copper plates.

The terminal plates C C on the right side are connected by a piece of wire; Z Z on the left side being similarly connected. When batteries are joined up in this way they should consist of equal numbers of equally efficient cells, otherwise there will be a tendency of the current from the stronger battery to run through the weaker, and soon render it useless. Wires are fastened at E and F and joined to whatever apparatus the current is required for. Suppose we wish to send it through a Galvanometer G, made by winding a few turns of thick wire round a magnetic needle. The external resistance in this case will be practically *nil.* Consequently the deflection of the needle will, if the E M F remains constant, vary in strength with the resistance in the battery. Thus supposing a battery of 5 cells in series yielding a current of ·1 Ampère to produce

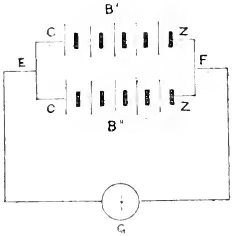


Fig. 1.

a deflection of 5°, two such batteries placed side by side as in Fig. 1, will yield ·2 Ampère and produce a deflection of 10°. The equation in the second case becomes

$$\frac{5}{25} = \cdot 2$$

because in adding the second battery we practically double the size of the original cells, and so halve the resistance. The E M F is not affected, as the energy or potential of the current is independent of any variation in the size of the plates.

This topic will be resumed in our next.

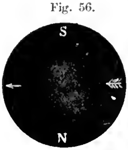
NIGHTS WITH A THREE-INCH TELESCOPE.

By a Fellow of the Royal Astronomical Society.

(*Continued from page* 311.)

If the reader will fish with a power of 70 or 80 between β Cygni and Delphinus, some 7° south-east of the former star, he will strike upon that very curious object, 27 Messier, Vulpeculæ—the so-called "Dumb Bell" nebula, of which ridiculous pictures appear in certain works on popular astronomy. We have done what we could to present a portrait of this nebula in Fig. 56.

Fig. 56.



27 M. Vulpeculæ.

Fig. 57.

μ Draconis.

Fig. 58.

ε Draconis.

The sprawling constellation Draco, which straggles over so much of the circumpolar sky, is our next in order for examination. From its situation the amateur can scarcely expect to scrutinise many of its chief objects in succession without getting a back-ache, and a stiff neck to boot, so inconveniently are they placed. Let us, however, express a hope that the intellectual pleasure to be derived from such a search may quite outweigh its concomitant physical discomfort. If we draw a line from γ Draconis, through β, and carry it on twice the distance between them, we shall strike 17 Draconis, a pretty and interesting triple. μ Draconis, a close but easy pair, is shown in Fig. 57. Rather more than 1½° south of β Draconis is a small but very pretty double star, 147 of Piazzi's hour XVII. It is invisible to the naked eye. If we draw a line from the Pole Star to γ Draconis, and fish on it, about half way between those stars, with a low power, we shall light upon that strange object, Herschel 37, IV., Draconis. This is the nebula which our greatest living English spectroscopist, Dr. Huggins, found to be gaseous, in 1864. Viewed in the instrument employed for the purpose of these papers, it presents the appearance of a large pale blue star out of focus. South-east of ε Ursæ Minoris 40 Draconis will be found. It is a wide and easy pair. 39 Draconis, half-way between γ and ζ, appears in the books as a triple star. It will require an extremely fine night and a high power, however, to show the *comes* to the principal star, whose light and proximity quite overpower it; so that it will ordinarily appear as a very wide double only, in a three-inch telescope. ο Draconis is a wide pair, but the colours are very pretty. The last object in this constellation which we shall look at to-night, ε Draconis, will form a severe test, at once for the observer's instrument and his eye, and for the state of the atmosphere. He must employ the highest power at his command, and even then the companion will often be involved in the diffraction ring surrounding the larger star. Fig. 58 gives an idea of this star when caught at moments of the best vision.

EARTHQUAKES IN THE BRITISH ISLES.—I.

Dr. Milne, recently returned from Japan, notes that men in England pay less attention to earth tremblings than they merit, though we have no such reason for noting them as they have in Japan. We are, however, all interested in the question whether this, our country, is liable—even at long intervals of time—to the influence of destructive earthquakes. We know that there are countries which seem as firm and unshaken as our own is wont to be—countries which have remained for centuries undisturbed by any save the faintest indications of earth-tremor, which have yet been suddenly visited by those fierce throes which hurl in a few minutes the largest and best built cities to the ground. We ask ourselves whether the inhabitants of Lisbon could have felt less secure than we ourselves do of immunity from serious danger? Yet we know that without warning, that large city was made in a few moments a mere heap of ruins, in and around which lay the unburied bodies of sixty thousand of her inhabitants.

We often have had evidence that our country is, at least, not wholly unaffected by the action of subterranean disturbances. An area one hundred and fifty miles long and some seventy miles wide—possibly much larger—was disturbed only some twelve years ago by a smart shock of earthquake. The effects produced by the shock were not very remarkable—indeed, when one compares them with the effects of the late earth-throes in Panama, British earthquakes generally remind us of the old line,

"Montes parturiunt, nascitur ridiculus mus."

The solid foundations of England may be shaken, with no more remarkable results than the disturbance of a few people in bed at the time, noises "resembling the scurrying [illegible] across the [illegible] rattling of crockery ware [illegible] a cupboard, "as though a cat were shaking a shelf," and [illegible]. Yet [illegible] the earthquake is, and it is quite possible that the force which actually produces the disturbance is one of tremendous energy. For it is an unsound argument to point to the effects which may be produced by ordinary surface shocks. It is true that the fall of a building, the explosion of a magazine, and even the passing of a vehicle, will shake the ground. But the conclusion often drawn from these facts—namely, that an earthquake may come of very slight and local causes—is unsound. A shock which is felt over half this island comes from no slight cause, and is in no way comparable with disturbances which are experienced over an area of but a few miles at the outside, as when a powder magazine explodes. The subterranean source of these wide-spread quiverings of our stable English ground are, we may be sure, deep-seated and energetic, even if it underlies immediately the region in which its action is felt. But if, as is probably the case, the throe is propagated from a distant source, and comes to the surface, so to speak, in our western counties, it may be comparable in energy, for aught we know, to some of those violent subterranean heavings which have worked the most terrible mischief to the human race.

Indeed, we have good reason for believing that the earthquakes felt in England belong to the same system, and arise from the same centre of subterranean action, as those which have shaken Portugal, Morocco, and Algiers, Southern Italy, Turkey in Europe, and Asia Minor. There is a peculiarity about the British earthquakes which is well worth noticing, and seems to be explicable in no other way. Three hundred earthquakes and upwards have been recorded as having shaken these islands, and it has been found that in nearly every instance the wave of disturbance has travelled in the same direction. This direction is (roughly) from south-west to north-east, and the seat of disturbance thus indicated is that submarine region between the Azores, Tenerife, and the Cape Verde Islands, which is looked upon as the principal source of the greater European earthquakes. Precisely as the last of the great earthwaves which devastated Peru came sweeping in from the Pacific, so the throes which destroyed Lisbon in 1755 swept in from the west. And though there are other sources of disturbance in the South European volcanic district, yet it has been the opinion of the most eminent geologists that these all communicate with the source underlying the western Atlantic, and that the latter source is the most deep-seated and therefore the most important of them all.

We proceed to give a brief account of the most remarkable evidences which these islands have afforded of the energy of subterranean forces, either acting immediately beneath them, or propagated along deep-lying channels from the far distant seat of disturbance which we have [illegible].

Some of the earlier earthquakes of which records have been handed down would seem, if the accounts can be trusted, to have been much more important than those which have recently taken place. Wendover relates that in [illegible] the whole of England was shaken by a great earthquake; and the earthquake of 1081 was accompanied, we are told, by a tremendous roaring noise—"a heavy bellowing," as one chronicler says—which was heard throughout the length and breadth of the land. In the Saxon chronicle it is stated that there was, in 1089, "a mickle earth-[illegible] over all England." A somewhat remarkable effect was ascribed to this earthquake. It happened that the [illegible] very backward in that year, and it was supposed that this was due to the earthquake, as though perhaps the [illegible] had been shaken somewhat down from their original place, and had so taken a longer time in attaining maturity.

A very singular event occurred in 1110. During the occurrence of a very sharp shock of earthquake at Shrewsbury, the River Trent was dried up at Nottingham "from morning to the third hour of the day," says the narrator, Florence of Worcester, "so that men walked dryshod through its channel."

We are now approaching a period when the most remarkable earthquakes which have ever been known in England were experienced. In 1133 a great earthquake was felt over a large part of Great Britain. In 1165, according to Matthew Paris, "there was an earthquake in Ely, Norfolk, and Suffolk, so that it threw down men who were standing, and rang the bells." In 1185, shocks were felt which were so violent that Lincoln Cathedral was flung down, and an immense amount of mischief was worked in that and neighbouring counties. Two years later there happened another earthquake, in which, according to Matthew Paris, many buildings, and some which were strong and well established, were thrown down.

If we are to believe Matthew Paris, the earthquake which took place in 1247 was attended by some very noteworthy phenomena. He relates that the shock was experienced with especial violence on the banks of the Thames, where many buildings were flung to the ground. But the singular feature of the event was that, a few days after, the sea became unnaturally calm, as if the tides had ceased, and so remained for about three months. It seems difficult, however, to associate the two events together in any way; and doubtless the calm of the sea, though it may have been remarkable, is to be ascribed to ordinary causes. Possibly the character of the phenomenon has been much exaggerated.

In 1248, the western parts of England were shaken with an energy far exceeding anything which has been known in recent times. Wide rents were opened in the churches of the diocese of Bath, and a portion of the tower of Wells Cathedral was flung down and fell through the roof. The cathedral at St. David's was also seriously damaged.

But from all accounts, it would seem that the earthquake of September, 1275, the last of the series of events which belonged to the epoch we have referred to above, was the most remarkable of them all. Matthew of Westminster relates that "by the violence of this earthquake the church of Saint Michael of the Hill, outside Glastonbury, fell down levelled with the soil." And it is said that many of the largest churches in England were destroyed or greatly injured by the same shock.

It is rather a singular circumstance that this period of activity was associated with an interval during which Mount Vesuvius was remarkably quiescent. After the eruption of 1049, ninety years passed, during which the mountain was not disturbed, and then another long rest of 168 years. That this repose was not due to any intermittence of subterranean action is clear from the fact that the volcanic district around Vesuvius was forced into unusual activity—as if an effort were made in this way to compensate for the temporary cessation of the great crater's activity as an outlet of discharge to the elastic fluids and lava which are formed during subterranean disturbances. It is related that the Solfatara Lake was in eruption, and the volcanic island of Ischia, which had been at rest for fourteen centuries, was roused into so active a state that in 1302, after many heavings, the island gave vent to a lava stream of enormous dimensions. This stream flowed for a distance of two miles.

It may seem startling to many to find earthquakes in

England associated with the movements of so distant a volcano, but we shall see as we proceed that there is good reason for believing that an association of this sort actually exists. Very few geologists doubt, indeed, that Vesuvius is connected with the region of disturbance we have already referred to as the probable centre whence English earth-waves have been propagated.

THE COMET.

By the Editor.

(*Continued from page 328.*)

If we are right in concluding that the comet which passed its perihelion on Sept. 17 is the same body which was seen in 1668, 1843, and 1880, the inference unquestionably is that the comet will before very long be destroyed by being absorbed into the sun. Let us inquire how this process of absorption, or such a process, would take place. I find that very erroneous ideas are commonly entertained on this subject. It is supposed by many that each successive return must of necessity produce greater and greater effect: and again, that the action by which the orbit is changed from a long oval to a circle is that which must in most marked degree affect the comet's physical condition. But the reverse is, in both instances, the case. Theoretically the effect at each return to perihelion ought to be less and less in the comet itself, and diminish its period and the length of the greater axis of its orbit in less and less degree: and again, the effects produced on the comet's physical condition by solar action will theoretically be enormously greater after the orbit has been changed to the circular form than they are now while the orbit is elliptical.

Let us, in the first place, consider the varying velocities of the comet at its point of nearest approach to the sun, this point—the perihelion—remaining unchanged in position, but the greater axis and period diminishing.

The formula for the velocity at any point in an elliptic orbit is as follows:—

$$V^2 = C\left(\frac{2}{r} - \frac{1}{a}\right)$$

where C represents the accelerating force of the sun at a unit of distance, a the mean distance or half major axis of the orbit, and r the distance of the body at the moment.

Suppose now that the distance of our comet from the sun's centre, in perihelion, is half-a-million of miles, or roughly, one 185th part of the earth's mean distance, and note that a body moving in an orbit having an infinite major axis and perihelion 430,000 miles from sun's centre would travel at a rate of 380 miles per second. Thus we have $(380)^2 = C\frac{2}{430{,}000}$ and if V is the velocity with which our comet, coming originally from a practically infinite distance, reached its perihelion on its first visit to our solar system, we have

$$V^2 = C\frac{2}{500{,}000}$$

wherefore $V = 380\sqrt{\frac{43}{50}} = 380\sqrt{.86} = 352.$

Let us find now a general formula connecting the velocity u at distance r in a parabolic orbit with v the velocity at distance r in an elliptic orbit, having mean distance a. We have

$$u^2 = c\,\frac{2}{r} \text{ and } v^2 = c\left(\frac{2}{r} - \frac{1}{a}\right)$$

$$\therefore \quad \frac{u^2}{v^2} = \frac{2}{r} \div \left(\frac{2}{r} - \frac{1}{a}\right) = \frac{2a}{2a - r}$$

and so long as r is very small compared with a we have

$$\frac{u}{v} = \frac{4a}{4a - r}\,;\ \frac{u - v}{u} = \frac{r}{4a}\,;\ \text{or,}\ u - v = \frac{r}{4a}\,.\,u$$

This is a very convenient formula in the case of our comet, for we have in this case $u = 352$ (miles per second). Thus, suppose the mean distance a reduced from infinity to 3,000,000,000; then velocity in perihelion (at 500,000 miles from sun's centre) is less than this by

$$\frac{5}{120000}(352) \text{ or by } \frac{352}{24000} \text{ miles per second,}$$

i.e., by less than $\frac{1}{68}$th of a mile, or 26 yards per second. This is all the reduction of velocity in or near perihelion required to change the orbit from the parabolic form to an elliptic orbit, having a mean distance rather greater than Neptune's, and a period not very different from the time occupied by the comet in returning after its visit in 1668. For, putting 1843 as the time of its next return, and, therefore, 175 years as its time of circuit, we find the mean distance corresponding to this period to be $\sqrt[3]{(175)^2}$. Here is a case for the use of logarithms: (for who wants to square 175, and then work out the cube root of the result? Not I, certainly: but)—

$$\begin{array}{r} \log.\ 175 = 2{\cdot}24304 \\ 2 \\ \hline 3)4{\cdot}48608 \\ \hline 1{\cdot}49536 = \log.\ 31{\cdot}287 \end{array}$$

showing a distance $31\frac{1}{4}$ times the earth's, or about 2,910 millions of miles.

Next, let us see what reduction would be necessary to reduce the mean distance to 1,000 millions of miles. The same process shows that the loss of velocity is

$$\frac{5}{40000}(352) \text{ or } \frac{352}{8000} \text{ miles,}$$

i.e., about three times as much as in the former case, say 78 yards per second, which means a further loss of velocity at this next perihelion passage of about 52 yards per second. This corresponds nearly enough with the period of 37 years, in which the comet seems to have performed its next circuit,—between 1843 and 1880. For we get in that case for the mean distance $\sqrt[3]{(37)^2}$: whence the sum

$$\begin{array}{r} \log.\ 37 = 1{\cdot}56820 \\ 2 \\ \hline 3)3{\cdot}13640 \\ \hline 1{\cdot}04547 \\ \text{add log. } 93{,}000{,}000 = 7{\cdot}96848 \\ \hline 9{\cdot}01395 = \log.\ 1{,}032{,}000{,}000. \end{array}$$

So that if the comet came out from a practically infinite distance, and were retarded during perihelion passage by only 26 yards, it would circuit next in a period of 175 years: and if at its next return it lost only 52 yards per second *more*, it would complete its next circuit in 37 years, or thereabouts.

But now, what would be its velocity in perihelion, if it travelled once round the sun in 2 years, its perihelion distance of 500,000 miles being unaltered? The mean distance corresponding to this period will be $\left(\frac{8}{3}\right)$ times the earth's.

$$= \sqrt[3]{7{\cdot}111}$$

$$\begin{array}{lr} \text{Now log. } 7{\cdot}111 & = 0{\cdot}85193 \\ \tfrac{1}{3}\text{rd of this} & = 0{\cdot}28398 \\ \text{Log. earth's distance} & = 7{\cdot}96848 \\ \hline & 8{\cdot}25246 = \log.\ 178{,}840{,}000. \end{array}$$

Thus the mean distance of the comet during its last orbit was no less than 178,840,000 miles, its greatest distance nearly twice this, or, roughly, about 357,000,000 miles.

The velocity in perihelion corresponding to this mean distance is less than the velocity per second with which the comet first reached perihelion, by

$$\frac{50}{71,536}(352) \text{ or by } \frac{35,200}{113,072} \text{ miles.}$$

This is about a quarter of a mile or more, exactly 410 yards per second, a reduction of velocity much more important than either of the former two, but still small enough compared with the velocity actually possessed by the comet in perihelion. The actual reduction from that at the preceding perihelion passage is (410 − 78), or 332 yards.

A still larger reduction in the velocity at perihelion would be required to reduce the period from two years eight months, to one year. For with the latter period the reduction of velocity in perihelion from that due to motion in a parabolic orbit would be

$$\frac{5(352)}{4\times 930} \text{ or } \frac{44}{93} \text{ of a mile per second.}$$

This is about 833 yards per second, or a reduction from the velocity at the preceding perihelion passage by

$$833 - 332 = 501 \text{ yards per second.}$$

There is reason to believe that a more important reduction than this took place—in which case the comet will be back in less than a year.

SCIENCE OF *THE TIMES*.

SCIENTIFIC articles in *The Times* are generally worth reading, for the same reason that the Spartan helots, when disguised in liquor, were worth watching—to wit, as awful examples. But there are degrees, even in such cases as these. Under what conditions, we wonder, can the following sentences from an article on earthquakes have been written?—"When the earth was conceived to be a crust floating on a sea of liquid fire, observation alone, and not experiment, seemed applicable to the storms which tossed and blasted the superincumbent mass. The ocean of molten lava resembled a capricious monster, which obeyed impulses incomprehensible to the sufferers by its fretful fury. An earthquake, according to the more recent belief, which Mr. Mallet's reasonings and illustrations have raised to the level of a law, is but a variety, gigantic in its proportions, of a process always in operation, and among the regular machinery for the action of nature." [Did anyone ever read such English?] "The earth is perpetually breathing and sighing throughout its whole frame. Its throbs cause a succession of minute motions as penetrating as the labour of earthworms, and as effective. Somewhere about the stupendous mass a similar species of movement is ever manifesting itself with a larger volume in the form of eructations. . . . . As Professor Milne remarks, in the origin of the astonishing ebullitions called earthquakes principal are usually modified by secondary causes. . . . . The object of Professor Milne's letter is to urge the claims of seismology to fuller recognition in countries *which neither can boast nor have cause to dread the earthquakes of the Pacific.* Phenomena, he points out, are present in unfailing and unvarying abundance within these more temperate regions. They wait or they come back to be inspected with a patience and a regularity unknown in the resort of earthquakes. Modern science has no inclination to tolerate that the earth should be suffering incessant modifications without inquiring what they are and how they are accomplished. Nature and its acts and faculties have too complete an unity for science to possess any option of neglect were it disposed to be neglectful. *The microseismic motions and the oscillations to which Mr. Milne refers, if they are part of the ordinary economy of nature, must mix with and affect all the rest of its departments. Even for the purposes of experiment, it is impossible to 'bury' or 'eat them up.'* The sole remedy is to consult them. The field has as yet few explorers. Its conditions of exploration and the attainable results are hypothetical. An extraordinary assemblage of phenomena is sure to reward the early pioneers. They have a new world before them. But nature, the more multiform its energy and manner of working, shows itself only the more uniform at heart. Its laws are as simple as their agencies are complex. *Science dissipates mysteries at the moment of grasping them. When the recesses of the earth are probed they will be found to hide no dark secrets defying tests and arrangements.* The same analysis which promises to reduce earth tremors to a system, and display by what physical instruments they are produced, may supply a clue to the portent of an earthquake. *Nature is as impatient of monstrosities as science. When nature and science are labouring together apparent physical anomalies are very speedily smoothed out and effaced.*"

Comment on inanities such as these would be idle. We have italicised the most salient absurdities, but there is little to choose between these and the others, or between the passages we have quoted and the rest of this scientific "leader." If these are our leaders, heaven help the led. Yet many wonder that "the general reader" is not attracted by science. How should he be when it is presented in such garb as this?

A HINT TO BOTANISTS:

OR LEAF COPYING.

IN reading the interesting account on the method of taking the impression of butterflies' wings, which I have often myself practised, I recalled a very simple, though excellent, plan for taking the impression of leaves and flowers which I think is not generally known, and which I intend to describe so that our entomological friends may not have all the advantage over our botanical scientists. In the first place procure a small bottle of oil (I always use olive), a camel's-hair brush or piece of rag, half a dozen sheets of white unruled copying paper, and a few sheets of white notepaper, also a good old-fashioned tallow candle with a large wick; having placed these articles ready to hand, commence operations by taking the leaves you wish to perform upon and putting them under a press, if you possess one, or put them in a large book so as to get them with a fairly even surface; then take a large sheet of your copying paper and oil it completely by rubbing it with your rag, taking care not to put on more oil than is necessary; this oiled paper must then be placed in a good draught or in the open air till it is fairly dry* (as otherwise the impression will be faint). When it is ready, light your homely tallow, and taking the corners of your oiled paper, hold it over the candle so that the flame just touches it, moving it about to prevent it from scorching. Do this until a fine layer of carbon is deposited on the paper, thick enough to only just see the light of the candle through the paper as

* You can, of course, always keep some ready, as it takes about two or three hours to get moderately dry.

you hold it over it. Be careful that the paper is equally black all over, as otherwise the impression will be blotchy. When you have done this, extinguish your candle and place your prepared paper on the table, black side uppermost. Then take your leaf on which you are going to perform, and, cutting out a piece of black paper of that size, place the leaf upon it; then, over that, place another sheet of paper, and with your finger rub carefully and evenly over the place where the leaf is, taking care not to shift its position. After this, lift off the top paper, and carefully raise your leaf from the blackened paper on to a sheet of white note-paper, and, when once you have laid it on, do not move it in the least, or it will smear; then, placing a clean piece of paper to cover the leaf, again rub well, and quite evenly, over where the leaf lies, for about two minutes; then remove your paper and leaf and you will find a beautiful impression of the leaf, with all the veins, even to the most minute, standing out in black. If this is allowed to dry it will not smear in the least, and will always retain its original freshness.

I do not suppose that my explanation has been very clear, but I have tried to make it as plain as possible. I have seen a very beautiful collection of flowers and leaves done by this method, and when they are arranged in groups or various forms, according to taste, they produce a very pretty effect. Some think tinting them with colours also very effective, but that is as your fancy may dictate.

J. F. ROBERTS.

ELECTROTYPING TELEGRAPH WIRES.—The Postal Telegraph Company of New York have recently acquired an electrotyping establishment in Ansonia, Connecticut, for the purpose of covering the steel wire they employ with a deposit of copper. The present capacity of the works is sufficient to deposit two tons of copper a day, and extensions are now in progress to treble this amount. When these extensions are completed, 980-horse power will be employed to drive dynamo machines for supplying the current necessary to cover thirty miles of wire a day, with 500 lb. of copper per mile.

ON Monday a deputation waited upon Mr. Shaw-Lefevre with reference to the restricted facilities for entrance to Kew Gardens. The deputation complained that not only were the public excluded from the gardens every day until after 1 o'clock, but the Temperate-house gate, close to the very handsome picture gallery, recently presented by Miss North, was being bricked up, and another entrance made 350 yards further down the road towards Richmond. It was pointed out that a large number of houses, ranging in value from £100 to £300 per annum, had been erected near the Temperate-house gate, and a new road made leading from the railway station to it, in the hope that it would be opened to the public, but the new gate would be at a spot where there was no population, and would give access to the least interesting part of the gardens. Mr. Shaw-Lefevre informed the deputation that the work was being carried out on the recommendation of Sir Joseph Hooker, the director, who had represented to the Department that it was for the public advantage. It was not desirous to multiply the entrances to the gardens. It was intended not only to brick up the Temperate-house gate, which had never been open to the public, but also to close the entrance now available for the public near Richmond, opening instead the new gate, which would be very ornamental, between the two. He would consider whether railings could be substituted for bricking-up the Temperate-house gate, so as not to shut out the view from the road. [Why not railings all along? – ED.]

Reviews.

MAGNETISM AND ELECTRICITY.*

ELECTRICAL science and its applications have forced themselves so prominently before the public during the past few years, that it is only natural we should observe a considerable increase in the number of publications issued with a view to giving more or less reliable information to those who desire it, or, we may rather say, to cultivate a more extensive taste for it. Amongst the class-books designed for the use of those who, having no previous knowledge of the subject, are anxious to make themselves practically acquainted with its many mysteries, we know of no better than the little work now before us. Dr. Wormell has already gained a well-merited reputation in the world of physical science, which cannot fail to be increased by this, his latest effort. He aptly points out in the preface that "the general purpose of science in education is to cultivate in the student an intelligent attitude of mind in relation to the things and phenomena about him, and to give him ability to describe as well as to examine and use them." The author has, therefore, taken considerable trouble to incorporate an excellent series of instructions in laboratory practice, and has thereby assigned to the work a place by itself. The practice is designed mostly with apparatus of an extremely inexpensive but very efficient kind, and such as can generally be made by the student. The book is divided into a number of "lectures," each one dealing with a special branch, the lectures on Magnetism being uniformly good, and several of the experiments of a very telling but simple nature. Terrestrial magnetism and its effects upon iron ships, with the means devised for the "correction" of their permanent and temporary magnetisations, are very ably dealt with, and the dangers that would accrue were such corrections neglected, are pointed out and illustrated. In the lectures on Electricity, the studious combination of hand and head-work is continued, the experiments growing in interest and importance; but perhaps the best portions of the book are those which deal with measurements and instruments for measuring—best, not so much because of their superiority over the other chapters or lectures, but rather because there has hitherto been far too strong a tendency to ignore that branch of the science which entitles it to a place amongst the exact sciences. The lecture on "Capacity and Potential" is an unusually clear and concise exposition of what appears to be to the student one of his greatest difficulties. It makes the important relationship existing between capacity and potential so easily comprehensible, that no further trouble with the subject should be experienced. Careful attention has also been devoted to the explanation of the principles involved in magneto and dynamo-electric machines, as well as telephony and other applications of electricity.

The work is almost free from errors. There are, however, a few—possibly printers' mistakes in the telegraphic characters, and it is to be regretted than an instrument which has been out of date these last twenty years should be given as an illustration of the Morse telegraph instrument of to-day. A more serious error has crept in on page 134, where, using a Galvanometer of low resistance, it is stated that cells being added in series to increase the electro-motive force (E. M. F.), "the current (c) is proportional to the E. M. F. producing it, or . . . . C varies

* *Magnetism and Electricity. An Elementary Text-Book for Students.* By RICHARD WORMELL, D.Sc., M.A., Head-Master of the City of London Middle-Class Schools. (London: Thomas Murby.)

as E. This is only true when the external resistance is greatly in excess of the internal resistance. The error is, however, corrected further on in the excellent lecture on "Resistances."

Altogether the book commands a front rank amongst elementary text books, and is well worthy of our recommendation. It is written in language which is simple but to the point, and our praise is due for the manner in which so much reliable information has been intelligibly compressed into so small a compass.

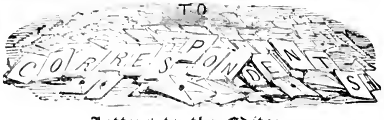
The Electric Light at Waterloo House. The extensive premises, situated at the corner of Cockspur-street, in the occupation of Messrs. Halling, Pearce, & Stone, have just been fitted with sixteen arc lamps by the Metropolitan (Brush) Electric Light Company, the motive power being derived from a 12 horse power (nominal) Otto gas engine.

We shall have Hampden and the three headed Parallax (Goulden Birley Rowbotham) upon us. The daily papers tell the following story: "An interesting experiment in signalling by sunshine has been made by our army in Egypt. Colonel Keyser ascended one of the Pyramids near Cairo, and setting up a heliographic mirror, reflected a ray of sunshine all the way to Alexandria, a distance of some 120 miles. The signals, appearing like pin-points of brightness, were distinctly readable on the coast, and took the form of a message from Sir Garnet Wolseley to the Khedive." The distance is scarcely 120 miles; nearer 110; but taking six inches for the depression in one mile from earth-curvature, corrected for refraction, we find for 55 miles a depression of more than 1,400 feet; so that a tangent to the earth's surface at a point midway between Alexandria and the Pyramids, would pass 1,400 feet above each of those places. Thus, if the mirror were 1,400 feet above the sea level at the Pyramids, it might have reflected sun rays to a point 1,400 feet above the sea level at Alexandria. But a less height at either end would not serve, or if there were a less height at one, then there must be a greater height at the other.

Elements of the Comet. As we expected, Dr. Hind's elements of the new comet, as given in our last number, have had to receive considerable modification. Instead of making the logarithm of the perihelion distance 8·09201, he makes it now 7·90653. The effect of this on the estimated perihelion distance in miles may be seen from the two following little sums:—

10 + log. perihelion distance	= 8·09201 or	7·90653
log. earth's distance	= 7·96818	7·96818
	6·06019	5·87501

These logarithms correspond to a perihelion distance of 1,148,000 miles and 750,000 miles respectively. We believe the distance we adopted, viz., 500,000 miles, is nearer the mark. At any rate, this approach by 365,000 miles to our estimate is satisfactory. Dr. Hind remarks that his later elements afford indication of disturbance of the comet's motion near the time of passage through perihelion. It can be shown from his elements that, at the time when Mr. Gill saw the comet touching the sun's limb (the edge of the sun's disc), it should have been projected more than 5′ within the limb. It follows that the comet was much retarded during perihelion passage, as we shall show more particularly next week. All yet known about the comet tends to show that the comet of 1668, of 1843, of 1880, and of 1882 are one, and that at the place of nearest approach to the sun this comet is very seriously disturbed.



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of **Knowledge**; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

SATURN'S RINGS.

[592]—As I am interested in the inquiry which has been made respecting the discovery of the primary division in Saturn's ring, will you kindly inform me where the copy of *Philosophical Transactions*, vol. i., which contains that drawing of the planet of which you have given a representation in Knowledge, No. 19, p. 307, can be seen, or in whose possession it is? A friend of mine has examined no less than seven copies of the said volume, and has not been able to find it. C. L. Prince.

The Observatory, Crowborough Beacon,
Tunbridge Wells.

[Mr. T. Ward, who kindly sent to us the extract to which Mr. Prince refers, will, we have no doubt, communicate the particulars required. The extract is (Mr. Ward writes) "from the first volume of the *Philosophical Transactions*, not the condensed or epitomised one which was referred to by Captain Noble, but the original issue that came out in monthly parts." Mr. Lynn remarks in the *Athenæum* on the difference between the picture, of which Mr. Ward has supplied a *fac-simile*, and the one professing to be a copy of it, "so that some carelessness was committed in reproducing it." It seems clear that the engraver carefully removed the very feature which Ball had been careful to indicate as anomalous. Every one who has had much to do with scientific illustrations will understand how the thing was done. The engraver removed what he regarded as a fault in drawing—result, a valueless picture. The picture sent by Mr. Ward shows what Ball really saw,—or rather what, by a curious optical delusion, he seemed to see. We must thank Captain Noble for restoring to Cassini the credit (whatever it may be worth) which is due to him in this matter.]

HIGH TIDES.

[593]—In your issue of Sept. 29 you kindly inserted my predictions of the high tides of Sept. 26-30. It may interest some of your readers to know how far these predictions were fulfilled. I take the computations as they stand in your paper, with 8 ft. 6 in. deducted, as there directed, and the observations are those made at the self-registering gauge at George's Pier, Liverpool, from the level of the Old Dock sill. It will be noticed how accurately the "diurnal inequality" is accounted for:

Date. 1882	Calculation. ft.	in.	Observation. ft.	in.	Error. in.	Bar.	Wind, direction	and force.
Sept. 26...	18	9	18	6	6	29.6	S.E.	fresh
	20	7	20	6	1	29.4	S.S.W.	slight
,, 27 ..	20	0	20	0	0	27.4	S.	calm
	21	8	22	3	7	29.5	W.S.W.	very strong
,, 28 ..	20	8	20	7	1	29.6	W.N.W.	fresh
,, 29 ..	21	10	22	0	2	29.6	W.S.W.	slight
	20	6	20	8	2	29.6	W.S.W.	fresh
,, 30 ..	20	11	21	6	7	29.6	W.S.W.	very strong

James Pearson, M.A., F.R.A.S.

LONG TRICYCLE RIDE.

[594]—Mr. G. S. Newth, of New College, Hampstead, yesterday rode to Bedford, 50¼ miles, on his "Otto," in the face of wind and rain, leaving London at 5.30 a.m., reaching Bedford 10.45.

Starting on the return journey at 1.30, London was reached by six o'clock. Allowing 15 minutes for refreshment, the 50 miles were ridden in 4 hours 15 minutes, and the entire journey of 100 miles in 9½ hours, without any previous training, and on wet, soft roads. J. F. P.

Sept. 22.

WOLLASTON AND FAIRY-RINGS.

[595]—In justice to the memory of one who is no longer with us, we beg, with your permission, to point out that the fungus theory of the origin of fairy-rings, advocated by certain of your correspondents, was propounded, so long ago as the beginning of the century, by the celebrated Dr. Thomas Hyde Wollaston. His paper on the subject is to be found in the *Philosophical Transactions.*

Alfred W. Soward,
I. Probert.

SPIRITUALISM.

[596]—About eighteen months ago I attended a lecture of Mr. Stuart Cumberland on spiritualism, his object being to expose the spiritualists. Considerable controversy took place between Mr. Cumberland and his opponents, but the latter were entirely defeated, inasmuch as they were afraid to come on his platform, fearful lest he should expose them. About ten months ago Mr. Carl Von Buch, of Lancaster Gate, and a friend, were fortunate enough to relate in the *Times* the capture made by them of a celebrated medium in the act of personating a spirit. This occurred in the rooms of the British National Association of Spiritualists, 38, Great Russell-street, now reconstituted under another name, where similar seances have been since held.

Recently, another well-known medium of the Association, a Miss Wood, was caught in the same manner by a spiritualist, who, having had his suspicions aroused, seized the "Ghost," and found it to be identical with the medium herself, while the chair was, of course, empty. We shall again, probably, have another explanation from the Central Association of Spiritualists, of the unfortunate medium made by their spirits "to act part wholly irrespective of their own volition," and other similar jargon, to prevent, if possible, the defection of their wavering adherents and the loss of substantial contributions to the good cause. As long as the world exists there will be dupes, and, therefore, knaves to dupe them, for the demand creates supply, and the supernatural has always exercised a fascination over many. The truths, if there be any, of spiritualism may be a legitimate field for inquiry, but a few good *exposés* of paid mediums will probably deter many from becoming victims to a fraud the worse in that it trades on the most sacred of human feelings, viz., the sanctity of the dead. E. P. W.

DR. HUNTER'S EXPERIMENTS.

[597]—Allow me to remark that Professor Owen's statement regarding Hunter's discoveries (Knowledge, July 28) does not agree with Sir William Fergusson's, mentioned in one of the articles on Vivisection in the *Nineteenth Century* (February, 1882). Sir William Fergusson says:—"So far as I have been able to make out—and I have inquired into the subject—Hunter's first experiment, if it may so be called, was on the human subject; and it was long after he had repeated his operation on the human subject, and others had repeated it, that the fashion of tying arteries on the lower animals originated and was developed."

San Remo. Mathilde van Eys.

THE FIFTEEN PUZZLE.

[598]—The "box-turning" solution of this puzzle from the lost position can be accomplished in 39 moves by moving the blocks in the following order:—14, 15; 10, 6; 7; 11, 15; 10, 13; 9, 5, 1; 2, 3, 4; 8, 12; 15; 10; 13, 9; 5, 1, 2; 3, 4, 8; 12, 15, 11; 13, 9, 5; 1, 2, 3; 4, 8, 12; turning the box whenever you please. A. B.

FLINT JACK.

[599]—Seeing that a reader of Knowledge (page 268) wishes to know where and how the wanderings of this celebrated man were ended, I wrote to the head-master of a large public school where I had heard "Flint Jack" mentioned in a lecture, and he kindly informed me that he had seen a collection of his manufactures and a photograph of him in the Blackmore Museum at Salisbury, and was told that he was there taken up as a vagabond and died in gaol, either at Salisbury or at Exeter. E. T. C. W.

Answers to Correspondents.

**** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* Knowledge, *the increasing circulation of which compels us to go to press early in the week.*

Hints to Correspondents.—*1. No questions asking for scientific information can be answered through the post. 2. Letters sent to the Editor for correspondents cannot be forwarded, nor can the names or addresses of correspondents be given in answer to private inquiries. 3. Correspondents should write on one side only of the paper, and put drawings on a separate leaf. 4. Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

L. R. S. Proportional to r^3 and proportional to $(2r)^3$, are exactly the same thing.—W. H. E. Ruth. Thanks, but for the present cannot find space for your letter. Much of what you say has been said by others (whose letters have reached us before yours).—Hatii. Your advice is excellent. I have ordered a new and very large waste paper basket, so that, as you pleasantly put it, "a place of honourable and luxuriant rest may be provided for the products of captiousness and hypercriticism."—A. B. I fear that no more space can be given to that Algebraical problem. It may be worth noting, however, that the two equations, $x^2 + my = a^2$ and $y^2 + nx = b^2$ represent two parabolas, having their axes coincident with the axes of y and x respectively. The former cuts the axis of x in two points, $a, 0$, and $-a, 0$, and the axis of y in the point $0, a^2 \div m$; the other cuts the axis of y in the points $0, b$, and $0, -b$, and the axis of x in the point $b^2 \div m, 0$. These parabolas may intersect in two points or in four, according to the values of a, b, m, and n.—If A. H. will send me one of the photographs referred to I may be able to give him the information he seeks. If the picture is on glass it may have been whitened with bichloride of mercury (A. Brothers).—C. Y. W. Letter 584, page 311[?] will find a full description of the Glycerine Barometer in the *Times* of 25th October, 1880 (Vega).—D. Illingworth. The *rationale* of your formula is bound to come out if we test it. Thus, let n be the number of the month, a the man's age last birthday. The first process of your formula gives us $2n + 5$. You multiply by 50, subtract 365, and then add 115. Clearly this gives $50(2n + 5) + a - 250$, or $100n + a$. In other words, the resulting number has his age in the last two figures, and the number of his month in the preceding digits or digit.—Taranaki. I have not heard of the paper you mention on the boomerang. I should like to, the subject being one of great interest to me. It seems to me to illustrate well the flight of birds.—T. wishes to know how the colour can be restored to the metallic scarlet of old plates.—F. R. M. would like to have a statement of the circumference, long and short diameters of (1) the Dolichocephalic, (2) the Brachycephalic, and (3) the average modern English skull.—J. B. Thanks. Good for our Gossip.—T. A. The explanation of the tides and of twilight is doubtless often incorrect in our school-books.—Sugston. Mr. Brudenell Carter is doubtless right about the rays surrounding stars. They are, of course, subjective phenomena. But he was quite mistaken about the Solar Corona. That theory was entertained by many who had never seen the Corona, not by any who had. If there had been any occasion to disprove it, the photographs would have done that for us. But the coronal rays are not at all like those seen around a luminous object.—H. A. would like to know if there is any evidence to show that dogs by accidentally biting themselves, as when flea-hunting, may self-inoculate themselves with hydrophobia.—Fitz. Brown. There is no reason for associating the colours of self luminous paints with the phenomena of metachromatism.—W. Parker. Your letter reached us too late for useful reply.—H. J. White. Prof. Tyndall's Address (Belfast) is published as part of the later editions of his "Fragments of Science" (Longmans). He certainly never made an apology for that able address. It assuredly needed none, even for those who differed from him. As for the little sum you set, I must really decline to work it. We must draw the line somewhere. G. Griffiths. There is no way of telling the odds against one horse from the known odds against another.—H. B. Richardson. Do not know the publishers of Mr. Birley's "Zetetic."—W. H. Banwell. Like you, I did not quite see what, in Mr. Arnold's article, drew down my friend's attack. If I were asked which I would rather give up, my literary or my scientific studies, I should unhesitatingly say the latter. Fortunately there is no occasion to give up either. Of course I am speaking only of the personal pleasure either form of study affords, not of their usefulness. But I have the greatest possible contempt for the class of classical studies to which F.R.A.S. referred. Bevan Lingwood wants to know of an English translation of Demosthenes' "Philippics." Oriter, J. E. S. They were electric clouds. Wood. The cause of light is not known. Science can only discuss the nature of light; she can deal with the How, not with the Why.—F. C. I am very sorry, but it would really be impossible to give [illegible] to you without departing from [illegible]. We cannot say which is the [illegible] Qualitative [illegible] Analysis. J. M. You ask for [illegible]. If [illegible] a garden path is elliptical and [illegible] or outline is not elliptical.—[illegible]. The [illegible] Rainband only corresponds in a [illegible] way [illegible].—F. W. R. See numbers 48 and 49 [illegible] of [illegible] observations. J. Munro. Quite im[illegible] to discuss manuscripts.—F. Gardner. [illegible] about [illegible] received. We do our level best, but our [illegible] sometimes (as the queen says).—A. G. [illegible]. We [illegible] assumptions you refer to only in illustrating [illegible], not to prove anything. Malcolm D[illegible]. You are quite right. The [illegible] in the numerator of right [illegible] fraction in lowest formula on page 172, first col., [illegible] changed to [illegible].—J. Fraser. I believe there is [illegible] rule for determining the slip in the case of [illegible] propellers. Newton Crosstand. The reasoning you have [illegible] has been refuted. Your mistakes are familiar ones. [illegible] think your views have been refuted, in the sense in [illegible] probably use the words. When my friend Mr. Dunkin [illegible] he was unable to refute your views, he no doubt meant [illegible] could not spare time to explain to you their incorrectness. [illegible] labour under the erroneous idea that every holder of [illegible] views is bound to correct their mistakes. John Greenfield. [illegible] earth's tilt is not caused by precession. I was right in saying [illegible] cause of it is not known. * * * recommends hot Scotch [illegible] slice of lemon, to Mephisto, in preference to brandy. Does [illegible] Three Star Whiskey? I fancy I recognise an old [illegible] in Three Stars. J. F. B. Yes, p. 258, col. 2, eight [illegible] from bottom, read "moon's" for "earth's."—B. Sanders. [illegible] misprint Truro for Tresco, but as no one would be [illegible] a lifeboat used at an inland place, it did not [illegible] worth while to correct. F. Mackeith. Many thanks [illegible] of the American meeting. Will probably use some [illegible] digestion. Ignoramus. I should say the less a lad of [illegible] or seventeen smoked the better. I dare say a half-bowl of mild tobacco per day would do no harm, but I am sure it [illegible] do no good. Then, would he stop there? A Highlander. Perhaps some one who has had experience in the use of the Rain-[illegible] spectroscope will give us a concise account of their expe[illegible]. Upsala. Now others very much like those papers. I am [illegible] of those who do. The earth's orbit is an ellipse; but on the [illegible] of that picture you would not be able to tell it from a [illegible]. Shorthand Writer has taken no strong drinks for eight [illegible] nor has he felt the need of them. He therefore firmly be[illegible] that "no man needs artificial stimulant and strong drinks [illegible] artificial." But is not our life artificial most of the time?—H. P[illegible]. A bladder does not weigh the same when empty and [illegible] air; for, if distended with air, the air is at [illegible] pressure and therefore of greater density than the sur[illegible]. But if simply full of air, it of course weighs no more [illegible]. Equally, an empty bladder and one full of [illegible] are of equal weight if weighed in water. But a bladder full [illegible] weighs more than an empty one by just the weight of the [illegible] in a vacuum.—A. G. B. Kennett. What [illegible] saw was a solar halo. The ice particles in the air at about 22° [illegible] the sun refracted the rays to the eye, each colour at its proper [illegible] from the sun.—J. A. Robson wants a book on isometrical [illegible] and projection other than Sopwith's.—C. Hankinson. Wants [illegible] on the blowpipe. T. Such questions more suitable for [illegible]. T. M. Not quite suitable.—Esther. (1) [illegible] part of a degree. There are rather [illegible] in a degree. (2) I do not know how to [illegible] as long as possible. By the way, how do [illegible] free from earwigs? W. H. Lane. [illegible] measured accurately the distance at [illegible] man's head without killing him. [illegible] rather a delicate one, I should imagine. [illegible]. I should be content with as [illegible]. We have scarcely so much available [illegible] possible. Gratefull is much [illegible] he has "learned more," he [illegible] from all the books he has seen." [illegible]. J. H. Ward says his binder [illegible] Moral." Send next volume [illegible] Constant Reader to adver[illegible]. J. Dimmock that Professor [illegible] "Science in the Modern State," is [illegible] Murray at 2s. [illegible]. Thanks. Soon.—E. T. C. M[illegible] will [illegible] be published. At present they are [illegible]. M. L. L. The editor of Knowledge is [illegible] result of some personal prejudice) to [illegible] for the purpose you mention, Mr. Proctor's work, now in the press, "The Stars in their Seasons," republished from Knowledge. For a first very simple guide, Mr. Proctor prepared "Half-hours with the Stars"; for fuller information the maps which have appeared here; for a knowledge of the quaint lore of the constellations, and other such matters, the "Easy Star Lessons." Each work, however, is complete in itself. I believe the publishers propose to reprint Five of Clubs' Whist disquisitions, in the form of an easy Guide to Whist, soon after they are completed.—Chas. Witham. I thank you, and the other subscribers in whose name you write, very heartily. C. S. You are quite right; the previous predominance of heads in no way renders the occurrence of a run of tails likely. There is no tendency to exact equalisation, only to equality of proportion. Thus, if there are to be a million tossings, it is very unlikely, antecedently, that there will be exactly 500,000 heads and 500,000 tails; but it is also very unlikely that the ratio of heads to tails will differ from unity by more than one-thousandth part. In other words, it is most probable that both heads and tails will lie in number between 499,750 and 500,250, but very unlikely that they will both be 500,000. Yet note that 500,000 is the most probable of all results—the most probable, yet very unlikely as compared with all other results taken together. Leonard D. You are doubtless right, but accuracy is secured by the power of correction. You may notice, for instance, that the Editor has recently not only corrected in these columns a mistake of his own, but published his correction elsewhere. This is, of course, only right. There is not a particle of merit in doing what it would be very wrong to leave undone. But if we all agree to point out our errors or to accept readily the corrections of others when we recognise their correctness, we cannot go very far wrong. Why did not you send a letter with your corrections, for publication? You may be sure it would have found a place.—Nausea. I doubt if there is even any alleviation for sea-sickness. You may prolong the trouble by slightly diminishing it, but the totality of misery is much the same. Yet remedy may be found in attention to the health before starting. If you take plenty of exercise for a fortnight, eat no pastry, little butter or cheese, and even reduce your customary allowance of milk, you will, if your constitution is like mine, suffer much less than you otherwise would. I have crossed the Atlantic in misery for the first five days on three occasions, and on three others without a qualm from shore to shore, the weather being rough all six times.—Solanum. It is admitted toads are not venomous.—J. Stevens. Thanks for Flint Jack extract. W. B. Wicken. It is chiefly because the temperance cause is injured by attacks on the moderate, that these are to be deprecated. If a Blue-Ribbonist asks me whether I sympathise with his cause, my answer is that I do most heartily; but if he asks me to denounce moderate drinking, and to assert, contrary to all experience, that most moderate drinkers end by becoming inebriates, I am obliged in common honesty to tell him, "that's a bay horse of another colour" (American version of our familiar saying). Subscriber. You want to know too much at once. But as you hail from Victoria, I answer. 1. The moon actually does rotate on its axis once in each circuit around the earth. (2) A diagram showing the moon's path for a year should be about three yards across. We have not space for that. (3) The moons of Jupiter move rather differently from our moon, their motions being more rapid, relatively, in their own orbits, and Jupiter's less rapid in his. (4) Certainly; many comets travel from star to star. (5) Given a passage through the centre of the earth (I am sure I have no objection) and a body of the same density to fall through, how far beyond the centre would it go, and how long would it oscillate? Well, that would depend on the resistance of the gases in the passage. If there were none, the body would oscillate through a whole diameter each way for ever.—Scott. It strikes me Mr. Foster was joking when he said, in his article on Nature Myths, that Tom the Piper's Son was the Thammuz of the solar myth. Perhaps Tom was. Perhaps, also, the Swan into which the Ugly Duckling turned was afterwards Leda's Swan, and later, in partnership with Mr. Edgar, took a shop in Piccadilly for the sale of articles of haberdashery to the Ledas (I would say leaders) of fashion.—F. W. Millett. It would be hopeless to attempt to determine the true position of the auroral streamers from such observations. R. Q. P. Yes, Carlyle's statement is quite correct. Any motion brought about by internal reactions alters the centre of gravity of the system.—J. A. Westwood Oliver. I think Boss and Smyth about right as to the destruction of the comet, but our earth is all right, I should imagine.—Alb. Barrett. I believe Aristotle was the first botanist whose works are extant. Only one would hardly call him a botanist, who studied so many subjects.—W. Probyn Nevins. Yes, it is really too bad of him to frighten all the other old women about the mischief the comet is to do the earth.—H'self. Do not know of any data by which time taken to make "pot-holes" can be determined.—J. Mackenzie wants to know the names of the authors of "The Key of the Universe," and "The Theory of Progression."—F. A. Bellamy. Mr. Collyns's book is quite paradoxical. He has mistaken the proof that the apparent brightness of the sun is the same from whatever distance it is seen, for a proof that the same amount of light is received from it. T. Winder. Thanks; it shall appear.—E. D. G. Yes, Routledge's "Discoveries and Inventions of the Nineteenth Century" is good; but surely you do not call it "a complete history of the Advance of Science" during the time? That was what I was asked for.—F. Stanley. Thanks. You will see that your wishes are already attended to.—Geo. Kamensky. Thanks; but no space at present.—C. W. Y. All right: Philology soon.—M. J. Harding. Will try to do so. But the publishers wish to bring out the maps in book form, and may not approve of a second printing of those maps. You doubtless notice the difference of scale.—R. Forrow. No mistake of that kind has been made. The true course of the comet does not intersect the sun.—T. E. Bonser. Truly, your suggestion seems an excellent one. It shall be followed.—Deo Fido. Yes, the new use of the "stethoscope" to foretell rain is striking.—N. W. S. You should divide by the *cube*, not by the *square* of B L. "That's how the error has arisen."

ELECTRICAL.

A. B. (1) Thanks. With an already acquired knowledge of electricity your age (20) would doubtless prove a very convenient one for commencing practical studies preparatory to becoming an electrical engineer. (2) I do not think you will do far wrong in joining the school. Go and see for yourself. I imagine electrical engineers are far too busy to find time for instructing pupils. (3) Electrician and electrical engineer are, to all intents and purposes, synonymous, the latter having, perhaps, a slightly more practical ring about it. There are times when one name has a preference over the other—for instance, we should speak of an amateur electrician, but scarcely of an amateur electrical engineer. Puzzled. The explanation of your difficulty will probably be that a Bunsen battery running down in four hours or so, the accumulator discharged itself during the night through the Bunsen, leaving a deposit of sulphate of lead on one of the plates. This is insoluble and non-conducting; accordingly, when you attempted to pass a charging current, it did not for a time get through; eventually, you say, it did get through, but left no stored energy. This was doubtless owing to the blotting paper which separated the much-too-closely-packed-plates, rotting through and falling to the bottom, *lead-trees* then forming across the space separating the plates. Use felt or asbestos next time. A medical coil revolving at a high speed would hardly suit your purpose, as it would give too much electro-motive force, while you would be deficient in current strength or quantity.—W. S. If space permits, your request shall be complied with, but supply and demand are not yet equal.—A. E. Neal. The Post-office, I think, sometimes sell single needle telegraph instruments at £3. 15s. each. If you cannot get supplied there, try the Silvertown Company, or Clark, Muirhead, & Co., Westminster.—C. J. Eve. 1, 2, 3, and 4, will be answered shortly in an article. (5) The Siemens' Armature is the simplest and best for your purpose. We have yet to learn which is the most efficient, after taking all things into consideration. (6) Yes. (7) Your wish shall soon be gratified, want of space is the only difficulty.

Letters Received.—Dazed.—J. Bemrose.—E. B. W.—T. E. Bonser.—Artarus.—Romolo.—Maui.—G. A. S.—W. F.—G. J. Over.—F. C. Brown-Webber.—Daleth.—W. Hainsby.—W. Ackroid. T. Walker.—W. C. Masters.—James Cram.—Gradatim.—Another Perplexed Student.—E. M. King.—Samson.—J. Greenfield.—Newton Crosland.—S. Barker.—Lara.—W. Bolden. J. Davidson.—More Light.—I. J. Rubie.—An Oxford Student.—C. I. Brown. H. W. H.—J. E. Howe.—W. S.—W. M. Beaumont.

Our Whist Column.

By "Five of Clubs."

We continue our brief summary of the chief rules for play—the axioms of the science, as it were—not to know which argues Whist unknown.

Play Third Hand.

Play your best if above and not in sequence with your partner's lead, and above second hand; but play lowest of head sequence, or of head cards otherwise equal in value (as Nine from Nine, Knave, King, if Ten and Queen have been played). But holding Ace, Queen, play the Queen, unless a single trick saves game.

You can safely finesse in trumps when strong in them, sometimes even against two cards. Never play a *needlessly* high card third in hand. If you can win the trick or force out the King card with a Ten or a Nine, it is a Whist offence of the first magnitude to play the Knave.

Play Fourth Hand.

Win the trick, if against you, as cheaply as you can. It is very seldom good policy to pass the trick for the chance of making two, unless the chance is almost a certainty. But if at the score two tricks are wanted to save the game, then, of course, you should try for the two tricks at the risk of losing even the one in your power. Only win your partner's trick when you are sure, or almost sure, of gaining at least two tricks by getting the lead into your hands. With the King card of your partner's suit, singly guarded, and only losing cards besides, take the trick from your partner and lead him the little one, unless one trick more will save the game, in which case, of course, your King card in your partner's suit will make it. Otherwise, it can make but that trick, and you cannot lead your partner his suit.

Leading Trumps.

Lead trumps when you see a good chance of getting out trumps and bringing in, either by long trump or re-entering card, your own or your partner's suit. With an established suit, every card left in the suit is a means, if wanted for the purpose, of drawing a trump from the adversaries. In estimating, then, your chances, count these winning cards as part of your strength against the enemy's trumps. Weak players seem unable to understand this. "Why should I lead a card for the enemy to trump?" they ask. The answer is, that a long trump against you will make, do what you will; if it takes one of your long suit, and leaves you the rest as winning cards, with power to bring them in, it does you the least harm possible. If, instead, you carefully refrain from forcing it out, and play (as weaklings always *will* do) your head-cards in the opponents' suits, that long trump is used not only to win its single trick, but to bring in the enemy's long cards. You *do not even save a single trick by failing to force, and you may lose two or three you might have made.*

Leading trumps from a weak suit is only excusable when, either you have commanding strength in all the plain suits, or the enemy have established a cross-ruff, or nothing but a strong trump hand of your partner's can save the game.

Rules Constituting the Language of the Game.

Return the highest of two left after first round: the lowest of three or more. Neglect of this rule is a very serious mistake: in trumps it often proves disastrous. With very strong trumps and a good suit, signal at the first opportunity, by playing or discarding an unnecessarily high card before a low one in the same suit. Remember, however, that strength which will justify a trump lead will not justify signalling. Leading trumps means that the trump lead is likely to suit your hand; signalling means that it is *certain* to do so. When your partner has signalled, lead your best trump at the first opportunity, unless you have four or more, when lead the smallest; but with four, three honours, or Queen, Knave, Ten, another, lead the best. Meantime, note that if he is a good player he will look out for the "echo to the signal"—so, if you have four trumps, or more, you should signal (in any suit,—including trumps). So also, if your partner leads trumps, and you hold four or more, no matter how small, you should signal in trumps, or at the first chance. Lastly, in leading a small card from a five-card suit, play the lowest but one, and follow with the lowest. This signal, called the *penultimate*, means that you have five in the suit, unless the circumstances are such that you might have led the highest of a short suit; in which case it is best to lead the lowest, for the consequences of a mistake as to a suit being strong or weak are likely to be much more serious than those arising from doubts as to your holding four or five.

TO CORRESPONDENTS.

P. A. R.—You held the second best trump, the place of the best being unknown, your long suit was established, and you held a couple of cards in your partner's suit. You ask us what you should have done. Can there be a shadow of a doubt? Your proper course should have been as clear as day to you. What you did was, you say, to play your trump, finding the best with your partner, who could not lead you your suit, so the adversaries made their long cards. Pardon me for saying that you were rightly served; but *it was hard on your partner.* You should have led the best card of your established suit. If the best trump was with an adversary, you would thus have forced it out, and your long trumps would then have brought in your suit, after playing out which you would have led your partner's. As the cards lay you would, of course, have done better still. It is utterly absurd to try to save every card of your long suit in such a case.

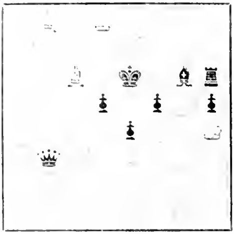
Our Chess Column.

By Mephisto.

PROBLEM No. 58.

By Leonard P. Rees.

BLACK.



WHITE.

White to play and mate in two moves.

[illegible] of a Cunningham Gambit recently [illegible]

White.	Black.	White.	Black.
Mephisto.	Amateur.	Mephisto.	Amateur.
1. P to K4	[illegible]	11. Kt takes B	B takes R (g)
2. P to KB4	[illegible]	12. Q to Kt4 (h)	Castles (i)
3. Kt to KB3	[illegible]	13. Kt R4 to B5	P to KKt3
4. B to B4	[illegible]	14. Kt B5 to K7 (ch)	K to R sq (j)
5. [illegible]	[illegible]	15. P to QKt3	Kt to Q2
6. [illegible]	[illegible]	16. B to Kt2 (ch)	P to B3
7. [illegible]	[illegible]	17. R takes B	P to B3
8. [illegible]	[illegible]	18. Q tks Kt (k)	Q takes Q
9. [illegible]	[illegible]	19. R tks P (l)	P to KR4
10. [illegible]	[illegible]	20. R to B7 mate.	

NOTES.

(a) [illegible] P to KKt4 [illegible] Q4 [illegible] of tempting an opponent into the [illegible] considered unsound, and it likewise [illegible] Allgaier Gambit.

(b) [illegible] Cunningham Gambit, which [illegible] although the books pronounce [illegible] 5. K to B sq [illegible] better to be followed by P to [illegible] White obtains a good position, and will regain the [illegible] We do not agree with this. In practice we have [illegible] We also intro[illegible] of our readers, [illegible] if instead of P to Kt3

5. [illegible] 6. $\frac{\text{P to K5}}{\text{B to K2}}$ 7. $\frac{\text{P to Q4}}{\text{P to Q4}}$ 8. $\frac{\text{B to K2}}{}$

[illegible] for Black, P to KKt4; this [illegible] P to KR4, and he obtains a good game. [illegible] better to abandon the Pawn that [illegible] 8. P to QB4, to be [illegible] QB3 [illegible] think that Black's [illegible]

[illegible] Pawn by an [illegible] the command of the KB [illegible] B takes BP (ch) and [illegible]

[illegible] 8. Kt to KB3, [illegible] of the [illegible]

[illegible] defence, [illegible] P (ch) does [illegible]

[illegible] Kt takes QBP. [illegible] Kt [illegible]

[illegible] a better game. [illegible] attack. If [illegible] P to QB3

(i) P to KKt3 would not have been much better, for White can shut in the Black Bishop by 13. P to Q3, threatening B to Kt5 or B4, followed by R takes B with a winning game.

(j) K to Kt2 would have enabled White to play Q to R4, threatening the dangerous checks on R6 and B6.

(k) This move at once forces the game.

(l) Threatening mate by discovered check with the Bishop next move.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Alfred B. Palmer.—Problem received with thanks.

Teddington. In Problem 56 the two Pawns on White QKt6 and Black QKt2 are necessary to prevent a second mate after 1. B to Kt6; but the problem is altogether wrong.

F. Dee. Thanks for communication. Solutions correct.

Leonard P. Rees. Problem already on hand. End position has given universal pleasure. Your Problem No. 57 we are assured is not a copy from that published in 1878 in the *Nottingham Express*; nor can we think that Mr. Spray has copied his position from a precisely similar problem, which appears in "Alexandres Beauties of Chess," by Paul Legnin, the position of which is White King on QKt6, Bishop on KKt3, and Rook on Q sq. Black King on QB sq. The idea being simple, it may occur to several more composers.

W. M. Foxcroft. Solutions correct.

S. Bassan Lello. Solutions correct. For No. 55, see last week's issue, where all solutions are given.

John Simpson. The problem referred to is a four-mover by a German composer (Eichhardt), where a similar mate with two Knights occurs; perhaps some of our readers will recollect the position. We hope soon to publish some select reprints.

J. B. B. Solutions (very) correct.

Correct solutions received of Problems No. 56 and 57 by J. P., G. W., C. L. B., E. A. F., F. S. L. No. 57, by Billy Batton, Bernard Wilmot, P. C. Hyland.

Contents of Knowledge *No. 50.*

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KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, OCTOBER 27, 1882.

Contents of No. 52.

Science and Art Gossip.

We gave last week the elements of the great comet of last September, and those of the comets of 1668 and 1843. We now give the elements of the great comet of 1880, as determined by Dr. Hind, twice, the second set of elements being the more trustworthy. The elements of the comet of 1843 are those which Dr. Hind gave as the most probable at the time:—

	Comet, 1880. 1st determination.	Comet, 1880. 2nd determination.	Comet, 1843.
Perihelion passage,	Jan. 27·6027	Jan. 27·6188	
	° ′	° ′ ″	° ′
Longitnde of Perihelion	279 6·8	279 52 11	278 35·1
,, ,, Ascending node	4 1·9	4 10 30	1 20 6
Inclination	35 39·8	35 20 21	35 38·2
Logarithm of Perihelion Distance	7·77371	7·739369	7·74123
Motion	Retrograde	Retrograde	Retrograde

As some, unfamiliar with these matters, have supposed that the close resemblance of the orbit of the great comet with that of the comets of 1668, 1843, and 1880 is not so significant to Dr. Hind, for instance, as it is to Professor Boss and the Astronomer Royal for Scotland, we note that two years ago Dr. Hind, writing respecting the above relations, remarked (and with great justice):—"If this close resemblance is the result of accident, the coincidence is a very unusual one in such computations, and in fact not far from being an unique case."

The *Christian Commonwealth* invites us to notice the first number of its second volume. We cheerfully comply. We notice what is meant to be a very severe attack on Tyndall, Huxley, Darwin, and all who hold views like theirs. We have seldom seen anything better calculated to injure the cause which the *Christian Commonwealth* professes to hold dear. Tyndall's views about matter and life, Huxley's about automatism, Darwin's about evolution, are twisted into attacks on religion, with which, in fact, they have nothing whatever to do. "When he [Huxley] claims and attempts to show that such a wonderful mechanism as the organ of sight could come into existence of itself, and without a design or a designer, through some mysterious process of development and natural selection, as, if our memory serves us, he has somewhere attempted to do, he probably comes as near making a fool of himself as is possible for a man of his eminent ability."

This is in exquisite taste. But Darwin, not Huxley, should have been addressed "Thou fool," by this most Christian teacher. Darwin shows the various stages of development by which the eye seems to have acquired its present qualities. He indicates a process which seems to many far more consistent with just ideas of a wise Creator's plan than the ordinary view, a process which also explains, what otherwise might fairly be regarded as scarce explicable, the defects of the eye in man and other animals. And here are the infidel words with which he expresses his atheistic doctrines:—"May we not believe that a living optical instrument might thus be formed, as superior to one of glass, as the works of the Creator are to those of man." ("Origin of Species," 6th edition, p. 146.)

It must be admitted, however, that Mr. Darwin's writings are wanting in such evidence of zeal and fervour as the *Christian Commonwealth* displays. He does not anywhere call those who differ from him *Fools*.

We would invite those who laugh to scorn the idea that the eye may have been developed, and lightly overlook the evidence that there *has been* such development, to point out in what respect the theory opposes religion *more* than the baleful doctrine that the monarch of the forest has been developed from the acorn. Is it because one process requires a few hundreds of years, and the other hundreds of thousands? But has not the *Christian Commonwealth* heard that to the Creator "one day is as a thousand years, and a thousand years are as one day"?

We maintain that the most dangerous enemies religion has in these times are those who teach that the doctrine of evolution is inconsistent with religion. They invite men to stake their faith on the failure of a doctrine which is to all intents and purposes *certain* to be successfully maintained. It is the story of Galileo and the earth's motion over again; but those who would ally religion to false teachings in science unfortunately address now a much wider public than did the persecutors of Galileo.

On Sunday, Oct. 16, singular evidence was afforded of Sir Joseph Hooker's zeal in defending Kew Gardens from the pestilent public (to whom they belong—a mere detail). The Temperate-house entrance is blocked up; for, as Mr. Shaw-Lefevre says, "It is not desirable to multiply entrances." But there was a lodge there occupied by a keeper and his wife. Their exits and their entrances were interfered with. But a sort of trap had been provided by which tradesmen could leave their goods. Through this trap, on the Sunday named, that unfortunate keeper and his wife had to climb in order to attend church. Their edifying energy attracted considerable attention: the comments on the occasion being rather oddly divided between Sir Joseph's zeal and the lady's stockings.

The young Hookers should be asked to report to Mr. Shaw Lefevre whether the shooting and fishing are good in Kew Gardens. The walls being high and the public excluded during the morning hours, it is impossible to know what success their sport meets with.

Miss North, showing a most reprehensible anxiety to encourage the public in studying the valuable collection presented by her to the nation, wished to have a number of seats provided in her gallery. But the stern director objected that the place would thus be made a rendezvous for nursery-maids.

And now a painful report is abroad averring that Sir Joseph Hooker is suffering from "nursemaids on the brain." Yet the few nurse-girls seen in Kew Gardens are a subdued and serious race, apparently ever conscious of a red-striped keeper round the corner.

The British Horological Institute, in union with the City and Guilds Institute, announces, in its educational programme, that the practical classes are under the direction of Mr. H. Bickley and Mr. C. Curzon, the class for instruction in mechanical drawing in relation to horology, under the direction of Mr. F. J. Britten, and the class for theoretical horology and mechanics under Mr. T. D. Wright. Students of the practical classes are admitted to the drawing class and to the theoretical class without further charge, and they are required to attend the theoretical class on Friday evenings, so as to fit themselves for the City and Guilds examination in watchmaking. There is an evening class for the teaching of escapement making, under the direction of Mr. Curzon. All necessary tools and drawing instruments are provided by the institute.

Recent discoveries in Indiana give a much more recent date to the mastodon than has been generally assigned. In one skeleton the marrow of the huge bones was still capable of use, and the kidney fat was replaced by lumps of adipocere. In another, found in Illinois, there was every evidence that it had lived upon the vegetation of the present day—upon the grasses and herbs that now grow in the vicinity.

The *Times* has been coquetting with the divining-rod. A number of letters, ascribing most marvellous results to its use, have appeared in the pages of our contemporary. And now a correspondent, Mr. T. K. Taplin, unkindly writes that the men who "worked the twig" in these cases, knew it was a practical joke. He also says he will take great pleasure in showing any person who may be curious in the matter how to "work the twig."

Typhoid fever may be said to be epidemic in Paris, 134 deaths having occurred there the week before last from this zymotic. The death-rate from other causes is normal.

In Providence, Rhode Island, with a population of 104,000, not a single death has occurred from small-pox since 1875. The reason is given as "general and careful vaccination."

Some excitement is visible in some of our textile trade journals, owing to the announcement by "an American consul at China" that the Chinese are preparing to manufacture cotton and silk piece goods. A cotton factory of an improved pattern will shortly be erected in Shanghai, and a factory to produce silk piece goods will be constructed in New Chiang. A blow at Lancashire and Cheshire commercial centres is feared.

M. R. Zeiller has made an examination of the fossil carboniferous flora of Tonquin. The species found resolve themselves into two groups, the one consisting of forms which have been long ago met with in Europe, whilst the other comprises specific types peculiar to India, Australia, and South Africa. It appears that in the carboniferous epoch there must have been two great and very distinct botanical regions, and the south of Asia marks their region of union.

Dieulafait found in one cubic centimètre of Dead Sea water enough lithia to show the spectrum of this substance at least a thousand times. The same water contains also so much boracic acid that it can be practically recognised in the residue from a single cubic centimètre of the water. Hence he infers that the present waters of the Dead Sea are the residues of the evaporation of an inland sea analogous to the Caspian or the Kara Boghaz.

For some months past observers have noticed a gradual lowering of the surface of the sands at Kirkcaldy. The incoming tides seem, from some unexplained cause, to carry with them towards the shore a vast quantity of the surface over which they flow, and the *débris* thus taken from the lower sands has accumulated all along the beach until it is nearly on a level with the road, a state of things which the "oldest inhabitant" never saw before. Simultaneously with this denuding process, and probably part of the same physical movement, the currents have in an equally erratic manner been scooping out, near ebb tide point, long hollows and alternate banks, parallel with the water. As a consequence of these changes, the beach, when the sea is out, instead of a long stretch of smooth, level sand, now exhibits a surface very much divided into hollows and banks; while inshore, nearer the strand, in addition to the long lines of loose stones thus laid bare, masses of rock hitherto invisible are now protruding in several places about two feet above the present level. On the other hand, the beach at high water mark has been raised a good deal more than the other has fallen. A striking proof of the latter was given recently, when the sea broke over the road, and instead of depositing stones, as on other occasions, left masses of pure yellow sand. These changes in the set of the currents may perhaps be only temporary, but the matter affords an interesting study of the results of tidal action, and the operating causes of the latter in this special form.

It is suggested that bicycles should be used in military operations. If a certain number of skilful bicyclists, familiar with every road and byeway, were attached to every district, they would be very useful in the event of invasion. In reconnoitring, the silence and speed of a "Phantom" or "Ariel" would be invaluable. As the *Globe* remarks, a dozen bicyclists, on a dark night, could pass within a yard of the most vigilant sentry, without his being certain whether an owl had flown past his head or not."

The growing scarcity of wattle-bark in Australia is causing anxiety among the tanners in that portion of the globe, and an export duty of £3 per ton is asked of the Colonial Government to prevent its going out of the country. It is stated that 1,500 men are employed in the Australian tanning industry, and that these must not be allowed to go adrift for want of work, as it is claimed will happen if the exports of hides and wattles be not restricted.

On Monday, this week, the Editor lectured on the "Birth and Death of Worlds" at Swansea; on Tuesday at Bristol; on Wednesday at Cardiff.

KEW GARDENS.

By Richard A. Proctor.

EVERY one has read Douglas Jerrold's "Two Windows," and knows whence the paper took its origin. "The two windows," says Blanchard Jerrold, "were seen on a summer's day. We had strolled through the lovely English village from which Herne Bay gets its name, and had gone through the churchyard to the park beyond. The rise and swell of the finely-timbered land, dotted with sheep, and white and yellow with daisies and buttercups, woke all my father's enthusiasm. He lingered and turned about, and could not feast enough on the beauties before him. As we turned the angle of a clump of trees, a long, low, white building appeared on the brow of the hill. 'There's a lovely situation!' said my father. 'What a view!' View! There was a long blank wall, stretched to the beauties of one of the loveliest spots in lovely Kent, with two little windows, about large enough for a hen to pass through. He wondered what the strange building could be. 'The House,' said a passing rustic. It was the workhouse, and the humane authorities had denied the poor the comfort of this view of the meadow, with Herne Church in the distance and the blue sea beyond. My father turned abruptly back from his walk, declaring again and again that it was the most detestable bit of wickedness he could remember." And who can wonder? To one of Jerrold's "abounding humanity," how bitter must have seemed the wrong here done by man to man, how burning the thought that in a world where, do what we will, there is so much of sorrow and misery, men can be found to hide away from the least happy of their kind the beauties displayed by Nature in her kindlier moods. A new reading truly of the words, "The poor ye have always with you," and "From him that hath not shall be taken away even that he hath."

Yet one might find a sort of defence for those "humane authorities." They were building for the poor, who, if they did not want to go to the poorhouse could go somewhere else. The house was not the property of those for whom it was being built; so that *they* had no right to complain if an extra amount of brickwork was thrown in. As for the pain which the brutality of these wretches might give to those not provided with hearts of stone, that was no affair of theirs. Besides, by letting the house be too attractive they might encourage pauperdom :—With much more devil's advocacy of the same kind (do we not know it all by heart?).

As one walks along the mile or more of high brick wall which protects Kew Gardens from the profane eye of the ordinary English passer-by, one recalls the story told by Jerrold; but one wonders what defence the "humane authorities" could make in this case. Out of the nation's money these grounds have been paid for, and all that has been needed for them has been provided. Out of the nation's money wages have been paid to certain persons —from the time of the elder Aiton until now, the time of the younger Hooker—to take scientific charge of these Botanical Gardens. A portion of the very money which the nation has thus provided is applied, by the very persons thus paid out of the national purse, to brick up the people's property, in such sort that, except through three or four gateways (heavily ironed) nothing but the tops of the trees can be seen. The walls have been extended further and further, and raised higher and higher (lest, perhaps, some unusually tall person on the top of a passing omnibus should look over and catch a glimpse of the hats of Sir Joseph's morning guests),—gateways which chance to command (after a keyhole fashion) some not altogether desolate part of the grounds, are bricked up, and obstructions, cleverly devised, hide every spot of interest which might possibly be seen through the principal entrances. And as I have said, all this is done with the people's money, by the people's paid servants, to spoil and hide away the people's own property.

When we ask why the Gardens are not opened earlier than one o'clock, we are met with the answer that "the morning hours are reserved for the necessary work of the gardeners, curators, and botanical students." We might believe this, supposing it were not an outrage on common sense that the presence of the public can interfere in the slightest degree with such work, were it not for those two thousand yards of brick wall. *They* are not necessary for the work of the gardeners and curators. They might very conveniently hide what work was *not* done; but assuredly if gardeners, curators, and the great Sir Joseph himself are too shamefaced to carry on their necessary works within possible sight of passers-by, who, through the railings, might watch them blowing up a casual tree or the like, then they ought to be too modest, one would say, to accept their periodical remunerations. As it is quite certain that the grievous wrong done to the public by the walling-in of their scientific gardens is not done by any means in the interests of the scientific work carried on at Kew, we may be permitted to doubt (apart from the *à priori* absurdity of the idea) whether the gardens are kept closed till 1 o'clock each week-day in the interests of science alone. A lofty wall, entirely hiding the Gardens from view, may be very convenient to convert the Gardens into a private park for Sir Joseph Hooker and his friends during the best part of every day: it assuredly has no scientific utility. It may most confidently be assumed that the late hour of opening, without which the hiding walls would be of little use, forms a part of the same plan. It was not for that purpose, however, that the Kew Gardens were provided. Sir Joseph Hooker may be an excellent botanist. I am assured that his paper on the *Balanophoraceæ* in the *Linnæan Transactions* shows great scientific acumen. But I am quite certain that the nation has not proposed to reward even his services to botany by making him proprietor during three-quarters of each year of what (in the way that he holds it) may be regarded as the finest park in the country. There are as good botanists as Sir Joseph Hooker in England; there is not *one*, I hope and believe, who would insult and wrong the public as he has done.

Let it be granted that when the Gardens are open, too many 'Arrys, with their accompanying Susan Anns, make their appearance on the scene. I am not myself a warm admirer of our 'Arrys and their "lady friends," as I think they call their sweethearts and wives. Their strange taste (or rather, utter want of taste) in attire offends the sensitive eye, their voices are too often discordant, their ways unpleasing, their manners conspicuous by absence. But if I find this the case (insomuch that I never enter the grounds when 'Arrys most do congregate there), my advocacy is all the more honest. It is a question of right and wrong. Many of us would find it pleasanter, perhaps, if none below the upper middle-class were allowed to walk along the Strand, but it would be a manifest wrong to exclude even the poorest. The wrong done to the public at Kew is as great, and should be as manifest.

But the question of hours of admission is less crying than the brick wall iniquity. Perhaps if that wall were replaced by railings, we might find all those we employ in the gardens, from Sir Joseph down to the least of all his gardeners, so busily employed in the morning hours, that we should feel loth to have them disturbed, say before noon. If it is so, even now, they do themselves, as well as their employers, an injustice by so carefully hiding their honest zeal. But how if it were not so? *If, for instance, these public gardens were used during the morning hours as a private park; or if, in parts of them, members of Sir Joseph Hooker's family were shooting or fishing?*

Personally I have no feeling whatever in this matter. I do not even know Sir Joseph Hooker by sight. I do not care myself about the Gardens. I have visited all the best botanic gardens in America, Australia, New Zealand, and Europe. I have seen nearly all the plants cultivated at Kew in their native homes, and surrounded by natural beauties such as scarcely all Britain can match. But I am an Englishman; I view this matter as a question of right and wrong; and I urge my fellow countrymen to notice that throughout the wide extent of the English-speaking communities of the world there has not been perpetrated a grosser wrong than that mile of brick wall. In such degree, as respects both time and extent of space, as these Gardens, the people's property, are turned from their real purpose, and converted (by walling and excluding the true owners) into private pleasure grounds, the nation is defrauded. It is an outrage on right and justice when this wrong is done by persons paid to preserve and improve the people's property. That long wall is a disgrace to England, a discredit to every Englishman who, having seen it, does not do all that lies in his power to have it replaced by such an enclosure as shall protect without hiding these public gardens.

When Mr. Ayrton, as First Commissioner, wronged and insulted Sir Joseph Hooker, it was quickly shown that this people's sense of justice is keen: Sir Joseph Hooker seems, however, to have read the lesson the wrong way. He treats those who took his part against oppression as his oppressor treated him. The present First Commissioner may rest well assured that *when he does his duty in this matter he will receive the support of every honest man in the land.*

TEASEL PHILOSOPHY.

By Grant Allen.

On the bank beside the little stream which has worn itself a deep chine in the soft blue mud of the lias, a tall lilac teasel is just now opening the buds between its stout prickles, under the warm rays of a favouring sun. Everything in nature is wonderful, especially if you have the trick to know it; and yet there are few things more wonderful than the teasel, which is a perfect marvel of minute provision, from the tip of its root to the topmost floret of its long cylindrical flower-head. Let us look at it bit by bit, from the ground upward. First of all, you see the lower leaves are long and narrow: but I advise you not to touch them incautiously, for though they look harmless enough above, the midrib is armed beneath with a long row of very formidable tooth curved prickles, sufficient to pierce and tear the toughest hide. From head to foot, indeed, the teasel is well defended against animal foes, for its flowers are prickly, its stems are prickly, its leaves are prickly, and, in short, it is prickly everywhere all over. Of course, it acquired these prickles in much the same way as the roses acquired their thorns, the gorse its stiff, piercing leaves, and the thistles their murderous defensive armour. All these plants originally grew in open places much overrun by wild, herbivorous animals; and, therefore, those among them alone survived which possessed in an incipient form some such natural means of defence against their four footed foes. At first, no doubt, the prickles on the evolving teasel were nothing more than a line of hairs, such as one may see in various parts of other plants; but these hairs would naturally differ in stoutness and sharpness on one individual or another; and those teasels which had them stoutest and sharpest would most often escape, while those which had them weakest and bluntest would soon be browsed down by ancient deer or modern cattle. As the survivors would always cross with one another, the prickly character would tend to be maintained; and as some of their offspring would every now and then be even pricklier than their ancestors, it would also tend to be increased so long as any benefit could be derived by the species from extra defensive appliances. Thus the teasels would at last acquire their present very inhospitable characteristics.

Again, observe that the stem-leaves of the teasel are united at their base, so as to form a sort of cup or basin, with the stem in its midst, capable of holding a fair quantity of water. Although the weather has been dry for three days past, you will see, if you look into it, that each of these cups contains at this moment about a wine-glassful of clear liquid: so that the plant practically consists of a dozen little reservoirs placed storey above storey, at a small distance from one another. Now what is the use of this singular and quaint-looking arrangement? At first sight, it might appear purely accidental; one might imagine that the leaves happened to grow in that particular fashion, and that the water lodged there for no special reason whatsoever. But there are very few accidents in organic nature; most things that turn up in plants or animals are either beneficial to the organism, in which case they get specially selected, or else hurtful to the organism, in which case they get rapidly weeded out. Now Sir John Lubbock has shown that the cups of water do subserve a useful function in the economy of the teasel. Ants and many other creeping insects are very fond of honey, and in order to get at it they often climb up the stems of honey-bearing plants and rifle the nectaries in the opening flowers. By so doing, they rob the blossom of its main attraction for bees or butterflies; while on the other hand they confer no service upon it in return; first, because their bodies are not adapted to the shapes of the flowers, and, secondly, because they do not go, like flying insects, straight from one plant to another of the same species, but, being guided by scent alone, climb up different stems indiscriminately, wherever the smell of honey lures them on. Thus they do not aid cross-fertilisation, but rather prevent it. Hence it is an advantage to plants to exclude ants and other such creeping honey-thieves. But, as all residents in the tropics well know, there are two ways of keeping ants from climbing up tables or safes to pilfer fruit or sugar. One way is by putting the legs of the table in little shallow pans of water, across which the ants cannot swim. The other way is by gumming fur around the legs, and so forming an impenetrable thicket, through which the little foragers cannot possibly force their way. Both these plans have been anticipated by the honey-bearing plants. Some of them, like the dead-nettles, protect themselves by bushy hairs, especially around the calyx and flower-stalk; others, like the teasel, protect themselves by cups of water on the stem, past which the boldest ant cannot venture.

But why are there more cups than one? Well, to begin with, symmetry alone would tend to make all the upper leaves grow alike; only under very special circumstances would a plant differentiate a single pair of leaves for a particular differentiated function. But, besides that, a number of cups serve the purpose better than a single one would do; for if an ant starts at the bottom, he will be stopped by the lowest cup; but if he mounts a neighbouring haulm of grass which happens to touch the stem a little higher up, he will then be baulked in turn by one or other of the upper reservoirs. The point is one of apparently small importance, it is true; but that is only because we fail to realise from our human standpoint the intensity of the struggle for existence between growing plants. Every flower which is rifled by an ant thereby loses its one chance of producing offspring; so that only those flowers which escape these ubiquitous little depredators can ever leave any descendants at all. As a matter of fact, almost all honey-bearing flowers, when one comes to examine them closely, show the most marvellously minute devices for excluding the ants, many of them so subtle and ingenious in their provisions as almost to surpass belief. The reason is that any deviation from the original type, however singular, would certainly be favoured in the survival of the fittest if only it gave the plant one extra chance of escaping such destructive pillage.

I might go on to point out in detail how the flowers are crowded into a long spiky head, so as to prove more attractive to the fertilising insects; how they are armed with stiff prickles longer than the florets, so as to save them from violent injury on the one hand, and to deter all but certain long-lipped insects on the other; and how man has made use of these prickly points for his own purposes in fulling cloth, by consciously selecting the most hooked varieties; but I have said enough, I think, to show you how interesting a plant the teasel is, and what are the principles upon which its peculiarities must be separately explained. Cut off its head carefully, and carry it home to examine at your leisure; and if you pull it to pieces conscientiously, that will teach you a great deal more about it than I could tell you in a week's talking.

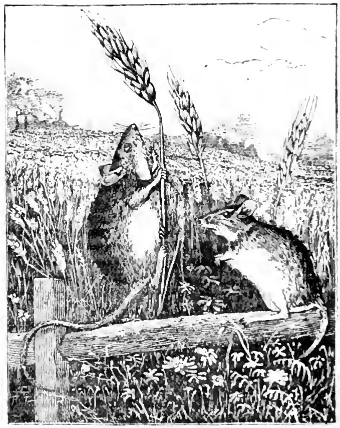
THE WHITE-FOOTED MOUSE, OR DEER MOUSE.

THERE are many persons who believe that all mice found in the fields and meadows are simply "house mice which have run wild." On the contrary, they differ so widely that they cannot even be admitted into the genus *mus*, to which the common mouse belongs.

The white-footed mouse is the *Hesperomys leucopus* of modern zoologists. Some have seen fit to include in it a sub-genus *vesperimus.* It was first described by the eccentric French naturalist Rafinesque as the *Musculus leucopus.* The meaning of the word *Hesperomys* is evening mouse, and of *leucopus* white foot. This species can be distinguished from the other mice of our fields and woods by the following description:—Ears large; tail slender, about as long as the head and body, and thickly covered with short hairs, no scales being visible like those of the common mouse. Colour of the body above, yellowish brown to grey; feet and lower parts of body, white. Tail distinctly bicolour; that is, its upper part is the colour of the back, and the lower portion white. Length of the head and body, $2\frac{1}{4}$ to $3\frac{1}{2}$ inches; length of tail generally equalling the length of the head and body.

The white-footed mouse is agile in its movements, and is an expert climber. The first nest of this species I met with in Pennsylvania was in a hollow stump, and was of a rounded form, and composed of leaves, grasses, and moss. Here they also nest under stone heaps, or logs, or in the ground. In New Jersey it generally builds its nest in thick briar bushes, several feet from the ground. These are made also of moss and leaves, but are interwoven with strips of fibrous bark, probably of the wild grape vine, to make them stronger and more secure. The hole or place of entrance to the nest is always at the bottom. These nests at first glance may readily be mistaken for those of birds. On shaking the bush or nest you will see the little inmates come forth and rapidly descend to the ground, and conceal themselves amid the bushes and grass. Sometimes you will observe several young adhering to the abdomen of the mother. These she assists in keeping their hold by pressing her tail against them as she climbs down the stems of the briars. The female produces young two or three times during the spring and summer, having from three to six young at a birth.

It has a habit of laying up little stores of grain and grass seeds. In our state they are generally composed of wheat, but in the South of rice. It is also fond of corn, but eating the heart only and leaving the rest untouched. This species is sometimes accused of destroying cabbage plants and other young and tender vegetables, and of gnawing the bark from young fruit-trees. It is doubtless true that this species is sometimes to blame, but the greater amount of this damage, I think, is caused by the meadow-mouse (*Arvicola riparius*, Ord), and the so-called "pine mouse" (*Arvicola pinetorum*, Le Conte).



The white-footed mouse is of crepuscular and nocturnal habits. Many of them fall prey to the different species of owls, notably the screech owl (*Scops asio*, Linn.), as the bones and fur of this mouse found in their ejected pellets clearly show. It has a wide geographical range, being found from Nova Scotia to Florida, and west to the Mississippi River, and perhaps far beyond.—*Scientific American.*

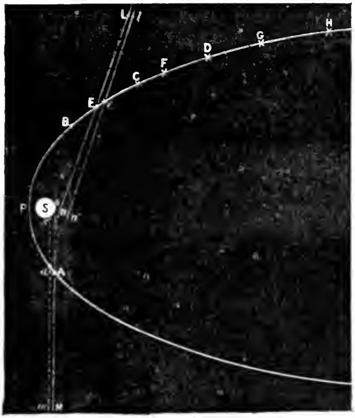
Cables on the West Coast of America. The length of cables and land lines worked by the West Coast of America Telegraph Company is as follows:—Cables (nautical miles): Valparaiso to Serena, 219·03; Serena to Caldera, 215·31; Caldera to Antofagasta, 229·00; Antofagasta to Iquique, 250·50; Iquique to Arica, 128·35; Arica to Mollendo, 146·12; Mollendo to Chorrillos, 510·08. Land lines: Chorrillos to Lima, 11·00; Lima to Callao, 7·00—1,716·72.

THE MENACING COMET.

By R. A. Proctor

(Continued from page 342)

DR. HIND found a singular discrepancy, which has been much misunderstood, between the movements of the great comet and the result of his calculations. On Sept. 17, Mr. Gill's assistants at the Cape Observatory saw the comet just touch the sun's limb, or situated as at A, MAs being their line of sight. From observations made on Sept. 18 and 22, and on Oct. 2, when the comet was situated as shown at B, C, and D, Dr. Hind calculated an orbit, which satisfied these observations perfectly; *but* when the place of the comet was calculated backwards for the hour when Mr. Gill's assistants saw it at A, it was found that the comet should have been as at *a*, the line of sight to it from the earth projecting it in direction *mas'*, or as seen at *s'*, well on the sun's disc. Here Dr. Hind rightly finds evidence of great disturbance—not saying of what kind. Some inexperienced persons have



said that, so far from being retarded, the comet was hastened near perihelion, having traversed the distance APB in the time in which, according to the calculated orbit, it should have traversed the distance *a*PB only. The reverse, however, is the case: Dr. Hind's calculations show that the comet, according to the deduced orbit, would have travelled the distance *a*PB only, or a less distance, in the time in which it actually traversed the distance APB; or, in other words, the orbit deduced from its motion after perihelion passage corresponded to a less velocity than that with which the comet had actually passed the perihelion part of its orbit. Hence the velocity after that passage was a reduced velocity; and the comet must, therefore, return in less time than its last circuit occupied.

It is note-worthy, that a similar observation was made in the case of the comet of 1843, though its significance was overlooked, astronomers not being then apparently prepared to accept the idea of cometic retardation by the resistance of the solar surroundings.

Professor Benj. Peirce, the eminent American mathematician, announced that Captain Ray (described to him, in a letter from Mr. Mitchell, of Nantucket, as "a man of sound judgment, a very accurate observer, and correct man") saw the comet of 1843, at 11 a.m., on February 27, at Concepcion, S.A., bearing almost precisely east, with scarcely any perceptible northing from the sun. The comet was only five minutes of arc from the sun, or about one-sixth of the sun's apparent diameter. This would correspond with the position E on the orbit, and the line of sight, LEn. Now, observations made later, as when the comet was at F, G, H, were well represented by an orbit which placed the comet on Feb. 27, 11 a.m., at Concepcion, at a point such as *e*, such that the line of sight, *len'* passed 115 minutes of arc from the sun. From this it would appear that even in passing from E to F, the comet had been retarded; for its motion, after passing F, corresponded to such a rate as would have carried it over *e* F in a certain portion of time, in which it actually traversed the larger arc EF.

I may add that Mr. Erck, a well-known observer, has written a letter to the *Irish World*, in which he says, on the strength of a single observation, that the comet is moving in a parabola. He evidently misunderstands the methods of computation used in these cases. The assumption of a parabolic suite suffices for ordinary observation, for parts of the path near the sun, where the eccentricity is very great even in the case of comets having known elliptic orbits. Mr. Erck found the comet on the predicted track—and so he was certain to do. His inference is quite erroneous that the comet is therefore travelling in a parabolic orbit.

NOTES ON THE COMET.

We receive from France, Germany, Italy, and Greece accounts of the Finlay Comet (as it should be called, having been first seen by him).

Ricco, who observed it at Palermo, notes that this is the first case of a comet which was shown to have passed perihelion by the changes which took place in its spectrum. On Sept. 27 he found the spectrum of the nucleus continuous, but traversed by a strong line, that of sodium. Enlarging the slit of the spectroscope, he saw a globular image of nucleus and coma, formed by the orange-yellow light of sodium. Many other lines besides the sodium line were present; but he could not determine their position. There was a band in the red, a line in the yellow near D, two others in the green, and an enlargement of the continuous spectrum of the nucleus in the green and blue.

Later, until October 1, the nucleus became less luminous and appeared double, and lengthened to 2″, with a very brilliant jet directed towards the sun. The tail was more curved, and diverging, in length nearly 15°, and at the broader end 1° 48′ in width; the southern end much stronger and brighter than the northern. A dark streak seemed to divide the comet along its whole length. At this time the comet was no longer so yellow as it had been; but the sodium line, though fainter, could still be seen. The three bands seen in the spectra of so many comets, and belonging to hydrocarbons, were now very conspicuous.

After October 1 the tail was longer (about 17°) and about 2° 48′ wide at its widest part. The three hydrocarbon bands could be traced 5′ from the nucleus. The spectrum of the tail continuous, and visible to the extremity.

Prof. Kruger, at Kiel, noticed that on October 5, during occasional moments of greater distinctness, the comet's head appeared to have two distinct nuclei. This was confirmed on the 7th.

A telegram from the Director of the Athens Observatory announces that a comet had been seen on October 8, four degrees south-west of the great one, and having the same motion. Has the comet been partially broken up in

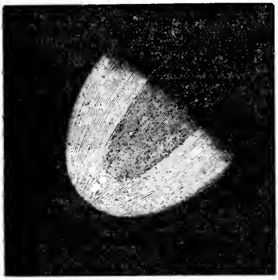


Fig. 1.

its passage through its perihelion? It is strange that, before the Biela comet broke up, Dr. Hind noticed that it appeared somewhat elongated, or pear-shaped.

The pictures illustrate the appearance of the head (Fig. 1) and the whole comet, as seen by the naked eye, during the last week of September.

The comet can still be seen, and well seen, towards the south-east in the morning hours, from about four. We shall give next week a map, showing its position and course (past and future) among the stars.

TRANSITS OF VENUS.

By the Editor.

ALTHOUGH not belonging to the more interesting relations connected with the occurrence of transits, the laws according to which the successive conjunctions of the earth and Venus recur, are worth examining, and they afford a useful exercise for the student of astronomy.

Let us, in the first place, regard the two paths as circles around the sun as centre, and traversed with uniform velocity—namely, with the respective mean velocities of the earth and Venus.

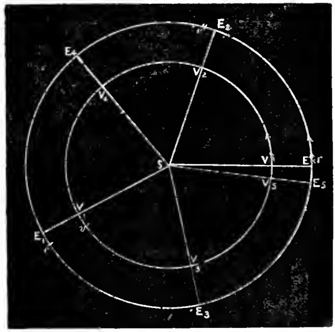


Fig. 1.

Let S (Fig. 1) be the Sun, E E_1 and V V_1 the paths of the Earth and Venus, and let us suppose that the planets start from conjunction on the line S V E, Venus at V and the Earth at E. Then we know that the earth completes the circuit of her orbit in 365·2564 days, while Venus's period of revolution amounts to 224·7008 days. Accordingly, when Venus has completed one revolution, and is again at V, the Earth has traversed a portion of her orbit which is to the whole circumference as 224·7008 to 365·2564; thus the Earth is as at *e*. The remaining part of her orbit, or *e* E, is traversed in 140·5556 days, and then the Earth is again at E, while Venus has got to a point *r* in her orbit, such that the arc V *r* bears to the whole circumference the proportion 140·5556 to 224·7008. The part *r* V is traversed therefore in 84·1448 days; by which time the Earth has got to *e'*, 84·1448 days' journey from E. It is clear that all this time the planets have not been in conjunction;* but it is also clear that they are now drawing near to conjunction, and that before Venus is at V again they will be in conjunction. For Venus will require 224·7008 days to get to V, whereas the earth will require 281·1116 days (obtained by taking 84·1448 days from the year), so that Venus now at V, and thus behind the earth at *e'*, will pass in advance of the earth before reaching V again. In order to determine where the two planets will be in conjunction, it is only necessary to notice that, at starting, Venus might be regarded as having one complete revolution to gain upon the Earth,

* It has only been for the purpose of making this clear that I have followed the two planets round arc by arc, as above.

[illegible] after two revolutions [illegible] only behind by the amount which the Earth traverses in [illegible]·1448 days. Thus [illegible] by the amount which the Earth traverses in [illegible] days; and what we require is to know in what time [illegible] will gain a complete circuit, or the amount traversed by the earth in 365·2564 days. This is in effect a [illegible] of three sum, which would in the ordinary way be stated as follows:—

As [illegible] : 365·2564 :: 149·4016 : period we require.

It will be found, if this sum be worked out, that the required period is one of 583·9204 days, and this is the period which is given in tables of elements of the planets as the mean synodical period of the Earth and Venus, that is the mean interval between the successive conjunctions of these planets on the same side of the sun.*

Now let this be noticed: The Earth in 583·9204 days will be at E_1 where the arc $E\,E_1$ is one traversed in 218·6640 days, and the remaining arc $E_1\,E$, therefore, is one traversed in 146·5924 days. But we know that the fifth part of an ordinary year contains 73 days, or about the half of the period required for traversing the arc $E_1\,E$. This arc, then, is about two-fifths of the orbit; and the arc $E\,E_1$ is therefore about three-fifths of the orbit. Let us inquire more particularly into this relation, because it is an important one in many respects.

The true fifth part of a year is a period of 73·0513 days, and three times this period amounts to 219·1539. Now, we have seen that the arc EE_1 is traversed in 218·6640 days. The difference amounts to 0·4899 of a day, or less than half a day. Thus, if we drew lines (EV one), dividing the orbits exactly into five equal parts, then the conjunction-line E_1V_1S lies less than half a degree from the nearest of these lines (for the earth's mean daily motion is slightly less than one degree), and behind, as respects the direction of the planet's motions. Manifestly, the next conjunction-line will be at E_2V_2S, rather less than a degree short of the nearest of the equidistant lines. The next will be as E_3V_3S; the next as E_4V_4S. And, lastly, the next will be as E_5V_5S, rather less than $2\frac{1}{2}$ degrees from EVS. Five synodical revolutions have now passed, giving, therefore, a period amounting to 2919·6020 days. Venus has made nearly thirteen revolutions, and the earth has made nearly eight. Since eight sidereal years amount to 2922·0512 days, the actual difference, or in other words the period in which the Earth traverses the arc E_5E, amounts to 2·4492 days. Now the Earth's mean daily motion in her orbit is 3548·193″. Multiplying this by 2·4492, we obtain for the mean value of the arc E_5E, 8690·236″, or 2° 24′ 50·236″. Thus we see that in five synodical periods there is a return to the immediate neighbourhood of the conjunction-line at the beginning. These five periods last very nearly eight years. We may say, in fact, that in eight years, wanting 2·4492 days, the conjunction-line EVS is shifted to the position E_5V_5S, 2° 24′ 50·236″ behind its former position. Thus we see that this conjunction-line will travel completely round in as many times eight years as 2° 24′ 50·236″ is contained in 360°, less one year, this one year resulting from the slight defect of five synodical periods from eight years. This period, which may be called a grand cycle of Venus and the Earth, has a mean value of 1192·0632 years. But it is manifest from Fig. 1 that in a fifth part of this time the conjunction-line $E_1V_1S_1$ will have passed to the position $E_4V_4S_4$*; while every other conjunction-line of the five equidistant ones in Fig. 1 will have passed round (backwards) to the position of the next. In other words, in the course of 238·412 years (on the average) there will have been conjunctions of Venus and the Earth all round their orbits at intervals as close as those which separate each of the five conjunction lines of Fig. 1 from its nearest neighbour. (It will presently be seen that this period, 238·4126, has to be somewhat enlarged to represent the mean interval between transits occurring at either the ascending or descending node of Venus's orbit.)

(*To be continued.*)

* [illegible] given above [illegible] intended to indicate [illegible] process for obtaining the synodical period of two [illegible] it represent the matter so reasoned out [illegible]. The proper process is as follows [illegible]

$$\frac{1}{224·7008} \text{ of the complete circuit.}$$

[illegible]

$$\frac{1}{365·2564} \text{ [illegible]}$$

[illegible] Earth

$$\left(\frac{1}{224·7008} - \frac{1}{365·2564}\right) \text{ [illegible] circuit.}$$

[illegible]

$$\frac{1}{[illegible]} \quad \frac{224·7008 \times 365·2564}{365·2564 - 224·7008}$$

[illegible]

[illegible] 5767·068[illegible]

[illegible] [illegible]8·193

[illegible] 2219·475

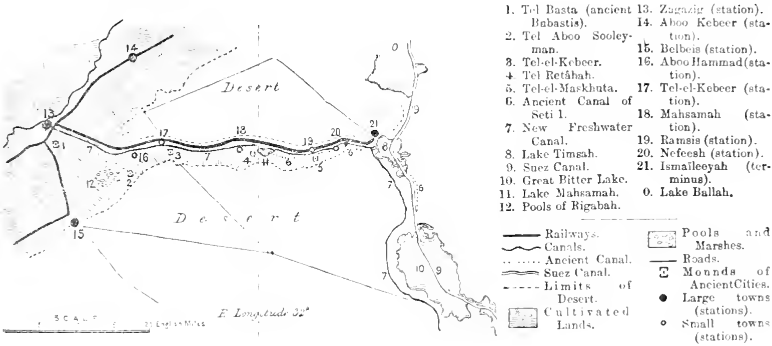
[illegible]

$$\frac{[illegible]}{2219·475} \text{ days} = 583·9204 \text{ days.}$$

* The correct way of stating this, that the mean period in which any conjunction-line reaches the place of the next behind is a fifth part of the grand cycle. There is not an actual conjunction along the line E_4V_4S at the end of this time, because the grand cycle does not contain an exact number of years.

Perpetual Motion.—After describing the electric launch recently run on the Thames, the *Spectator* of Sept. 30 says: "Nothing is said about expense, but a boat which can travel at this speed without coal and with no funnel must for many purposes be of almost immediate use. As the charging machines can be put up anywhere, the practical problem of electricians must be to reduce the size and weight of the accumulators. Once small enough to be carried, they might drive a steamer across the Atlantic, being perpetually recharged by a dynamo driven by the motion itself."

Lady Companions for the Insane.—Dr. Rees Philipps, in his reports on the Wonford Lunatic Hospital for the Insane, at Exeter, strongly advocates the appointment of educated ladies as companions to the inmates of the female departments of asylums for lunatics of the upper and middle classes. Every hour that he spends in the female wards of the hospital under his charge strengthens his conviction of the beneficial influence on lady patients of kindly companionship and the nursing of gentlewomen. A certain proportion of lady nurses has been introduced into that admirably-conducted registered hospital—Barnwood House at Gloucester, and the medical superintendent, Dr. Needham, is satisfied that he obtains more work from these lady-nurses, and at no increased cost, than from nurses drawn from the domestic servant class. If this opening for useful and meritorious work were more widely known than it is at present, many gentlewomen of suitable position and temperament would doubtless avail themselves of it. The emoluments offered are not large; but an honourable livelihood and interesting occupation are not without their attractions. —*Medical Press.*



MAP OF WADY TUMILAT.

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

By Amelia B. Edwards.

XII.—THE ANCIENT CANAL.

WE have now to see how far all these scattered topographical details correspond with the actual position of the ancient mounds of Wady Tûmilat; the sites of which, with their Arabic names, are laid down in the accompanying sketch-map. Zagazig, the modern county-town of the modern province of Sherkeeyeh, has risen, not upon, but near, the ruins of Bubastis (Egyptian, *Pa-Bast*, *Pa-Beset*, *Pa-Baris*); that famous city dedicated to the worship of the cat-headed Goddess Bast, where the cat was a sacred animal, not one of whose nine lives could be taken under pain of death to the slayer. The piled mounds of the ancient city, brown and jagged, like extinct craters, rise close beside the railway, and are familiar objects to all who journey to and fro between Cairo and Ismaileeyah. The Arabs call the place "Tel Basta"; its name having clung to it unaltered to this present day. A network of canals fed from the Great Moo'ezz Canal (in old time the Tanitic branch of the Nile) here intersects the country in all directions; and from this point the Freshwater Canal, without which M. de Lesseps' workmen could not have been kept alive, was conducted through Wady Tûmilat to Ismaileeyah, and thence along the western shores of the Bitter Lakes to the head of the Gulf of Suez. At a spot rather more than half way through Wady Tûmilat, which is 37 miles in length, there may be seen upon our map the small sheet of water called Lake Mahsamah.* This natural reservoir could not have been more usefully placed for the purposes of the new Canal, and the French engineers were not slow to utilise it. In all probability, however, it had been made available for the same purpose some three thousand years before; for here, at various points along the bottom of the valley, the engineers came upon the bed of the ancient canal begun by Seti I., carried on by Rameses II., and in later times successively resumed and abandoned by the Persian, Greek, Roman, and Arab rulers of Egypt. This is the canal which Herodotus describes as "derived from the Nile a little above the city of Bubastis, near Patumus (Pa-Tum) the Arabian town, being continued thence until it joins the Red Sea" (Book II., chap. 158); and which Strabo describes as flowing "through the Bitter Lakes and emptying itself into the Red Sea." Both, however, are mistaken as to the mastermind which first conceived the idea of uniting the waters of the Nile and the Gulf of Suez. Herodotus attributes the beginning of the canal to Nekau (Necôs) the successor of Psammetichus I., and Strabo gives the glory to Sesostris (Rameses II.) But the chronicled walls of Karnak—even the outer walls of that Hall of Giant Pillars which Seti I. dedicated within to Amen the God, and without to himself the Pharaoh—preserve to this day not only a record of the existence of the canal in his time, but a sculptured representation of it, in perfect preservation. The King, returning from victories in Syria, drives his captives before his chariot, and is met on the frontier by his priests and nobles, bearing bouquets and chanting praises. The Canal flows between the conqueror and his subjects. It is fortified and crossed by a bridge. Its waters swarm with crocodiles, and it empties itself into a large basin on the Syrian side. The inscription expressly draws attention to the presence of the crocodiles in its waters, and states that the name of the canal is "The Cutting." This is the celebrated bas-relief which the guide-books erroneously describe as representing the return of Seti across the Nile. This view has unfortunately obtained the support of M. Lenormant, who admits that the stream is hieroglyphically described as a "canal," but declines nevertheless to recognise in it anything but the Pelusiac branch of the Nile. Yet there is a witness whose testimony on this point seems to me to be incontrovertible; and that witness is the ancient artist himself. I wish I could put his elaborate bas-relief, in all its simple truthfulness of treatment, before the eyes of the readers of this number of Knowledge. I wish I could point out to them, more forcibly than by written words, the childlike device by which he has striven to show that the canal is an artificial work. Representations of rivers are not uncommon on Egyptian monuments. Three famous examples in illustration of the Battle of Kadesh on the Orontes occur on the pylons of Luxor and the Ramessum, and on the north wall of the Great Hall at Aboo Simbel;

* Within a short distance of Mahsamah village and station, where the successful little action of September 25 was fought, and several trains were captured.

and in each of the others the artist has been careful to show the windings of the stream, and the irregular outline of its banks. But here the canal is drawn between two straight and strictly parallel lines, each planted with a formal row of trees. Nor is this all. Under the wheels of the royal chariot, in a short-hand style of landscape art which has much to recommend it, we see three pieces of water and three little towers, each labelled with its name. These indicate fortified places along the route. One piece of water is enclosed in a square basin surrounded by walls; evidently a reservoir. The two others, in marked contrast to both the reservoir and the canal, are purposely irregular in form, as would befit the representation of natural lakes or pools. And so also, it must be noted, is part of the boundary outline of the large basin into which the canal discharges its waters on the Syrian side.

But Professor Ebers, who has lately studied these sculptures on the spot, places the question beyond further dispute. "The canal," he writes, "is defended by fortifications and a gate, and bears in the inscription the name of The Cutting."* The balance of opinion among Egyptologists, it may be added, is altogether on this side; including, by the way, the opinion of so distinguished an outsider as M. de Lesseps, who acutely remarks that "the basin into which the canal discharges its waters is, and can only be, the lake which in our days bears the Arab name of *Timsah*, signifying *crocodile*."† And obviously, if Lake Timsah ever merited its name, the crocodiles must have found their way thither from the Nile, by way of the canal, *it being zoologically impossible that they should have come from anywhere else.*

Moreover—and this is a curious fact which has escaped M. de Lesseps, and which, so far as I know, has not been remarked before—the ancient Egyptian name for crocodile was "*Emsuh*"; and *Emsuh* is clearly the same word as *Timsah*, the consonants *m*, *s*, *h*, being identical; the vowels in Egyptian and Arabic mutable; and the initial *T* doubtless a later addition. Also, there being no crocodiles in Arabia, the Arabs would naturally import the Egyptian name into their language. Hence it is fair to conclude that Lake Timsah, like so many other localities in this Egypt of indelible memories, perpetuates a name which is in itself a page of ancient history.

The channel of the canal of Seti I. was in the first instance discovered by the French expedition in 1798; and in 1859-60, when M. de Lesseps' engineers surveyed the ground for the new Freshwater Canal, they not only retraced the course of that earliest work, but at various points they actually found its steep banks lined with solid masonry. And so accurate was the original levelling, that more than once they simply followed and reopened the work of their Pharaonic predecessors.

If further proof is needed to establish the identity of this ancient canal, further proof is forthcoming. Herodotus, though mistaken in attributing the first design to Nekau, states that it was "completed by Darius"; while Strabo, who comes nearer the fact in ascribing its origin to Rameses II., states that "Darius succeeded to the completion of the undertaking, but he desisted when it was nearly finished, influenced by an erroneous opinion that the level of the Red Sea was higher than Egypt, and that if the intervening isthmus were cut through, the country would be overflowed by the sea."—Book XVII., chap. 25. Now whether Darius completed the canal or did not complete it, is nothing to the present inquiry. All we need ascertain is the fact of his having put his hand to it; and this fact was proved as long since as 1798, when M. de Rozière discovered, at a spot near the southern end of the Bitter Lakes, a broken statue of the "Great King of Kings," and some red granite blocks carved with a polyglot inscription in Persian, Median, Assyrian, and Egyptian characters, which has been translated by M. Oppert:—

"A great God is Auramazda, who created heaven; who created earth; who created man; who gave to man a will; who established Darius as King; who committed to King Darius so great and so glorious an empire. I am Darius, King of Kings; King of lands of many tongues; King of this great earth far and near; son of Hystaspes, the Achaemenide. Says Darius the King:—I am a Persian. With the power of Persia, I conquered Egypt. I ordered this canal to be dug from the river called Pirava (Nile), which flows in Egypt, to the sea which comes out of Persia. This canal was dug there as I commanded. Afterwards I said:—Go and destroy half of the canal from Bira to the coast. For such was my will."*

I venture now to assume that the identity of the ancient Pharaonic canal is sufficiently proven, and that it is shown to have been carried at least as far as Lake Timsah by Seti I.

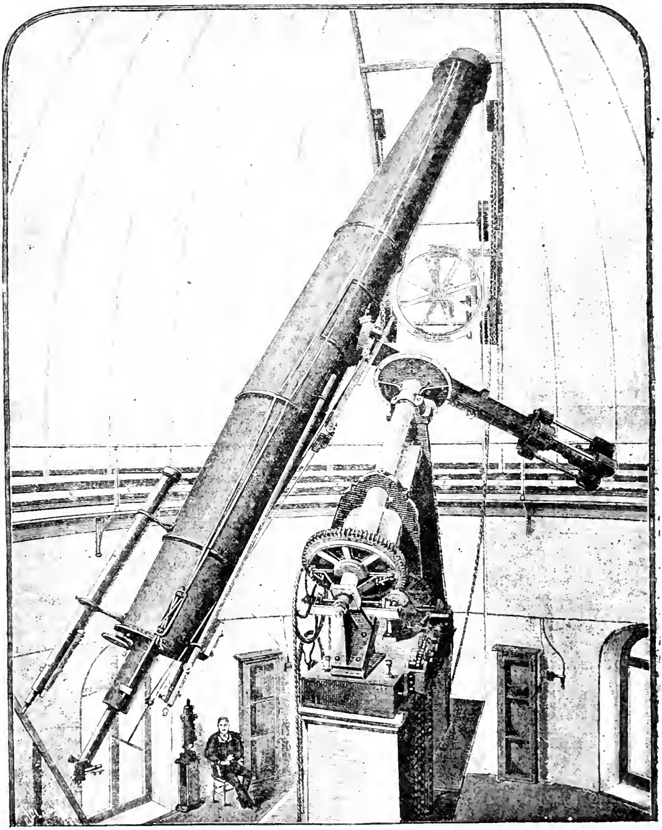
* See Ebers, "L'Egypte." French translation by G. Maspero. Vol. II., p. 20.

† [illegible] "Travaux [illegible] de Suez." De Lesseps. Paris, 1862.

* The above English version of M. Oppert's French translation is from the pen of Sir Erasmus Wilson (see "The Egypt of the Past," chap. viii., p. 481. Second edition. 1882.) This curious monument was first published by M. Oppert in the "Rapports de l'Egypte et de l'Assyrie," p. 125. The three cuneiform inscriptions were engraved on one side, and the hieroglyphic text on the other. Unfortunately, it was much injured by the workmen employed on the Suez Canal; the Assyrian text being, according to M. Oppert, "entirely annihilated," and the Median nearly so.

Southwark and Electric Lighting.—The Vestry of St. George-the-Martyr, Southwark, took an important step at a recent meeting, with regard to the electric lighting question generally. It was resolved to oppose the application of all companies for licenses, under the third section of the Electric Lighting Act, unless they were prepared to guarantee to the Vestry that, after paying a dividend of 7½ per cent., one-half of all profits accruing beyond should be handed over to the Vestry towards the reduction of the local rates, in consideration of the concession granted for the laying down of the necessary works. This is looking forward with a vengeance.

Infant Feeding.—At a recent meeting of the Paris Academy of Medicine, M. Tarnier read a paper on this subject. He began by stating that he much preferred cup or spoon feeding to a nipple-bottle when the child cannot be fed on mother's milk. Although condensed milk may be wholesome for adults, M. Tarnier declares that it is quite useless for young children; and he considers that nothing can be compared with the mother's milk, which is well known to be the first of all foods for infants. Artificial feeding has been tried in Paris with very disastrous results, as may be seen by the following statistics, drawn up by M. Bertillon:—In 1881, 60,856 children were born in Paris, of whom 14,571 were sent away to be nursed, while 46,285 remained in the city. Of the latter number, 10,180 died, being a mortality of 22 per cent., while 5,202 (more than half) of the former died of athrepsy—that is to say, bad feeding. Of these 5,202 infants, 3,067 were fed with a nipple feeding bottle.—*Medical Press.*



THE NEW PRINCETON TELESCOPE.

THE accompanying engraving shows the great telescope of the College of New Jersey, as it stands in Halsted Observatory at Princeton. It ranks fourth in the list of great refractors in use, and is by far the largest belonging to any collegiate institution.

Halsted Observatory was built some fourteen years ago, at a cost of about $56,000. In making the alterations necessary for the reception of the new telescope some $5,000 more have been expended. The telescope and its accessories cost $26,000. This sum was contributed by the friends of the college; the largest donors being Robert Bonner, Esq., and R. L. Stuart, Esq., who gave respectively $10,000 and $6,000.

The telescope was made by Alvan Clark & Sons, of Cambridgeport, Mass.; and all the appointments of the Observatory are of the most modern character. The iron dome under which the telescope is mounted is 39 feet in diameter. The apparatus for turning the dome and opening the shutter is driven by a four-horse power gas-engine, which also actuates a small (Edison) dynamo-machine for operating the electric lamps used in illuminating the building and furnishing electric currents for various spectroscopic purposes.

The following data respecting the telescope have been kindly furnished by Professor C. A. Young:

The diameter of the object glass is 23 inches. The radius of the curvature of the crown glass lens, outside surface, is 265·8 inches; inner surface, 81·9 inches. These surfaces are both convex. The flint glass lens (concave on both sides) has for the surface next the crown lens a radius of 73.4 inches. That of the surface next the eye is 222.2 inches. The distance between the lenses is 7.5 inches. The focal length is 30 feet 1 inch. The steel tube of the telescope has a length of 28 feet and a diameter of 33 inches in the middle. The length of the polar axis is 10 feet; diameter at bearings, 8 inches and 6 inches. The diameter of the coarse hour circle is 30 inches; of the fine hour circle, 28 inches. The length of the declination axis is 9 feet; its diameter at bearings, 7½ and 5½ inches. The diameter of the declination circle is 30 inches.

The driving weight of the clockwork weighs 320 pounds, and has a fall of 12 feet. The radius of the sector by which the clockwork drives the telescope is 10 inches. The centrifugal regulator or governor weighs 22 pounds, and revolves once in seven-tenths of a second. The weight is taken off the lower pivot by floating the regulator in mercury. The weight of the telescope and mounting is about seven tons. The height of the centre of motion above the floor is 20 feet 9 inches. The declination circle is read from the eye end of the telescope by microscopes 9 feet long.

The telescope is provided with position and double-image micrometers of the best construction. The star spectroscope, by Hilger, of London, was constructed under the supervision of Mr. Christie, the Astronomer Royal, upon the same plan as that of the instrument for some time in use at Greenwich, but upon an enlarged scale. It is a direct-vision instrument, with three (so-called) half prisms. It is more than 6 feet long, and weighs, with its appendages, about 159 pounds. For the present it is expected this telescope will be devoted mainly, though not exclusively, to stellar spectroscopy.

For the purpose of comparison the following facts with regard to other large refracting telescopes will be found of interest. But two instruments excelling the Princeton telescope are now in use, namely, the 25-inch telescope made by Cooke, of England, and owned by Mr. Newall, of Newcastle-on-Tyne; and the 26-inch equatorial, made by the Clarks, at the Naval Observatory, Washington. The third larger instrument, made by Grubb, of Dublin, and having an aperture of 27 inches, is now in process of mounting at Vienna.

The instrument nearest in size below the Princeton telescope, now in use, is the Strassburg refractor, with an aperture of 19 inches. There are in process of construction five larger instruments, namely:

The Poulkowa telescope, 30 inches, and the McCormick telescope, 26¼ inches; both by the Clarks. The Henry Brothers, in Paris, are making a 29-inch telescope for the Nice Observatory, and another, of the same size, for the National Observatory at Paris. One of the disks of glass (the crown) for the Lick telescope, to be 36 inches in diameter, has been received by the Clarks, who are waiting for the flint disk before beginning the grinding. This gigantic instrument, when finished, is to be erected on Mount Hamilton, California.—*Scientific American.*

Cost of One Horse Power.—An American contemporary says:—According to the following excerpt from the *School of Mines Quarterly*, the cost of one horse power per hour is as follows, from experiments lately made at Carlsruhe: 100 h.p. steam engine, .95 pence; 2 h.p. steam engine, 5.50 pence; 2 h.p. Lehman's caloric engine, [illegible] pence; 2 h.p. Hock motor, [illegible] pence; 2 h.p. Otto gas engine, 3.26 pence; 2 h.p. Otto Langen gas engine, [illegible] pence; 2 h.p. Schmidt water-engine (fed by city water supply), 11.57 pence; horses, 25.00 pence; men, [illegible].

Reviews.

BACKBONED ANIMALS.*

It were enough to say of this book that it is a work by Miss Buckley to commend it at once to our readers, for of Miss Buckley, as of Mr. Grant Allen and one or two others (would there were more), it may truly be said that they have published nothing which has not been charming.

Miss Buckley speaks as if she could not keep silent, so much her subject interests her, yet all the time she speaks as if she had her audience always before her, and felt she must make clear to all what is so clear and simple, and withal so charming, to herself. She does not seem, like so many writers about science, to think that she will gain no credit for profundity if she does not use words a foot-and-a-half long. So far from that she invents simple words to replace the Greek and Latin terms with which foolish folk in past times chose to clothe and cloak their ideas. She does not speak, where she can help it, of *Vertebrate* but of *Backboned* animals, not of *Mammalians* but of *Milk-givers*, not of *Marsupials* but of *Pouched* animals. She writes, in fact, as if she wanted to be understood and wanted to interest her readers in her subject, whereas some of our naturalists have written as if that were the last thing in the world which a science-writer should aim at, the main motive for writing being (they seem to assume) to show how learned and profound the writer is.

But Miss Buckley's book is very difficult to review. Not a page in it fails to attract and to suggest reflections. There is not a chapter from which one would not like to extract at least half.

Not being able to do this, we note that Miss Buckley takes the several members of the backboned family, and shows how each of them is related to ancestral forms, "restorations" of which appear in the picture headings of the several chapters. It must be admitted, by the way, that these picture-headings suggest ideas somewhat like those which boys must form from the study of Mr. Ballantine's books—"The Fur Trader," "The Coral Island," "Gorilla Hunters," *et hoc genus omne*. One would suppose life with these primæval creatures must have been a scene of perpetual adventure. Thus we have in a space less than a quarter of a mile square, a *Deinotherium* and a *Mastodon*, three *Helladotheria*, or ancient giraffes, a Hippopotamus, a *Tapir*, a *Rhinoceros*, a *Hyæna*, an *Antelope*, and a small monkey, *Pithecus Pentelicus*. On the cover, a Zebra is added, and for the Deinotherium, towards which, at p. 256, a Hippopotamus is advancing with an expression showing that he is not quite sure whether those inverted tusks will quite suit him, a nondescript horned animal (presumably an antelope, but the horns are not right) is substituted, which seems likely to fare ill between the Hippopotamus and an Elephant (Mastodon) and Rhinoceros, who are eyeing it more intently than encouragingly. Of course, the primæval woods, and streams, and lakes were never so closely crowded with inhabitants as they are shown in such pictures; but, for purposes of illustration, these pictures do very well. In fact, there is no other way of treating such subjects without greatly multiplying the number of pictures.

The illustrations, by Mr. Carreras, jun., Mr. Coombe,

* *Winners in Life's Race, or the Great Backboned Family.* By Arabella B. Buckley, author of "The Fairy Land of Science," "Life and her Children," &c. (Edward Stanford, London.)

Mr. Smit, and Miss Suft, are excellent and numerous. They are also very fully and clearly described.

A thoroughly excellent and enjoyable work from Frontispiece to Finis.

A CONCISE CYCLOPÆDIA.*

The first number of this Cyclopædia has been sent to us. It promises to be a very useful addition to the series of educational works for which Messrs. Cassell's house is so well-known. The following extracts illustrate the style of this convenient work of reference :—

"Acacia, a name incorrectly given to certain flowering shrubs, often grown in English gardens, the correct title of which is *Robinia Pseud-Acacia.* They are called locust trees in America. (A good cut, showing leaf and flowers, here given.) The real acacias are a genus of plants belonging to the *Mimosa*, a leading division of the Leguminous order. The type is the *Acacia Arabica*, or gum-arabic tree, which has doubly pinnate leaves, and heads of flowers like velvety pellets of bright gamboge hue. The *Acacia Catechu* furnishes *Catechu*, a substance used in tanning leather."

"Allegiance (from the Latin *alligo*, I bind), the lawful obedience which a subject is bound to render to his sovereign. The bond of allegiance may, however, be said to be mutual and reciprocal, the subject being bound to obey the sovereign, and the sovereign to protect the subject."—[It should have been added that where there is no personal protection, either needed or proffered, there is no personal allegiance,—it is merely a feudal fiction. In a country like England, for instance, citizens are protected by, and therefore owe allegiance to, the state. In old times personal allegiance or duty to a suzerain, though it implied some degree of subjection, was a valuable quality, as useful to the feudal chief as to his follower. In our time, allegiance to aught but the state is little less than treason to the nation,—or it would be, if it meant anything but flunkeyism. There are some words—*allegiance*, *loyalty*, and *faith* are among them—so noble, that the honest mind is pained when they are used, as they too often are, in a degrading, time-serving sense.—Ed.]

"Accident (from the Latin *accidere*, to happen). In *Logic*, a term applied to any quality which does not essentially belong to a thing, or form one of its invariable attributes. For example, when we say of a piece of iron that it is *solid*, we state one of its invariable characteristics ; but if we say that it is *hot*, we are merely stating an *accidental* circumstance connected with it. Again, in speaking of a man, if we say that *he has two legs*, we state an essential attribute, in the absence of which we cannot conceive of him as a man ; but if we assert that he is a *native of Paris*, it is a mere accident" (though if we were speaking of American man, it would be an essential). [The explanation of this logical term is clear enough ; no one can well misunderstand it ; albeit, we may note in passing that iron is not always solid, and some men are so unfortunate as to have but one leg or none.—Ed.]

The Cyclopædia will be very cheap, the monthly parts, of which there will be twenty-seven, costing but 6d. each.

ANATOMICAL STUDIES.†

Although this work is specially intended for medical students, it is one which, for many reasons, has value for the lay world. Every one ought to know where lie the chief muscles, bones, and nerves of the human body ; the chief internal organs, the arteries, veins, and so forth ; although not every one, fortunately, wishes to dissect and analyse them. Now, if there is a good deal in this book which is of interest only to dissecting students, there is much more which shows, in a way we have never seen surpassed, just those relations of the human body which every one ought to know. The publishers, as the author remarks, have been very liberal in the matter of illustrations, there being no fewer than five hundred and sixty-four. A few are somewhat rough, but even these are exceedingly instructive to the student : in fact, their very roughness shows what they are—sketches from the hand of a master.

The present volume deals with the limbs and pericardium ; the second will deal with the thorax, abdomen, pelvis, &c. : and the third with the anatomy of the neck and brain, and organs of special sense. The book is not precisely one for the drawing-room table, but for the study ; not wholly, however, for the medical man's study ; it teaches much which every man of sense ought to know.

* *Cassell's Concise Cyclopædia.* (Cassell, Petter, Galpin, & Co.)

† *Human Morphology : a Treatise on Practical and Applied Anatomy.* By Henry Albert Reeves, F.R.C.S.Ed. Vol. I. (Smith, Elder, & Co., London.)

LIFE-HISTORY OF A PLANT.

By E. W. PREVOST, PhD.

The study of the life-history of a plant is of great interest, as showing the elaborate arrangements whereby the mineral matters of the soil and the gases in the air are brought together to form one organism, which shall be fit for the food of man or beast. In the present article I do not intend to give any description of the structure of a plant, nor any account of the manner in which its juices pass from one part to another, but rather to point out the materials which form the plant-food, and the changes which they undergo so as to produce what we recognise as a vegetable structure.

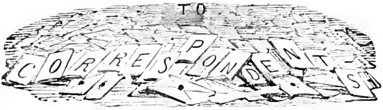
The plant possesses a distinct set of organs capable of absorbing mineral food dissolved in water, and there are also means whereby oxygen and carbonic acid gas can be inspired and transformed into tissue. The young sprout being at first incapable of seeking for its food, is dependent on the seed for its supplies, consisting of two distinct substances—nitrogenous or albuminous matter, and oil and starchy matters. These two last might have been classed separately, but it is unnecessary here to draw any distinction between them, for it appears that the oil is, during germination, for the most part converted into starch. The effect of moisture and warmth causes the seed to sprout, throw out a stem and root, but these being but feeble must be supplied with food ready prepared, and it is under the influence of the oxygen which obtains access to the seed, that a small portion of the albuminous matters contained in the seed is altered, and the products act as a ferment which attacks the insoluble starch, converting it into a sugar that can pass with the water always present into the small sprout ; when there it becomes again insoluble, and adds to the structure of the rapidly-increasing seedling. The first part of this change, such as the starch has undergone, is well exemplified in the malting of barley, which after its removal from the malt-house, contains a large amount of "glucose," a kind of sugar which is recognised readily by the taste. The transformation of a portion of the albuminous matter into a ferment, not only results in the conversion of starch into sugar, but at the same time the remainder of the albuminoids are rendered soluble and without any change in their composition ; they can then accompany the glucose during its passage into the seedling. We see then that the seed is a storehouse for the young plant, providing nourishment until it is strong enough to send down roots into the earth, and put out leaves into the air to seek out food for itself. When the plant becomes strong, and is no longer dependent on the seed for its food, the chemical processes which take place are still more wonderful ; how some of the new substances are formed, or why the absence of some one ingredient of the soil (generally present in but very small quantities), should produce certain well-known results, is still unknown. From the soil, and by the roots, are derived the mineral matters and the nitrogen ; the latter in the form of nitrates, which in the plant are completely changed in character, being no longer a combination of nitric acid with a base, but the base has been separated, and the nitrogen of the acid, combined with sulphur hydrogen and oxygen, is deposited in the new form of albumenoid matter, which is insoluble in water ; but being insoluble, and deposited in the minute cells of the plant, it would appear impossible that it could migrate from one part to another, and this would be the case if no other substance were present; but phosphate of potassium is absorbed by the plant, and this coming in contact with the albuminoids, renders them soluble; they can now pass through the cell-walls of the stem, and upwards into the seed, where they are stored up for future use. Phosphates are also necessary for the production of certain fats, of which they form a part, for the fat of the horse-chestnut and oak contains a small percentage of phosphorus. Of the other salts sucked up by the roots, the sulphate of lime is worthy of mention, as it is necessary to the formation of albuminoids, sulphur being an essential ingredient of these matters, whereas phosphorus is not; and also many essential oils require this element in their composition, and it is to its presence that the oils of black mustard and garlic owe their peculiar pungency.

The function which many of the other ingredients found in the ashes of plants perform is still somewhat uncertain, but all experiments indicate that potash, lime, and magnesia (the alkaline earths, as these two last are termed) are indispensable to the life of the plant, and that the absence of iron is accompanied by abnormalities of growth. When a soil contains no iron, and this does not occur naturally, the foliage loses its green colour, the loss being due to the non-formation of chlorophyll, or the green colouring matter, and when this is absent, the process of assimilation as performed by the leaves ceases, and therefore the plant is in an unhealthy condition; when we come to speak of the respiration and assimilation of plants, an explanation of these terms will be given, but at present a few words on the use of potash soda and silica will not be out of place; but we will not attempt to dilate on the uses of other ash ingredients, such as chlorine, for as before stated, there is no accurate information concerning them, but that they are requisite is certain, while what their function may be is uncertain.

For all general purposes, the chemist considers that the alkalies, potash and soda, are interchangeable; that what soda will do, so will potash, and as the former is the cheapest, it is therefore the most frequently employed. Plants, however, detect a difference, for we find both soda and potash present in their ash in varying quantities, and neither of them entirely absent, so that each must have a distinct part to play; still, to a certain extent they are interchangeable, for cultivation greatly alters the proportions in which they are present, and this alteration is very marked in the case of the asparagus, which when growing wild, contains equal quantities of these bases, but by cultivation nearly the whole of the soda disappears, while the potash increases nearly threefold. Silica or sand is to be found in every soil, either in the free or combined state, and hence we might suppose that it was indispensable, and certainly it exists in every plant in large proportions, more especially in the hard outer parts, the straw and stems containing a very large quantity of this substance, which is generally considered to be necessary for their rigidity. There are some very remarkable instances known in which deposits of silica are found in plants. Very notable is that occurring in the joints of the bamboo, resembling opal, and bearing the name *tabasheer*; but yet, though silica exists universally in plants, its absence (under artificial conditions) does not seem to prevent their full development.

The alkaline earths, as well as potash, seem to be necessary for the formation of the various salts, such as the oxalate of lime in the leaves of beet and in the common rhubarb, or the oxalate of potash in the wood sorrel. These bases are introduced in the form of nitrate and phosphate or sulphate, but in the plant they separate from the acid, and combine with new acids, which are elaborated through the agency of the leaves. Having glanced at the functions performed by the mineral constituents, we will pass on to those of the leaves, and here as before, no attempt will be made to answer the question, How do the leaves act? but rather our intention is to show the results of their action. The leaves are the means whereby the plant communicates with the air, absorbing from it that portion which is injurious to the life of animals, namely, carbonic acid gas, which consists of carbon and oxygen; under the influence of sunlight these two components are separated in the leaf, the one from the other, the carbon or solid part remaining in the plant to form all the various compounds, such as starch oil and acids, while the oxygen is exhaled into the air for the use of animals, this retention of carbon and conversion into starch, &c., has been termed assimilation to which we have already referred; now we can appreciate the immense importance of plants of all kinds, for without them the atmosphere would become so overburdened with the harmful carbonic acid, that it could no longer support life nor combustion. A small experiment will readily demonstrate the action of leaves on carbonic acid. If a green mare's-tail, immersed in a glassful of spring-water, be exposed to sunlight, a number of small bubbles will soon be noticed on the surface of the leaf. In a short time they will increase in size, and finally float to the surface, when, by proper means, they can be collected and shown to consist of oxygen, which possesses the property of causing a glowing splinter of wood to burst into flame when introduced into it. This oxygen has been produced by the decomposition of the carbonic acid dissolved in the water. It would be incorrect to suppose that the leaves absorb no oxygen, but always give it out, for at all times a proportion of oxygen is inspired, and in the dark, carbonic acid is exhaled, yet the quantity is always less than that of the oxygen exhaled during the day, and at low temperatures the amount of oxygen absorbed exceeds that of the carbonic acid. How to account for the production of starch from the materials at the disposal of the plant is somewhat difficult; but theoretically, six volumes of carbonic acid combining with five volumes of water produce starch, six volumes of oxygen being liberated; but when once the starch is produced, we know, from laboratory experiments, that sugar can easily be produced from it, as well as oxalic acid, &c. The purpose of the leaves is not only to collect air food, but also to get rid of superfluous water, for the roots are continually pumping in water laden with mineral food, so that to allow of the circulation and deposition of this food the water must be got rid of. This water is exhaled from the leaves in the form of invisible vapour, but the quantity depends on the state of the atmosphere, which when moist almost wholly prevents exhalation; on the other hand, in very dry weather, exhalation takes place too rapidly, and the plant withers. Light exerts also a very great influence; the stronger the light the greater is the amount of water exhaled, and, generally speaking, the maximum occurs shortly after midday. During hot and dry weather a grass plant has been known to exhale its own weight of water during the twenty-four hours. From what has been now said, it will be seen how necessary are plants to animals, and animals to plants, for without the one the other would not long survive, for when the atmosphere became exhausted of carbonic acid, which is formed by animals, the plants would then have no means of building up starch, &c. The great difference between plants and animals should also be noted, that whereas the plant is continually feeding only to increase and store up material, the animal feeds to increase and repair the waste that is continually proceeding.

A Thunderstorm in the Matterhorn.—Mr. Alfred S. M. Buttemer writing from Lausanne, says: —"A short account of a summer storm on the Matterhorn may interest some of your readers. Our party consisted of my wife and myself, with two guides. We had been rather long in making the ascent, owing to a considerable quantity of snow and ice on the rocks, and it was one o'clock before we left the summit. The morning had been fine and warm, but about noon snow fell. On the top the sun came out, and the view on the Italian side was perfectly clear. About five minutes after commencing the descent the sky suddenly became dark, and snow fell in such density that, as one of our party described it, you could grasp a handful from the atmosphere. A peal of thunder made our guides hurry on. Directly afterwards we heard a sharp crack, resembling the report of a rifle, and each of us felt a slight shock in the head. A peal of thunder followed instantly. The guide who was carrying an ice axe threw it away in alarm. A second and much louder crack followed in about a minute, and we all experienced a powerful shock. The guides felt it in the head, and one of them complained of a severe headache for the rest of the day. My wife described it as passing through the body. I felt it entirely in the knees, which seemed as if momentarily dislocated. Thunder followed immediately as before. After this, there were a few distant peals of thunder, and in an hour the snow ceased and the sun came out. About a foot of fresh snow had fallen, which made the descent tedious, and necessitated passing a second night in the Zermatt cabane. Some friends who had ascended the Weisshorn on the same day had neither snow nor thunder.—*Times*.



Letters to the Editor.

[*The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.*]

All Editorial communications should be addressed to the Editor of KNOWLEDGE; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

⁂ *All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

PHYSIOLOGICAL EXPERIMENT.

[I insert Z.'s letter, not that I agree with him, for I do not, but it is interesting as suggesting the question *why*, under the conditions considered in my reply to A., one would be ready to permit physiological experiment—suitably conducted to reduce pain to a minimum—on the most valuable and worthy specimen of the lower animal races, while most of us cannot even admit the thought of kindred experiment on the most worthless, and worse than worthless, of human beings.—R. P.]

[600]—If there is any such thing as freedom of speech for those whose ideas are in advance of the masses, the intellectual "variations" on which mental progress depends, I pray you in its name to give me a hearing. Let me point out that your crucial question in reply to A. 2. (KNOWLEDGE, August 11, p. 186) concerning the practice of physiological experiments on animals, ought to be carried further and to be applied to what, at present, is regarded, even by some physiologists, with unreasoning and unreasonable horror—namely to free experiment on human subjects of *the least valuable kind* for the benefit of the more valuable portion of humanity, its progressive front.

The true generalisation of the special case supposed by you is, that the suffering of those dear to us is of infinitely more importance to each of us (if we are of an affectionate disposition, as you and I are) than any amount of possible or problematical suffering of unknown and chloroformed beings, especially if of any inferior class.

This is true. Such is human nature, as may be seen in others, and felt in ourselves every day. We care very little indeed for utter strangers if their interests and the interests of our own friends conflict. And if, further, our judgment pronounces the hypothetical unknown persons to belong to a type indisputably inferior to our own dear and valued ones, we are all of us ready to consent to—*anything* in short likely to relieve the agonies or protract the lives of these precious ones.

Unless, therefore, one is enslaved by popular prejudices, it is difficult to see *why*, with our modern advanced views and the renunciation of those effete superstitions which assumed a non-existent fundamental distinction between human and other animals, so much objection should still be made to even the most distant approach to physiological experimentation on living human subjects of the inferior classes. No physiologist worthy of the name can doubt the supreme usefulness of such experiments and the unsatisfactoriness of the restriction to other animals, all more or less differing in physiological structure from man. A vast amelioration of pain would, in all probability, accrue to the higher and most valuable human beings by the sacrifice of a few of the worst and quite opposite of valuable. Is it not perfectly absurd that a Beaconsfield, a Gladstone, a Herbert Spencer, or a Huxley, should be liable to the most excruciating diseases possible to conceive—pains inflicted by the ruthless vivisector, Nature, as penalty for somebody's disobedience to her laws—and that a few brutal murderers and other breakers of human laws are not to be made to suffer a little pain (or much, even, unavoidable) under the humane conditions you enumerate with regard to experiments on other animals, in order that a means of cure, or prevention of these agonies, should be found? That no physiologist should or would be allowed to inflict an *unnecessary* pang even on murderers is of course. Yet is it not strange that those who take this view *cannot get even a hearing* in these times of boasted freedom of speech? The unpardonable "blasphemy" which all sects unite to enforce silence upon is an opinion in advance of the age.

I ask, where is the *real cruelty here?* What comparison can be made between the pains of the lowest types of mankind and the pains of the exquisitely sensitive higher types? To one of these exquisitely sensitive beings a word or look may cause far greater "tortures" than a kick causes to some thick-skinned "habitual criminal."

I, for one, long for the time when science will burst its last fetters and soar free, full of faith in that beneficence of nature which ordains that some shall suffer that others may enjoy. I long for this time to come for one reason—because I love sound reasoning and hate the transparent sophistries and inconsistencies (opaque, however, to so many!) of the present temporising race of vivisectionists.

Is not the prevalent notion, that human beings are somehow so fundamentally distinct from other animals as to require to be treated on totally distinct principles, obviously a relic of superstition and sacerdotalism? It has been the work of science to demonstrate the utter groundlessness of this conceit. Is the progress of science to be stopped by it for ever? Z.

P.S.—After all, why endeavour to cure disease, or to prevent it? Why "interfere" with the spontaneous processes of natural selection which infallibly brings about the survival of the fittest to survive, without help of ours? Ought not vivisection to be defended solely on the ground that it exists? And is not the course its development will take quite certain in spite of all sentimental opposition?

TALKING CANARY.—REASONING (ALSO MURDEROUS) MAGPIE.

[601]—I notice in a recent number of KNOWLEDGE an account of a talking canary, supposed an unique instance.

I had the acquaintance of an old maiden lady some years ago, and now deceased, who had a Belgian canary, to which she was in the habit of talking constantly, as a mother to her babe, and she found that the bird, after many vain efforts, could at last repeat several words, as "sweet pet," "pretty dear," and similar things.

A singular case of reasoning power in a magpie came under my notice in the severe winter of '80-81.

The bird was hung out in all weathers right through the year, and as usual during the heavy snow and frost of the time named. It hung in the old-fashioned willow or reed cage, in which was a tin of soaked bread, &c., that it was supposed, with a few odd bones and scraps, to subsist on. However, it wanted something more delicate, and had an incentive to sport, for noticing that the poor sparrows were evidently very hungry and without food, it took a piece of bread from the tin and placed it through the bars on the outside ledge of the cage; natural result, the sparrows made for it and eat it, the magpie evidently biding his time until at the right moment he dashed from the perch and seized the unfortunate sparrow, dragged it through the bars and killing it, partly ate it. This, I understood from its possessor, happened frequently.

CHAS. L. CANE.

LAPIDARIES AND DECEPTION.

[602]—I saw with some interest the letter you alluded to in KNOWLEDGE, complaining of the deception practised by the lapidaries in Wales. The same complaint was made in *Land and Water*, in 1879, by "T. R. Sachs," in a letter which was satisfactorily answered by two parties, one signing himself E. R. (Bury). This correspondent referred to the fact of his having always had his stones polished by Mr. Thomas White, Terrace-road, Aberystwith, and says that he was twice allowed to see the process in his workshop. He had several specimens which he picked up on that shore, and saw them cut and polished at Mr. White's. He also had a crystal which he saw cut in facets by the lapidary, and which he took from his hands. He added that he should be glad to let Mr. Sachs see the specimen if he wished. I have also had many crystals which I have picked up cut by Mr. White, and I have watched the various processes of cutting one of them from the rough stone, till it came out perfectly transparent, and I can vouch for the reality of the work. During the height of the season it would be *impossible* to admit the innumerable strangers who would crowd into the workshop to see their own stones cut; but early in November I was admitted, when comparatively little work was going on. There may doubtless be lapidaries who do not hesitate to substitute foreign crystals, as many customers are impatient to have work done, but respectable men who have been known by the

Professors of the College at Aberystwith would scarcely venture to [illegible].

Some persons are [illegible] names commonly given to these quartz crystals, [illegible] amethysts or topazes, from which they wholly [illegible] chemical constitution, but they are so called from their [illegible] colour, which is often very perfect. H. M. W.

COINCIDENCES.

[603]—Because of Mr Webb's thrice-repeated association with the No. 123 (see his letter 524, page 219), I am tempted to relate a [illegible] circumstances. One Thursday evening in December last I gave a half-sovereign by mistake (among coppers) [illegible]. He discovered my mistake and returned the [illegible]. Next morning I found I had again parted with it. I inquired [illegible], and again it was restored to me—it had been picked up [illegible]. The next day (Saturday) I was lucky enough to find a half-sovereign lying in the mud on the pavement in the middle of the town—there were at the time many people passing and repassing. I walked home, a distance of a quarter of a mile up the street, and on arriving found that a gentleman living with me, and whose word was not for a moment to be doubted, had missed a half-sovereign, which he thought must have gone through a hole in his pocket. I ascertained that my friend would probably have passed over the spot in question about an hour previously. That I should have been the finder is the more strange as our routes abroad were quite irrespective the one of the other, and if I had not deviated from my usual daily course to my work and crossed the road (a thing I may do, perhaps, once in a hundred journeys) I should not have gone near the lost coin. A. R. W.

UNIVERSITY OF LONDON.

[604]—Will any reader who has lately gone over the ground give me any information or hints respecting the matriculation examination of the University of London? I have passed the First-class College of Preceptors' examination; but not having learnt Greek, natural philosophy, or chemistry, and wishing to matriculate, I am anxious to join classes, or a class, held in London, and devoted entirely for the preparation of students wishing to matriculate. Will any reader inform me where the best and most inexpensive classes are held? Also the best books to read for the above-mentioned subjects? MATRICULATING STUDENT.

COLD BATH AT NIGHT.

[605]—On page 314 of KNOWLEDGE, letter 583, "J. S." recommends a cold bath at night to produce sleep. Apart from the sleep-producing, is this a healthy practice? Perhaps some of your medical friends will give their opinion. A. E. ORAM.

HOT DRINKS.

[606]—Allow me to reply to E. D. G. and M.D. on the question of "Hot Drinks." The temperature I named was relative more than precise, and my information may be a little old. In Kirke's "Physiology," eighth edition, page 279, we see the following in regard to digestion:—"It agrees with the processes of both fermentation and organic catalyses, in that whatever alters the composition of the pepsin (such as heat above 100°, strong alcohol, or strong acids) destroys the digestive power of the fluid."

T. R. ALLINSON, L.R.C.P.

SUGAR AND THE TEETH.

[607]—I have been told that sugar in its natural state has no effect on the teeth, but that in its manufactured state it is a great cause of decay. Now, could some of your many readers inform me what is the process which makes sugar thus hurtful, and also what kind of sugar has no, or at any rate the least, effect on the teeth? ODONTALGIA.

BALLAD.

[608]—"D. Davies" will find the ballad about "half-crown and [illegible]" in a book called "Town and Country Reciter." I purchased the book some years ago in Catherine-street, Strand, at a [illegible] shop. Price 6d. GEO. LAWSON.

A LUMINOUS SEA.

[609]—Mr. Walker (568, p. 282) says "that the waters of the Arabian Sea were as thickly impregnated with organisms at 20 ft. as at the surface." I am not aware that the Arabian Sea has any properties of its own in this respect, but I can answer for it that it is not the case everywhere. I remember on a voyage from New Zealand recently, being awakened by the second mate when about 600 miles W. of the Azores, to see a luminous sea. In this case there was a brisk breeze from the N.W. blowing, and, as far as the eye could see, the waves seemed topped with green fire. The ship drew 20 ft. of water, and in the wake of the vessel there was the same appearance; but, as far as I could judge, and I examined it attentively for two hours, the phosphorescence did not extend below the surface, and only seemed to be driven down by the ship making eddies in the water. The same darkness at the horizon was visible, there being no moon, but a bright starry night.

The whalers say that these organisms only flash forth when disturbed, as they would be by the wind. It is very probable that they inhabit the sea in large fields, moving very little. FLORIAN.

ENGLISH SNAKE.

[610]—Can you kindly inform me if any scientifically recognised snake differing from both the adder and the ringed snake is indigenous to England; and if there is one, can you also tell me whether it is venomous or not? It is reported that such a snake is to be found in the New Forest, Hampshire. C. E. S.

SHIPS IN A CALM.

[611]—In reference to ships approaching one another in a calm (recently referred to in the "Answers to Correspondents" in KNOWLEDGE), it may interest "E. F. B. Harston" and some of your readers to know that only on certain conditions do ships approach each other when becalmed; for when the ship's heads are in opposite directions they never collide.

Captain Basil Hall, in his "Frag. Voy. and Trav.," after alluding to the inevitable destruction of ships should they come in contact with one another when becalmed, goes on to say:—"To prevent these frightful rencontres care is always taken to hoist out the boats in good time, if need be, to tow the ships apart, or, what is generally sufficient, to tow the ships' heads in opposite directions. I scarcely know why this should have the effect, but certainly it appears that, be the calm ever so complete, or 'dead,' as the term is, a vessel generally 'forges ahead,' or steals along in the direction she is looking to—possibly from the conformation of the hull."

It would seem from this that there is a force acting in opposition to that of the attraction, which force, under certain conditions, predominates.

As to the nature of this second force, and why its influence is not felt when experimenting upon a small scale, it would be interesting to know. C. CARUS WILSON.

SINGULAR RAINBOW.

[612]—Mr. Ackroyd [562, p. 282] explains this by "a sheet of water lying between the *observer and the bow*." Should it not be, "between the observer and the *sun*?"

I have a note of one similar to that in sketch [562] (the second secondary only partly formed), which I saw at Dieppe, July 24th, 7 h. 15 m., year of last Paris Exhibition. I was on the pier near the lighthouse, the sea at my back, in front I do not recollect what, but from rough notion of the position of the town, compared with the fact that the sun must have been some 60° W. of N., I should think the only water between me and the bow was that of the inner harbour, probably sheltered from a low sun by row of houses.

A. LE SUEUR.

[Would not water in either position produce the observed effect? ED.]

FISHERMEN'S SUPERSTITIONS.

[613]—Last year, when out in a fishing-boat off Bridlington Quay, my brother chanced to mention "rabbits" during conversation, and was immediately told by one of the fishermen that no fish would be caught, as it was most unlucky to speak of rabbits. The man said that sometimes the whole fishing-fleet would turn back after starting for the fishing-grounds, if rabbits were mentioned, as they knew it would bring bad luck upon them.

Whilst cruising in one of the Grimsby fishing-boats last month, a friend of mine found a common pin upon his coat, and on the captain of the boat seeing it he was immediately taken on deck, so that the captain might see it thrown overboard, as the presence of a pin on board would bring bad luck to the cruise.

THOMAS WINDER.

LETTERS IN TYPE.—Ancient Monuments, by J. E. S.; Ichneumon Wasp, by G. R. Wynne; Monkey and Mirror, by A. M. D.; Brain Troubles, by G. R. W.; Milky Sea and Joshua, by P. A. F.; Intelligence in Fish, by E. T. C. W.

Answers to Correspondents.

⁂ All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded, nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

W. CHALMERS MASTERS. Your seeing two-thirds of a rainbow was, it seems to me, a rather remarkable circumstance. THOS. WALKER. The paper on bicycle riding will be more suitable a little later. The others on "How to Get Strong" shall be continued more regularly.—W. ACKROYD. Mr. Grahame's question was put as for information, not as a foeman's whether worthy or unworthy of cold steel.—DALETH. Quite impossible to answer definitely. For most nebulæ we should recommend the lowest powers.—JOHN GREENFIELD. You seem to have singularly mixed ideas about astronomical matters. If Jupiter were to fall into the sun there would, I assure you, be a considerable disturbance. It is not the case that the various planets are so going over, as you call it, as to tilt.—SAMSON. The writer of the papers on "How to Get Strong" thinks the pulleys best about two feet apart.—GRADATIM. No; there is no reason in the nature of things why the interval between two periods of maximum glaciation should be 21,000 years. The variation of the eccentricity on which the change really depends has no such period.—MAUI. A slight difficulty arises from the fact that Venus is shown in both pictures midway between the horns of the crescent moon.

Mile and miles I've travelled, Sir,
Ten thousand miles and more,
But Venus in that place, Sir,
I never, never saw.

B. M. It would lead to interminable discussion if attacks on Encyclopædias were invited, as they would have been had we inserted your letter. We fail to see any insult at page 302, certainly none comparable to the gross insult commented on. There you and I and all of us were touched. But then you may be one of those who like to be insulted. There was a Frenchman who had been kicked by the little Great Napoleon, to whom that application of imperial boot-leather appeared ever after in the light of an honour. Men are so differently constituted! I should have considered it a duty I owed to the dignity of manhood to resent the insult at the time as far as I could with just and reasonable regard to personal safety, and ever after (unless apology were made) to speak of the attack as a mean and cowardly action. If you recognise no duties in such matters, you yet should understand that others may.—C. A. EDES. Mr. Erck is mistaken in supposing that the parabolic orbit can be proved in that way by a single observation.—S. or C. JAMES. The answer was for another, whose letter was not written on a post-card, but on a full sheet covering four pages. I do not know where there is a large telescope the owner of which could let you use it. Mr. De la Rue's photographs of the moon are not, I believe, sold now. You can get Rutherfurd's from Mr. Woodbury, and Ellis's from Mr. Browning. LORESMITH. Did the naughty printers call you "Lovesmith?" They shan't do so any more. Now with regard to the effect of a body as large as the moon falling into the sun, you are quite mistaken. It can be shown that if the moon were to fall straight into the sun, the fall would generate as much heat as would correspond with the sun's emission during more than a year. Suppose all this extra heat poured out in a week. Then during that week, the planets would receive about fifty times as much heat as they could stand; at least our earth would.—JOHN JONES. Thanks for your kindly note. There has been no intentional mystification. The Editor of KNOWLEDGE and Mr. Proctor, Mr. R. A. Proctor, and Mr. Richard A. Proctor are, of course, one and the same person. Yet it is not an idle fancy or a mere joke which causes me to speak at one time as Editor, and at another in my own name. As Editor I may have to explain that some statement cannot be accepted, which as Richard Proctor I would not take the trouble to contradict. And in other cases there are differences. I believe, between ourselves, that there never was any one less fit in his personal capacity for the post of Editor than Mr. Proctor: it pains him so much to have to decline any communication or to contradict any assertion, however rash. But duty comes in to give him strength.—ANOTHER PERPLEXED STUDENT. The difficulty arises from the circumstance that the quantity under the radical may be taken either positively or negatively; the process of solution is blind to this distinction. You get two answers, one solving the equation when radical in numerator is taken negatively and the one in denominator positively; the other solving it when these conditions are reversed.—M. H. C. Pardon me; I think it is quite correct to say that the clouds, really straight bands, appear to the eye to be curved. You say a straight band or line must always appear to the eye to be straight. I assert, on the contrary, that a straight line always appears to the eye to be part of a great circle of the optical sphere or sphere of vision. The image on the retina is curved. You draw a distinction between the effect on the mind and what appears to the eye. Perhaps you can explain where the difference lies. I know of several periodicals which follow the example you refer to. Suppose the one you specially refer to is *Nature*.—C. A. G. Have not myself seen any later information of interest respecting the silk moths than is given in Tyndall's "Dust and Disease."—ROMOLA. No; we thank you. Nothing about Spiritualism in KNOWLEDGE till we know something about Spiritualism.—DAZED, G. J. OVER, AND OTHERS. Question about the heliographic messages from Pyramids to Alexandria already dealt with; see last number.—E. B. W. Sound being something heard, I suppose it may be fairly said that without ears there would be no sound. Without matter no space, (or no matter what space). No matter or all matter unchangeable, no time. Also, we have no time and no space for such matter.—THOS. E. BONSER, NEWTON CROSLAND, and OTHERS. We quite agree with you that the accepted modes of drawing galloping horses are more true to nature than the views formed from the instantaneous photographs. One might as well show cannon-balls in a battle picture over the soldiers' heads as these absurd attitudes. They suggest rest instead of motion. Want of space prevents our inserting your remarks. You will find that similar views are expressed at p. 514 of Vol. I.; also in an article by the Editor which appeared a few months since in the *Gentleman's Magazine*.—J. CRAM. I trust you are wrong about the comet raising the sun's heat, at least in any great degree. W. S. Your theory about the apparent size of the rising or setting sun or moon is quite untenable. The effect, due to irradiation, to which you refer, is well known and measurable. It cannot account for an apparent increase many times greater.—J. E. W. HOWE. Thanks for your pleasant note. Readers are practically unanimous about the weather charts. C. J. B. points out (quite fairly) that it was rather hard on "the conductor at both ends of the house" mentioned at p. 325, to expect it to do double duty.—AN OXFORD GRADUATE. You would begin to feel warmer as soon as your distance from the sun was perceptibly reduced. The air round you might be very cold, but believe me you would feel uncomfortably warm on the side turned towards the sun.—J. J. RUBIE. It might theoretically be so in the case of perfectly elastic breathing apparatus.—JOSH. DAVIDSON. I wish I knew the temperature of the sun: I would in that case tell you gladly.—W. BOLDEN asks if Nature's light is visible or invisible? At a venture we should say it was visible. But we have only indistinct ideas of his meaning.—LARA. Let the perps. CE and BD meet in O, and AOG be drawn to the third side. Join ED. Then obviously, a circle will circumscribe ADOE: wherefore angle EAO = angle EDO. But it is equally obvious that a circle will circumscribe BEDC; wherefore angle EDB = angle ECB. Therefore angle BAG = angle ECB = Comp. of EBC. Hence BGA is a right angle.—S. BARKER. We believe the writer of those articles proposes to use Grecian models. We therefore return the photograph you have kindly sent us.—BRYUM wants a recent work on British Mosses. Z. Y. X. and IOTA. Thanks. J. P. KIRKMAN. Your problem requires diagrams. Will deal with it in our mathematical column in our next, if possible.—SUBSCRIBER. Considering that all the paper used during several months past was provided at the same time, you can hardly be right in asserting that the paper continually falls off in quality. I fear you notice every time a sheet is a trifle inferior to the last, and do not notice when a sheet is slightly superior to the last. It is, perhaps, natural enough, but rather annoying, for the proprietors have far better reason than any subscriber can have, to complain. C. M. W. M. Suppose, first, your wager of two to one against an honour at each cutting limited to two. The possible events are four:—Plain, plain; plain, honour; honour, plain; honour, honour. Results to you respectively, £2, −£1; −£1, −£4. The chances of these events, respectively, are $\frac{81}{169}$, $\frac{36}{169}$, $\frac{36}{169}$, and $\frac{16}{169}$; therefore the value of your expectation is $£2\left(\frac{81}{169}-\frac{36}{169}-\frac{32}{169}\right)$, or nearly 3s. 1d. So that as your expectation from a fair bet should be nothing, you obviously have the best of the bet. You will find a similar result if you analyse cases of three, four, or more cuttings. That is the only sound way of treating such cases. If you were betting against the occurrence of one honour, at least, in two trials, you would wager less than evens, or exactly 81 to 88, but in that case you would get nothing if either cutting gave a plain card, the other being an honour; in the case you suppose you get an offset for such cases. In the long run you would be sure to win at the odds you name. J. H. W. L.

[illegible] many who know the [illegible] shape of canine jaw [illegible] premolars of the upper [illegible] a socket. Have sent [illegible] cannot, as a rule, expect [illegible] Rather a wide question. There [illegible] written to meet so [illegible] will find that Airy fully [illegible] Tracts. The inclination of the [illegible] solar attraction, as the [illegible] to a solstice, and continually [illegible] passes from a solstice to an equinox. This is, in [illegible] S. C. The momentum of a body [illegible] and is represented by the product of [illegible] of a body is represented by [illegible] of its mass into the square of its velocity.—Jules M[illegible] Thanks for your pleasant comments on my lecture at W[illegible]ark Institute. As to your queries (1) I meant only that the centre of Jupiter is denser than those outer parts which are formed of deep atmospheric layers laden with clouds. (2) The [illegible] and uproar going on in the solar atmosphere would not be heard beyond its limits. I said "if we could visit the sun and live" we should hear such uproar. (3) The water on the moon would gradually be withdrawn into the moon's substance as the contraction due to cooling left capillary cavities for it. The atmosphere would partly follow the retreating water, partly be gradually reduced by entering into chemical combination with the substances forming the rock surface of the moon.—X. Z. Have received no answer to that query; will certainly publish when I do.

ELECTRICAL.

Phœnix. I regret to say your question is so mixed that I cannot adequately answer it here. Briefly, to work two electric lamps (presumably incandescent) you would require twenty-five to thirty Bunsen cells, or a dynamo machine, which would require more power than a man could exert, to drive it. Large steam-engines for driving dynamo machines light about eight lamps per horse power. See previous articles in Knowledge on the subject.

Our Mathematical Column.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

By Richard A. Proctor.

No. XI.

THE reader has seen enough of the application of the differential calculus to problems of maxima and minima to feel satisfied of the value of the method. I may now briefly consider another class of problems to which the calculus may be conveniently applied.

A differential coefficient is in reality a fraction of the form $\frac{0}{0}$, or what is termed a vanishing fraction, and like many other vanishing fractions it has a real value. Now it is often necessary to find the value of vanishing fractions, and though ordinary algebra may often be successfully applied for this purpose, it is not always possible, and often, though possible, it is exceedingly difficult, to evaluate a vanishing fraction in this way. The differential calculus enables us to treat such fractions very simply.

Let us take such a vanishing fraction, and consider what is really required for its evaluation.

Take the fraction $\frac{(x^2-a^2)}{x^3-a^3}$ the numerator and denominator of which both vanish when x is equal to a. Now we can at once find the value of this fraction by striking out the common factor $x-a$, and so changing it into the form

$$\frac{(x+a)}{x^2+ax+a^2}$$

the value of which is $\frac{2}{3a}$ when $x=a$. Even to this simple application of algebra there is an objection, since striking out a factor [illegible] to 0 is a questionable process. The result, however, is correct [illegible].

The only legitimate way of treating such a fraction would be [illegible] its value when x is taken very nearly equal to a, [illegible] trying to find out what value the fraction approaches [illegible] exactly equal to a. Let us do this. Our fraction be[illegible]

$$\frac{(a+h)^2-a^2}{(a+h)^3-a^3} = \frac{2ah+h^2}{3a^2h+3ah^2+h^3} = \frac{2a+h}{3a^2+3ah+h^2}$$

Here we can see at once that by making h small enough we can get our fraction as near as we please to

$$\frac{2a}{3a^2}\left(i.e., \text{ to } \frac{2}{3a}\right)$$

in value; and we therefore conclude that $\frac{2}{3a}$ is the value when h is 0, or x equal to a. But a little consideration will show the reader that the process corresponds exactly to that for obtaining the differential coefficient both of the numerator and denominator. Hence he will be prepared to find that when we have a fraction of the form $\frac{u}{y}$, where both the expressions u and y involve x, and both vanish for a certain value of x, the fraction may be evaluated by simply writing for u its differential coefficient $\frac{du}{dx}$, and for y its differential coefficient $\frac{dy}{dx}$.

Take, for instance, the expression

$$\frac{x-1}{x^6-1}$$

which assumes the form $\frac{0}{0}$ when $x=1$. Following the rule, we write for a new numerator the differential coefficient of $x-1$, *i.e.* 1, and for a new denominator the differential coefficient of x^6-1, *i.e.*, $6x^5$. Our fraction thus becomes $\frac{1}{6x^5}$

which has the value $\frac{1}{6}$ when $x=1$.

But it may happen that the new fraction thus formed is itself a vanishing fraction. In this case we must repeat the process until we obtain a fraction which is not indeterminate in form. Thus suppose we have the fraction

$$\frac{(x-1)^3}{x^6-3x^5+3x^4-3x^2+3x-1}$$

which is of the form $\frac{0}{0}$ when $x=1$. We apply the rule, getting

$$\frac{3(x-1)^2}{6x^5-15x^4+12x^3-6x+3}$$

which is still of the form $\frac{0}{0}$. Again, applying the rule, we get

$$\frac{3 \cdot 2 \cdot (x-1)}{30x^4-60x^3+36x^2-6}$$

which is still of the form $\frac{0}{0}$. Lastly, applying the rule yet once more, we get

$$\frac{3 \cdot 2 \cdot 1}{120x^3-180x^2+72x}$$

And when $x=1$, this fraction has the value

$$\frac{6}{120-180+72} = \frac{6}{12} = \frac{1}{2}$$

Other vanishing fractions may be similarly treated; and this application of the differential calculus thus becomes of great utility.

Our Whist Column.

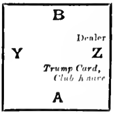
By "Five of Clubs."

THE Editor sends me the following game, played on the opening night of the Kew Whist Club. It is a very imple case of bringing in a long suit:—

THE HANDS.

A.
Clubs—Q, 7, 6, 4, 3.
Diamonds—A, Q, 7, 5, 4, 2.
Spades—9.
Hearts—A.

Y.
Clubs—10, 5, 2.
Diamonds—K, 6.
Spades—Kn, 10, 4, 3.
Hearts—Kn, 9, 6, 5.



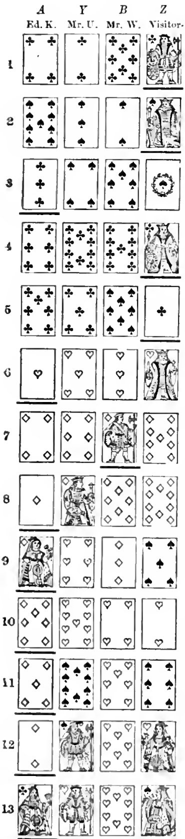
B.
Clubs—9, 8.
Diamonds—Kn, 8, 3.
Spades—8, 7, 2.
Hearts—10, 8, 7, 4, 3.

Z.
Clubs—A, K, Kn.
Diamonds—10, 9.
Spades—A, K, Q, 6, 5.
Hearts—K, Q, 2.

Score:— { A, B, = 2
{ Y, Z, = 3

THE PLAY.

NOTE.—The card underlined wins the trick, and card below leads next round.



REMARKS, INFERENCES, &c.

1. *A* properly leads a trump, though an honour turned, having five, one honour. He leads the penultimate.

2. *B* does not hold four trumps, or he would "echo" to his partner's lead of trumps.

3. The penultimate sign is completed. *Z*, of course, should have led his Queen of Spades.

4. *Z* should see that *B* holds no more trumps. *Y* plays the Ten to help his partner, *B* having shown weakness in the first round of trumps.

5. *Z* does his best to help his adversaries. He not only gives up the command in trumps utterly, but draws two cards for one. He should have forced *A* with his Spade Queen.

6. Even now the lead of Spade Queen would have been the correct thing, though, as the cards lie, it would have done no good.

7. It is necessary, to save game, to make every other trick, for *Y Z* are two by honours. Now, either the King is with *B* or not; if *B* holds it, whether guarded or unguarded, *A B* must win, for *A* holds the long trump with which to re-enter, if *B* is unable to return trumps. If the enemy hold King guarded, the lead of Diamond Ace must lose the game for *A B*, whereas there is a chance that *Y* holding the King guarded, *B* may hold the knave. *A*, therefore, plays on the line which gives the best chance of winning.

8, &c. The rest of the game plays itself. *Y Z* have nothing more to do with it.

SEEING EIGHT CARDS.—A correspondent asks whether, after a trick has been turned, the cards of that trick and the previous trick may all be exposed. The answer is that they may not. Four cards only may be seen at once, just after a trick has been turned; five after a card has been led; six after second hand has played; seven after third hand has played; eight after fourth hand has played, until the trick thus completed is taken up and turned. In some Whist circles a singular mistake prevails: it is maintained that only between the playing of last card to a trick and turning the trick, can the cards of the previous trick be looked at. This, however, is not the case; the previous trick can always be examined.

THE SIGNAL.—Jack of Clubs (English Whist knows no Jack) wants to know if one can signal after trumps have been led by an adversary? Certainly you can. Often a signal so played is most effective. Thus, your right-hand adversary leads trumps, in which you hold, say four, headed by two honours, Ace, King, Knave, nine. Your partner wins with the Queen, third hand being very weak. Your partner then leads his suit, and you signal in it. He leads trumps through strength. The original leader of trumps, even if he held Ace four others is now placed at a disadvantage. If he plays the Ace, he must lead through your strength, and you can either at once force out his trumps, by leading your King and then a forcing card, or play your own and your partner's suit, retaining the power to stop trumps when led once more.

Our Chess Column.

By MEPHISTO.

SOLUTION.

PROBLEM No. 57, BY LEONARD P. REES, p. 318.

1. B to R5.	1. K takes B.
2. R to Q4.	2. K to R6.
3. R to R4 (mate).	

HOW TO CONSTRUCT A PROBLEM.

GENERAL rules on the subject of problem construction have been given by various eminent composers. The main point given by all authorities is to have first an idea of a mate, which subsequently may be worked out into a problem. Every position where a mate can be given will do for that purpose, provided we can so arrange the pieces as to render the mating process both difficult and correct.

Difficulty and correctness are the main requisite features of a problem. Correctness is, undoubtedly, the chief point. It means: First, that there should be but one first move.

Secondly, that against each of Black's best defences there ought only to be but one way of effecting a mate. We wish it to be well understood that the more variations and different mates there are in a problem, the better it is, but White must always have but one last move to effect the different mates; thus, for instance, it will never do to have one of the variations of a problem to terminate with B to R6 or Kt5 mate. This would be called a dual.

Thirdly, every piece on the board ought to have its proper use, both for attack and defence, and the less pieces we have to work out an idea, the better.

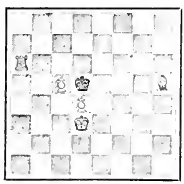
If we succeed in so arranging the pieces as to meet the above requirements, we have a problem, and with some practice in the correct construction of problems, difficulty and variety of combination soon follow.

We cannot do better than give our readers a specimen of construction.

Taking a chess-board, we first endeavour to obtain a clear idea of our mating position; after some little time we hit upon the idea in diagram A, and determine to work it into a problem.

A

BLACK.

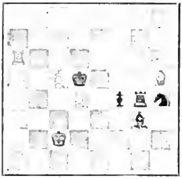


WHITE.

Our intention is to effect a mate by bringing the Bishop round to QKt3 in three moves. At present we have no less than three mates on the first move, which we must, of course, prevent without disturbing the idea of our problem. This we can do at once by placing the King on QB2, which gives us K to Q3 as a good first move, and renders the perception of the main idea to bring the B to QKt3 more difficult. In order to prevent the mate by 2R to Q6 and B to B7, we want a Black Rook on Black KKt3, but we do better by placing that Rook on KKt5, thus placing a piece in front of the Bishop, after 1. K to Q3, the Rook would be compelled to play to Kt3, to prevent mate. But the Rook on KKt5, besides playing to Kt3, can also give check on Kt6, or by R takes P. We can easily [illegible] that by placing a Black Pawn on Black KB5 and a Black [illegible] on Black KKt6. But instead of a Pawn on Kt6 we had [illegible] seeing first that he cannot in [illegible] interfere with the [illegible] of our idea. Now, after 1. K to Q3, R to Kt3 we cannot prevent the mate by 2. B to B3. [illegible] by placing a Black Knight on Black KR5, arriving at the position in diagram B.

B

Black.

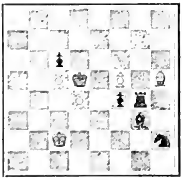


White.

Now we congratulate ourselves with having constructed a problem [illegible] the [illegible] of bringing the Bishop to QKt3 from his [illegible] post on KB5, although there are two intervening pieces, but unfortunately we discover some more defects. After 1. K to Q3, R to Kt3 White can effect a mate by 2. B takes R, followed by R to Q6 mate. This puzzled us for a long time, till we determined to do away with the White Rook altogether, if possible, and in its stead we placed a Black Pawn on Black QB3 and a White Pawn on White KB5. But we found that Black, in reply to 1. K to Q3, need not play R to Kt3, but can defend by Kt to Kt3, which makes the mate impossible, for if 2. B takes R, then Black escapes by Kt to K4 (ch). After some consideration we found that the Knight could be placed on KR7, where it also would prevent the mate by B to B3. We accordingly altered the position, as in diagram C.

C

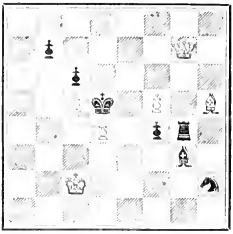
Black.



White.

But we had always reckoned on Black replying with R to Kt3, [illegible] of course, since we have removed the White Rook, there [illegible]; thus, after 1. K to Q3, Black can reply with R to Kt2, and here we saw a fresh difficulty, for if 2. B to Q sq, [illegible] replies with R to QKt2, and there is no mate. A Black Pawn on Black KKt2 would not do, as in reply to 1. K to Q3, [illegible] would spoil the mate. A Black Pawn on Black QB2 would of course have prevented 2. R to QKt2, but the superior [illegible] placing a White Queen on Kt6. We compel [illegible] improve our problem by leaving the Queen [illegible]. But will it hold good? Cannot the Queen effect a mate any other way? This is one of the greatest [illegible], any alteration we may make must [illegible]. We placed a White Queen [illegible] whether White could not effect [illegible] 1. K to Q3. We tried the different [illegible] Queen K6, Q6, or B7 and B takes R, but we found [illegible]. We found, however, [illegible] 1. K to Q3, R [illegible] 2. B takes R [illegible] Black to play [illegible] a Black Pawn on [illegible] prevent it to our readers, not as a difficult composition, but merely for the purpose of showing how to construct a problem :—

Black.



White.

White to play and mate in three moves.

We recommend our readers to follow the above on a board.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

W. (to whom we are obliged for his communication) informs us that the idea embodied in Mr. Rees's Problem No. 57 is also contained in the following position, taken from "Kling's Chess Euclid". White.—King on KB5, Rook on K4, Bishop on KB4. Black.—King on KR2. In this position Black has the choice of refusing to take the Bishop.

C. S. Bright.—Problem 54. 1. Q to B4, if P to Q4. 2. Q to B4(ch), K to Kt8. 3. Q to Kt 3 mate. Solutions correct.

H. A. L. S.—To your first two questions we reply that we do not concern ourselves with gossip about public chess players. If the match comes off it will be played in a "private" room at Simpson's. Admission by ticket, to be had on application to either player.

Edward Wilson.—9. Q takes Kt P ought to have lost the game at once by 10. Q to K4(ch), Kt to K2. 11. B to B3, Q to Kt3(ch). 12. B to Q4. Bringing out the Knight would have been correct for Black.

Kit.—Problem will be examined.

E. A. F.—For solution of No. 54, see p. 334.

H. Seward kindly informs us that the move 8. P to QB4 in the declined Cunningham Gambit is also given by Wormold as best.

Correct solution of Problem No. 58 received from John O'Keeffe, H. V. T., Geo. H. Bonner, Novice, A. Phelps Benest, H. Seward, J. P., E. C. H., H. A. D., W. G. Reynolds, S. Jordan, C. H. W. Hammick, John Watson, Squire, T. Steele Sheldon, Bernard Wilmot, R. Collings, R. J. P., E. A. F., Berrow.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, NOVEMBER 3, 1882.

CONTENTS OF No. 53.

Science and Art Gossip.

IT seems likely that we shall soon hear of serious volcanic outbursts in the Italian region of subterranean activity. At Cassone, Verona, and Brescia earthquakes have been felt and houses thrown down.

PROFESSOR C. W. C. FUCHS announces that the total number of recorded earthquakes for the year 1881 is 297, volcanic eruptions numbering 10,—the most important being that of Mauna Loa, in Hawaii.

"PRESENT evidence," says Prof. Owen, in *Longman's Magazine*, "concurs in concluding that the modes of life and grades of thought of the men who have left evidences of their existence at the earliest periods, hitherto discovered and determined, were such as are now observable in 'savages,' or the human races which are commonly so called."

M. BERGERON, a French scientist, has produced a miniature imitation of the craters in the moon by sending a current of hot air through a brass tube into a mass of melted, but gradually cooling, metallic alloy. M. Bergeron looks upon the experiment as suggesting the manner in which the lunar craters may have been formed.

THE French Minister of Marine has appointed a commission to investigate and report upon a new arrangement for illuminating submarine operations. A powerful arc lamp is enclosed in a water-tight casing, the bottom of which is formed of a glass plate, and the top is provided with a reflector that will distribute the light over a circle about 100 ft. in diameter. The series of experiments, which it is intended shall be very complete, will be conducted at Marseilles. The divers will be in telephonic connection with the surface, and be able to direct the movements of the lamp, which will be suspended over the operations, and can be shifted at will.

THE *Nautical Gazette* says that during the year 1881 the vessels lost at sea averaged about one every four hours. A large proportion of these losses occurred from carelessness, and mostly in fogs and other darkness. There were 400 ocean steamer collisions in 1879 and 1880 in the North Atlantic Ocean alone. Each of these might have been avoided if the master of one colliding vessel had been informed in proper time of the course pursued by the approaching one. These losses gave an average of over one steamer a day in which human life was sacrificed and valuable property destroyed. The *Gazette* believes that if a system of fog-signals had been in use, such as the Barker code, nearly all of these disasters would have been prevented or avoided.

LIEUT. HOVGAARD, in a letter to Herr Gamel, the projector of the Danish Polar Exhibition, states that the *Dijmphna* is frozen in near Novaia Zemlia; but he hoped to get free during the equinoctial gales and reach the Jenisei. All well on board.

REASON is not always heard in vain. The Temperate House Gate to Kew Gardens, which was being bricked up so resolutely, is to be unbricked again, and restored to its former condition. It is pleasant to be assured that this is being done "with the full concurrence of Sir Joseph Hooker;" yet he must not take it ill if we address our thanks more pointedly to Mr. Shaw-Lefevre.

IT should in fairness be added that this is not absolutely the first time that Sir Joseph Hooker has been known to give "his full concurrence" to a desirable measure. For a long time the members of the Kew Fire Brigade sought in vain for permission to erect a station and engine-room on the borders of his territories. But they "went about with him." They persuaded a son of this local magnate to become a captain in the Fire Brigade, and he, in turn, persuaded his father to allow a small portion of his park to be used for the erection of a Fire Brigade station. These potentates must be deftly dealt with.

WE have spoken of the blowing up of casual trees in Kew Gardens. Sometimes the work of destruction goes on so actively that one might imagine a siege was in progress. It is very necessary that many of the trees, when they show signs of decay, should be removed. Other trees are saved, and the Gardens are in many cases improved. Hundreds of tons of wood have thus been disposed of. This wood was, one would say, the property of the nation—not worth very much, perhaps—yet if Sir Joseph had had it sold, however, and the proceeds given to the poor or to his gardeners, no one would have complained, we think. He found another use for it, however. *It made splendid bonfires.*

ACCORDING to Professor F. C. Phillips, healthy plants may absorb through their roots small quantities of lead, zinc, copper, and arsenic. The lead and zinc may enter the tissues in this way without harming the plants, but the compounds of copper and arsenic exert a distinctly poisonous influence tending to kill the plants when present in the soil in considerable quantities.

AN astronomical observatory has lately been erected by the Italian Government on Mount Etna, above Catania, which is the highest inhabited building in Europe, as it beats the St. Bernard Hospice by over 1,000 feet. It has two stories with spacious balconies, and has been built on a cone near the summit of the mountain. The observatory will not be touched by any eruptions, as the lava always flows down on the further side of the volcano.

SEVERAL Russian Physicians have been making researches as to the prevalence of colour-blindness in that country. Women are found less subject to it than men. Out of 10,828 railway servants examined, no less than 251 were colour-blind, and 32 proved to have an imperfect capacity for distinguishing colours, making the average percentage of colour-blind 2·6. Experiments on sailors and pupils in naval schools disclosed a much higher percentage, 6·08 per cent. of colour-blind, and 8·5 with imperfect vision.

THE *New York Herald* office was lighted on the night of Sept. 4 last by the Edison system, which has been in successful use ever since, the total number of lamps in the installation being 612, distributed as follows:—In the engine and boiler room, 9; press-room, 98; folding room, 17; stereotype department, 10; machine-shop, 90; telegram office, 9; counting-room, 51; library, 60; office and private rooms, 17; composing and editorial rooms, 86; main composing room, 196; halls and passage, 18; and reflector for illuminating bulletin board outside building, 13. The current is conveyed from the dynamos (K type) from the machine-room to the *Herald* building through 400 ft. of conductors laid in a tube. The Edison Company is about to light the American Sound Boat *Pilgrim* with 502 incandescent lamps.

SYDNEY, New South Wales, is to have in its lighthouse an electric light, the merging beam of which is to possess a luminous intensity of more than 12,000,000 candles.

A CRISIS in the Italian coral trade is reported imminent. This is due to the remarkable productivity of the new coral banks discovered two years ago at Sciaccia, on the north-west coast of Sicily. So great has been the output of a second grade coral that last year one-half of the exports of Naples, which were valued in all at about 7,500,000 dols., consisted of coral. Most of this was sent to British India, in spite of the fact that that market was overstocked. Coral, both in Italy and India, has therefore become a drug in the market, and will not bring the holders cost price.

THE method of cleaning brass which is in use at all the United States arsenals is claimed to be the best in the world. The plan is to make a mixture of one part common nitric acid and one-half part sulphuric acid in a stone jar, having also ready a pail of fresh water and a box of sawdust. The articles to be treated are dipped into the acid, then removed into the water, and finally rubbed with sawdust. This immediately changes them to a brilliant colour. If the brass has become greasy it is first dipped in a strong solution of potash and soda in warm water. This cuts the grease, so that the acid has free power to act.

A FROG was found frozen in the middle of a 250 pound cake of ice at New London, Conn., a few days ago, but after lying for a few moments in a pail of water, it showed signs of life, and was soon very lively. The ice in which the frog was imprisoned was cut last February, so that it must have been frozen for nearly seven months.

THE *Coal Trade Journal* (New York, Sept. 27) says that the largest vein of coal in the world has recently been discovered in what was the Ute Indian Reservation, in Colorado. It comprises 1,600 acres of land; the coal is semi-bituminous and of jet black colour, is said to be of excellent quality and almost free from sulphur. It will smelt iron without coking, having been used by the miners in the neighbourhood for dressing their steel drills, and pronounced by them superior to charcoal for the purpose. Three railroads are completed within a few miles, so that there is no want of transport.

MM. EGASSE, MANGIN, AND CLORIS-BAUDET, of Paris, have recently conducted some interesting experiments having for their object the development of a system of night signalling by means of small captive balloons, to which are attached incandescent lamps. The balloon experimented upon was about 7 ft. in diameter, and was made of translucent impermeable paper filled with hydrogen. Within it, and suspended from the top, was a Swan lamp. The balloon was allowed to ascend, and when in the air the current was passed through the lamp, the effect being to illuminate the paper sphere to such an extent as to allow it to be visible for a very considerable distance. By suitable connections, a system of Morse signalling may be established, and messages transmitted at night with great facility. Of course, the foe must be requested not to read the messages, but turn his head the other way.

WITH last number the first year of KNOWLEDGE closed, though the second volume will not be completed till the end of 1882. As some evidence that we have dealt fairly with our readers and subscribers (and perhaps rather more than fairly), we note that three volumes of articles reprinted from KNOWLEDGE are now nearly ready for issue namely, "NATURE STUDIES" and "LEISURE READINGS," by Messrs. Grant Allen, Andrew Wilson, Edward Clodd, A. C. Ranyard, Thomas Foster, and the Editor; and "THE STARS IN THEIR SEASONS" (the monthly Star-maps, with notes, by the Editor). The price of these three books (6s., 6s., and 5s. respectively) is almost exactly double the yearly price of KNOWLEDGE. Besides these works, a large portion of the Editor's work on the Great Pyramid (published by Messrs. Chatto & Windus) is taken, with the illustrations, from the pages of KNOWLEDGE, as are some of the most interesting papers in Mr. Mattieu Williams's new work, "Science in Short Chapters"; while the Publishers of KNOWLEDGE have not reprinted papers by Dr. Carpenter, Miss A. B. Edwards, Dr. Ball, Mr. Slack, and other writers, which have appeared in KNOWLEDGE during the past year. Adding to these the continued articles on Electricity, Athletics, Butterflies and Moths, Flowers of the Month, and other subjects, Reviews (by divers writers), Gossip, Extracts, Notes, Correspondence, Queries and Replies, Mathematics, Chess, and Whist, it must be admitted, we think, that we have given readers a fair return for their weekly two-pence.

IN the coming months we propose to do better still. Several subscribers note, not grumblingly but suggestively, that continued articles appear at too long intervals, or irregularly. This will be corrected. We have arranged for series of papers by Messrs. Grant Allen, E. Clodd, and others, whose names and subjects will presently be announced, each series being continued, at intervals not exceeding a fortnight; for weekly notes on astronomical phenomena observable during each coming week; and for other new features of interest and value which our growing experience, or the hints of valued correspondents have suggested. We believe our readers will admit that KNOWLEDGE grows from more to more, in interest, as well as in other ways.

A PROBLEM IN ATOMIC PHYSICS.

By Prof. J. Tyndall.

We must refresh ourselves by occasional contact with the solid ground of experiment, and an interesting problem now lies before us awaiting experimental solution. Suppose 200 men to be scattered equably throughout the length of Pall Mall. By timely swerving now and then, a runner from St. James's Palace to the Athenæum Club might be able to get through such a crowd without much hindrance. But supposing the men to close up so as to form a dense file crossing Pall Mall from north to south: such a barrier might seriously impede, or entirely stop, the runner. Instead of a crowd of men, let us imagine a column of molecules under small pressure, thus resembling the sparsely distributed crowd. Let us suppose the column to shorten, without change in the quantity of matter, until the molecules are so squeezed together as to resemble the closed file across Pall Mall. During these changes of density would the action of the molecules upon a beam of heat passing among them at all resemble the action of the crowd upon the runner?

We must answer this question by direct experiment. To form our molecular crowd we place, in the first instance, a gas or vapour in a tube 38 in. long, the ends of which are closed with circular windows, air-tight, but formed of a substance which offers little or no obstruction to the calorific waves. Calling the measured value of a heat-beam passing through this tube 100, we carefully determine the proportionate part of this total absorbed by the molecules in the tube. We then gather precisely the same number of molecules into a column 10·8 in. long, the one column being thus three and a half times the length of the other. In this case also we determine the quantity of radiant heat absorbed. By the depression of a barometric column, we can easily and exactly measure out the proper quantities of the gaseous body. It is obvious that one mercury inch of vapour, in the long tube, would represent precisely the same amount of matter—or, in other words, the same number of molecules—as 3½ in. in the short one; while 2 in. of vapour in the long tube would be equivalent to 7 in. in the short one.

The experiments have been made with the vapours of two very volatile liquids—namely, sulphuric ether and hydride of amyl. The sources of radiant heat were, in some cases, an incandescent lime cylinder, and in others a spiral of platinum wire, heated to bright redness by an electric current. One or two of the measurements will suffice for the purposes of ilustration. First, then, as regards the lime light. For 1 inch of pressure in the long tube, the absorption was 18·4 per cent. of the total beam; while for 3·5 inches of pressure in the short tube, the absorption was 18·8 per cent., or almost exactly the same as the former. For 2 inches pressure, moreover, in the long tube, the absorption was 25·7 per cent.; while for 7 inches, in the short tube, it was 25·6 per cent. of the total beam. Thus closely do the absorptions in the two cases run together—thus emphatically do the molecules assert their individuality. As long as their number is unaltered, their action on radiant heat is unchanged. Passing from the lime-light to the incandescent spiral, the absorptions of the smaller equivalent quantities in the two tubes were 23·5 and 23·1 per cent.; while the absorptions of the larger equivalent quantities were 32·1 and 32·6 per cent. respectively. This constancy of absorption, when the density of a gas or vapour is varied, I have called "the conservation of molecular action."

But it may be urged that the change of density, in these experiments, has not been carried far enough to justify the enunciation of a law of molecular physics. The condensation into less than one-third of the space does not, it may be said, quite represent the close file of men across Pall Mall. Let us therefore push matters to extremes, and continue the condensation till the vapour has been squeezed into a liquid. To the pure change of density we shall then have added the change in the state of aggregation. The experiments here are more easily described than executed; nevertheless, by sufficient training, scrupulous accuracy, and minute attention to details, success may be ensured. Knowing the respective specific gravities, it is easy, by calculation, to determine the condensation requisite to reduce a column of vapour of definite density and length to a layer of liquid of definite thickness. Let the vapour, for example, be that of sulphuric ether, and let it be introduced into our 38-in. tube till a pressure of 7·2 in. of mercury is obtained. Or let it be hydride of amyl, of the same length, and at a pressure of 6·6 in. Supposing the column to shorten, the vapour would become proportionally denser, and would, in each case, end in the production of a layer of liquid exactly 1 millimètre in thickness.* Conversely, a layer of liquid ether, or of hydride of amyl, of this thickness, were its molecules freed from the thrall of cohesion, would form a column of vapour 38 inches long, at a pressure of 7·2 inches in the one case, and of 6·6 inches in the other. In passing through the liquid layer, a beam of heat encounters the same number of molecules as in passing through the vapour layer, and our problem is to decide, by experiment, whether in both cases the molecule is not the dominant factor, or whether its power is augmented, diminished, or otherwise overridden by the state of aggregation.

Using the sources of heat before mentioned, and employing diathermanous lenses, or silvered mirrors, to render the rays from those sources parallel, the absorption of radiant heat was determined, first for the liquid layer, and then for its equivalent vaporous layer. As before, a representative experiment or two will suffice for illustration. When the substance was sulphuric ether, and the source of radiant heat an incandescent platinum spiral, the absorption by the column of vapour was found to be 66·7 per cent. of the total beam. The absorption of the equivalent liquid layer was next determined, and found to be 67·2 per cent. Liquid and vapour, therefore, differed from each other only 0·5 per cent.; in other words, they were practically identical in their action. The radiation from the lime-light has a greater power of penetration through transparent substances than that from the spiral. In the emission from both of these sources we have a mixture of obscure and luminous rays; but the ratio of the latter to the former, in the lime-light, is greater than in the spiral; and, as the very meaning of transparency is perviousness to the luminous rays, the emission in which these rays are predominant must pass most freely through transparent substances. Increased transmission implies diminished absorption, and, accordingly, the respective absorptions of either vapour and liquid ether, when the limelight was used, instead of being 66·7 and 67·2 per cent., were found to be—

Vapour .... 33·3 per cent.
Liquid .... 33·3 „

no difference whatever being observed between the two states of aggregation. This same was found true of hydride of amyl.

This constancy and continuity of the action exerted on the waves of heat when the state of aggregation is changed,

* The millimètre is $\frac{1}{25}$th of an inch.

I have called "the thermal continuity of liquids and vapours." It is, I think, the strongest illustration hitherto ... of the ... nservation of molecular action. *Lond...*

THE COMET.

By R. A. Proctor.

(*Continued from page 355.*)

THE illustrations which we give this week speak for themselves, and will serve better than any verbal description to show what the Comet is doing at present, where it is going, and what it looked like when last well seen in this country.

In the first place, we give a map (Fig. 1) showing the course of the Comet among the stars during the present month.

The map has been formed from a section of one of the twelve maps of my "Library Star Atlas." The direction of the tail is such as to correspond to the direction of a great circle towards the point on the star-sphere opposite to the position of the sun's centre.

But this map, being taken from a star atlas, is not calculated to show the position which the comet will have upon the *sky*, as distinguished from the star-sphere, especially as the region athwart which the comet is at present travelling is not rich in conspicuous stars. (The star α Hydræ, the nearest third magnitude star, see Figs. 2 and 3, is called Alphard, or the solitary one.)

We might refer those of our readers who possess Parts IV. and V., or the numbers for Feb. 3 and March 3 (14 and 18) to the star-maps corresponding to the hours between which the comet will be best seen in November; for those maps, which are for 10 p.m. on Feb. 6 and March 8 respectively, show the aspect of the heavens two hours later, or at midnight on Jan. 7 and Feb. 6 respectively; two hours later still on Dec. 7 and Jan. 7 respectively; two hours later, or at 4 a.m. on Nov. 6 and Dec. 7 respectively; and thus the second of them (that given in No. 18) shows the aspect of the heavens at 6 a.m. on Nov. 6. We have them in the maps for February and March, at 10 p.m., the aspect of the heavens at 4 a.m., and at 6 a.m. on Nov. 6; and readers who possess these maps can at once turn to them to see whereabouts the stars shown in Fig. 1 are at these hours; whence, of course, their position at any intervening time can be at once inferred, the motion being slight in the interval. On Nov. 11 the maps show the aspect of the heavens from 3.45 a.m. to 5.45 a.m.; and so on, earlier by a quarter of an hour for each four days (about) until on Dec. 6 we have the second map showing the heavens for 4 a.m., but still serving to indicate the aspect of the star sphere to later hours, because the diurnal motion of the heavens in the part where the comet is, lies in the morning hours nearly parallel to the horizon.

But, as many of our present readers do not possess these earlier star maps, we have thought it well to give sections, showing those parts of the sky where the comet is in the early morning hours. All that we have just said applies to Figs. 2 and 3.

In fig. 4 I give a picture of the comet formed after careful study of ...teen pictures which have reached me from as many correspondents. None of these (and some score of others, who have described without picturing the comet) seem to have noticed the marked form of the lower fork of the tail, as described by Major John Herschel;

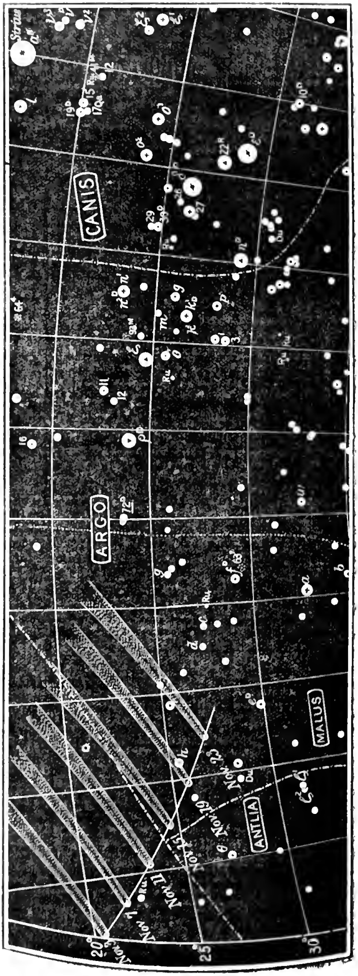


Fig. 1. Course of the Comet during November.

* ... [illegible]

but as he used a binocular, and gave some time to the study of the comet's appearance, the peculiarity was doubtless correctly indicated by him. I have not felt justified, however, in doing more than slightly strengthen the delineation of this southern fork, as shown in three of the pictures sent me. I have not thought it well to send several of the pictures to the engraver, simply because the result would have been bewildering to those who have not yet seen the comet. On the other hand, I could not select any single picture. It seemed to me that a picture formed by showing only those features which at least five of the observers depict, and also others who have sent drawings to other periodicals, would give a more correct idea of the comet's real aspect than six or seven discordant drawings.

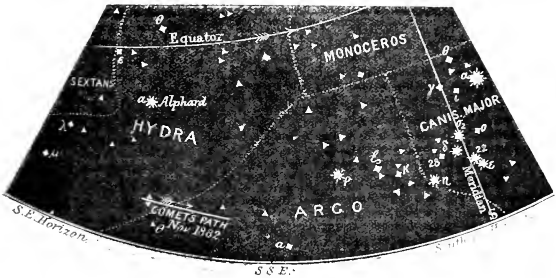


Fig. 2. Showing the path of the Comet in November, the stars being as seen
On Nov. 6, at 4 a.m.
Nov. 10, at 3.45 a.m.
Nov. 14, at 3.30 a.m.
Nov. 18, at 3.15 a.m.
Nov. 21, at 3 a.m.
Nov. 25, at 3.45 a.m.
Nov. 29, at 3.30 a.m.
Dec. 2, at 3.15 a.m.

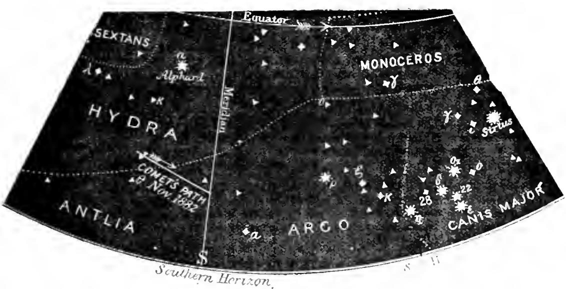


Fig. 3. Showing the path of the Comet in November, the stars being as seen
On Nov. 6, at 6 a.m.
Nov. 10, at 5.45 a.m.
Nov. 14, at 5.30 a.m.
Nov. 18, at 5.15 a.m.
Nov. 21, at 3 a.m.
Nov. 25, at 3.45 a.m.
Nov. 29, at 3.30 a.m.
Dec. 2, at 3.15 a.m.

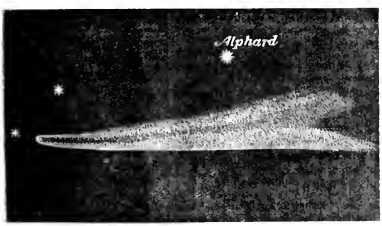


Fig. 4. Great Comet of 1882, as seen Oct. 23, 5 A.M.

I may note that these observers are in error who regard the dark streak behind the nucleus as the shadow of the latter. Whatever this characteristic feature of so many comets may be, it is not *that*.

EARTHQUAKES IN THE BRITISH ISLES.—II.

(Continued from p. 341.)

AFTER the great shock of 1275, more than a century passed without any remarkable earthquakes. In 1382 a shock took place by which several churches in the south east of England were thrown down, and this was, we believe, the last earthquake by which property of any consequence was destroyed.

In recent times, earthquakes have taken place with tolerable frequency in the British Isles. In fact, of the three hundred earthquakes recorded as having disturbed our country, nearly two thirds belong to the present century.

If we run over the period which has elapsed since 1755 we shall find sufficient evidence of the distinctness with which earthquake shocks have made themselves felt in England. We select that year because the whole of the country was then shaken by the effects of the great earthquake at Lisbon. It was at a little past nine that Lisbon was destroyed, and very soon after—so soon, indeed, that it was at first considered that the shocks took place at the same moment—a variety of singular forms of disturbance were experienced in different parts of England, Scotland, and Ireland. It would occupy much more space than we can here spare to record all the remarkable events related respecting the share our country had in the great earth tremor which spread outwards on every side from the centre of disturbance in 1755. But a few of the more striking will not fail, we think, to prove interesting to our readers.

At Barlborough, in Derbyshire, a surprising and terrible noise was heard on the western side of a large body of water called Pibley Dam, which is said to have covered at least 30 acres of land; then a great swelling wave of water came in from the south, and rose two feet on the sloped dam head at the north end of the water. The wave subsided, but presently returned again. And the agitation continued, with gradually decreasing violence, for three-quarters of an hour.

At a place in Surrey called Busbridge there was a canal about seven hundred feet long and fifty-eight feet broad. At the eastern end of this canal the water, at the hour we have named, was observed to be in a great state of turmoil and agitation. The surface of the water, instead of being level, was seen to be ridged like the roof of a house, only rounded at the top. This ridge extended lengthwise about thirty yards, and stood about three feet above the usual level of the water. After oscillating for a few moments, this heaped-up water swept suddenly towards the northern bank of the canal, and poured over the grass-walk on that side. It then returned and swept with still greater force over the grass-walk along the southern bank. It was noticed that the bottom of the canal was left dry for several feet when the water swept towards the south. The flux and reflux of the water in the canal continued for upwards of a quarter of an hour, during which the sand of the bottom was thrown up and thoroughly mixed with the water, which continued turbid long after the disturbance had ceased. During the whole time of the movement, a noise was heard (as if beneath the ground) resembling the noise of water turning a large mill.

At Eyam bridge, in Derbyshire, the overseer of the lead mines felt a sudden shock which raised him violently from the ground in his chair. The plaster of the room fell all around him. The roof was so violently and visibly shaken that he imagined the engine shaft had fallen in. When he rushed out to inquire about the supposed accident, he found that those who had been at work underground had experienced yet more singular effects. Two miners who were employed in drawing the ore along the drifts of the mines were shaken so violently that for awhile they were too terrified to move. They were afraid to climb up the shaft, as they believed that it was beginning to fall in upon them. While they were consulting what should be done to secure themselves from the danger, a second shock more violent than the first frightened them so much that they ran precipitately to the other end of the drift. Then they climbed up to another miner who worked twelve yards below them. He told them that the second shock had been so violent that he had seen the rocks around grinding upon one another. While he was talking a third shock came, which was accompanied by a loud rumbling noise in the bowels of the earth. Presently another shock followed, and five minutes after a fifth. The most violent of all, however, was the second, a circumstance which corresponded in a remarkable manner with the extreme violence of the second shock experienced at Lisbon. A reference to the narrative of this catastrophe in the essay on earthquakes in "The Borderland of Science" (Vol. I. of *Knowledge Library*), will show that it was this shock which had the principal part in the destruction of the city and its inhabitants.

At Shireburn Castle, in Oxfordshire, there is a moat which encompasses the building. On the morning of the earthquake the air was calm and loaded with a somewhat heavy fog. The water of the moat was as smooth as a looking glass. Suddenly one corner of the moat was observed to be disturbed in a singular manner. While all the rest of the water maintained its smoothness unchanged, this part began to flow backwards and forwards in a surprising manner. The flux and reflux were observed to be quite regular. Each flow of water began gently, then its violence increased by degrees, and at last it rushed in upon the shore with wonderful impetuosity. This motion continued for a considerable time, and excited great amazement amongst those who witnessed it, since they were quite unable to account in any way for so mysterious and persistent a commotion.

At Loch Lomond, the waters of the lake suddenly rose upon its banks, and that to so great a height that a boat was carried in one place forty yards inland, and there left. In five minutes more the water rose again as rapidly as before, and again receded. This peculiar motion lasted for more than an hour.

During the same great earthquake, women who were washing on the banks of the Tay were swept off their feet by a wave.

(*To be continued.*)

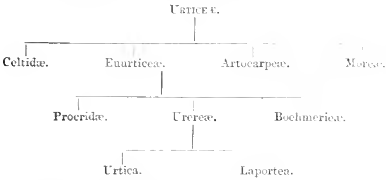
STINGING-TREES.

In Knowledge of Sept. 15, page 256, there appeared a paragraph on "The Stinging-Tree" of Queensland, Australia. As that most interesting colony possesses at least three perfectly distinct plants, each fully deserving that title, it may not be amiss for me to add a few remarks with regard to Queensland stinging-plants in general, and these three trees in particular. But first of all, I must take exception to some of the statements made by "A Traveller," quoted in the paragraph to which I have referred. I used for many years to shoot in scrubs in both North and South Queensland, and during that time I was stung, not "only once, and that very lightly," like the "Traveller," but times without number, and often very severely; but, unlike him, I was never "warned of its close proximity by its smell." A friend of mine, who has had considerable experience in Australian scrubs, writes:—"The stinging plants have no notable smell, and certainly none that would attract attention. The trees are usually isolated."

I have noticed that upon very close examination, especially if the leaves be bruised, a faint, unpleasant odour may be detected, but this is in no case sufficient to attract attention in a scrub. Again, the stinging-trees are always, so far as my experience goes, more or less isolated, and never form anything approaching to the "little forest" mentioned by the "Traveller." *Urtica incisa*, however, is said to cover almost completely one island in the Fitzroy River, and grows in great profusion in that neighbourhood, but it can never in any sense of the word be called a tree.

The sting produces in most cases a small white mark, which soon disappears, and, if on the hand, the pain, which is excruciating, gradually extends from the affected spot up the arm, till it reaches the axilla, where it often becomes very intense. Its duration varies from half an hour to several hours, and even when the pain has ceased, the slightest touch to the affected spot, or, above all, the application of cold water, will renew the pain.

In considering the stinging-plants of Queensland, we need only, for our present purpose, deal with the natural order *Urticeæ*, and of the seventeen genera of that order, found in Australia, we are most concerned with the two—*Urtica* and *Laportea*. Their relation to the sub-tribes and tribes of the order is shown in the following table, which I have constructed in accordance with the classification adopted by Bentham and Von Mueller.



Of the genus *Urtica* there are two species in Queensland, both herbaceous plants:—

1. *Urtica incisa*, found chiefly on the Fitzroy river, and said by M. Thozet, of Rockhampton, to grow in great profusion.

2. *Urtica Urens*, a common weed in this country, and found in the neighbourhood of dwellings in Queensland.

In the genus *Laportea* we have, on the other hand, the three great stinging-trees to which I have referred. They are:—

1. *Laportea gigas*, a large tree, often attaining a height of 100 ft. or more; but I have not myself seen any specimens over 80 ft. The wood is soft, fibrous, and juicy, and the bark smooth and ash-coloured. The base of the tree is supported by prominent angles or buttresses. The leaves are from 1 ft. to 1 ft. 6 in. long, and nearly as broad, smooth above and sprinkled with a few stinging hairs, but more or less covered with short, soft hairs underneath. It is found chiefly in South Queensland. The sting is severe, but, as far as my experience goes, not so bad as that of *L. moroides*.

2. *Laportea photiniphylla.*—A fine tree, from 60 to 70 feet in height, with a straight stem. The wood is soft, and the leaves are almost elliptical in shape, nearly smooth, and sprinkled with a few stinging hairs. It is found in the Moreton Bay district, and also in North Queensland. M. Thozet mentions having found it on the Fitzroy River.

3. *Laportea moroides.*—A small tree, with most virulent stinging hairs. The leaves, which are about 9 inches long, are covered with short soft hairs on both sides. The fruit, which I have only twice seen, is of a beautiful purple colour, succulent, and densely clustered. This tree is found chiefly in the Kennedy district in North Queensland. Mr. Fitzalan, of Bowen, mentions that it is common about Port Denison and Edgecumbe Bay.

These three stinging-trees, which Bentham and Von Mueller place in the genus *Laportea*, are by many botanists included under *Urtica*.

Of all the stinging-plants of Queensland the virulence of which I have been so unfortunate as to ascertain practically, *Laportea moroides* surpasses the others, both in the severity of the pain produced at the time and in the duration of its effects.

I would refer those who wish for further information on this subject to Bentham's "Flora Australiensis," Vol. VI.

Ernest Black.

A FEW HINTS ABOUT THE RAIN-BAND SPECTROSCOPE.

Since writing to the *Times* on the subject of "The Spectroscope and Weather Forecasting," I have had so many letters and inquiries from various parts for information about the rain-band spectroscope and how to use it, that I think a few concise rules and facts in regard to it may prove acceptable to many readers of your widespread and useful periodical. With your kind permission I will briefly mention the following, viz.:—

1. Adjust the focus and slit of the spectroscope so that the lines in the spectrum may be of the clearest definition, and whilst taking an observation, shade the eyes with the hands, in order that all extraneous light may be excluded as much as possible.

2. Observe in a general way from ten to twenty degrees from the horizon, and towards the quarter from which the wind is blowing, but if the latter be not practicable, point the instrument in a northerly, in preference to a southerly, direction.

3. If 80 per cent. of the dark band be shown at the zenith, heavy rain will certainly occur before long.

4. During wet weather, the amount of rain-band may be low; this for the most part denotes fine weather to follow.

5. If the instrument be directed towards the point from which the wind is blowing, and should the clouds be passing in one and the same direction, and 20 per cent., or less, of the rain-band be shown, no rain will follow for at least six hours, in spite of any threatening appearance of the sky.

6. With a knowledge of the course and peculiar characteristic of storms, which is not difficult to acquire (*vide* "Aids to the Study and Forecast of Weather," by W. Clement Sey, M.A.), it is possible to foretell rain by the help of the spectroscope with surprising accuracy.

Observers will not be disappointed if the above suggestions are carefully attended to. The principal difficulty lies in determining the percentage of rain-band; but this is to be overcome by practice and experience, and they will find that after a time the indications of the spectroscope can be read at a glance of a few seconds in duration.

F. W. Cory, F.M.S.

SATURN'S RINGS.

The volume of "Philosophical Transactions" from which I forwarded you the extract given in No. 49, p. 307, is in my possession, and is peculiarly interesting. The title-page is as follows:—

"Philosophical Transactions: giving some Accompt of the present Undertakings, Studies and Labours of the Ingenious in many considerable parts of the World. Vol. I. for Anno 1665 and 1666." These Transactions were not issued by the Royal Society, but were edited by their Secretary, Henry Oldenburg. The first number was issued on Monday, March 6, 166$\frac{4}{5}$, and was followed by monthly parts in April May, June, July. At the end of the July number is this note:—

"*Advertisement.*—The reader is hereby advertised that by reason of the present Contagion in London, which may unhappily cause an [illegible] ... Morris [illegible] ... for a [illegible]

[illegible] Nov. 6, 166[illegible], and was [illegible] the December and January [illegible] Monday, Feb. 12, 166[illegible], the [illegible] engraving which I sent you. [illegible] Another interesting feature [illegible] printer was changed owing [illegible] his place turned down in the [illegible] In January, 166[illegible], we find the following [illegible] somewhat [illegible] The volume terminates [illegible] or, as we should now [illegible]

[illegible] issued in monthly [illegible] by the Great Plague, [illegible] few copies seem to be in [illegible] that I forwarded you, I traced [illegible] may rest satisfied that it was a [illegible]

THOS. WARD.

[illegible] Northwich.

Mr. E. W. Maunder, of the Greenwich Observatory, writes to us that the credit of restoring to Cassini the [illegible] or to Auzout, who made his telescope), [illegible] the division in Saturn's ring system, is due to Mr. Lynn, formerly of the Government Observatory, Greenwich. "Two years ago," he says, "Mr. Lynn pointed out that the [illegible] to have accompanied Ball's paper in the Phil. Trans. [illegible] omitted from several copies." On [illegible] of the present year, Mr. Lynn examined a copy of [illegible] to Mr. Prince, and the first sight [illegible] diagram [illegible] given *fac simile* is shown at p. 295 of KNOWLEDGE for Sept. 29 convinced both Mr. Prince and Mr. Lynn that Ball had never recognised the division, or anything like it. Captain Noble and Mr. Prince, the day [illegible] the same picture, and arrived at the [illegible] Mr. Lynn wrote to a monthly astronomical [illegible] circulation, setting forth his [illegible] the Cassini [illegible] credit of the discovery. Captain Noble wrote to us to a similar effect, [illegible] of the picture which he and Mr. Lynn and Mr. Prince had examined. It required a rather shrewd [illegible] who perhaps should not) to infer from these [illegible] what Ball had really suspected. But Captain Noble's communication coming at once before [illegible] thousands of readers, the natural result followed. An [illegible] correspondent, Mr. T. Ward, was able to resolve [illegible] *fac simile* of Ball's original observation [illegible] of the Transactions." This [illegible] that what I had conceived was [illegible] had, by an optical [illegible] the planet's north and [illegible] that there were [illegible] side, and reaching [illegible] other. All this was [illegible] Captain Noble for [illegible] We did not [illegible] to [illegible] Mr. Lynn [illegible] the [illegible] the [illegible] for [illegible] The [illegible] difficulty of this [illegible] paper of wide circulation, rather than [illegible] appear [illegible] often, and [illegible]

MR. STANLEY'S DISCOVERIES.

A CORRESPONDENT of the *Globe* who has interviewed Mr. H. M. Stanley, says that gentleman has had practically unlimited means at his command, through the generosity of the King of the Belgians, who, moreover, has been the main supporter of several of the so called International African Expeditions; as Mr. Stanley puts it, he has been in a position to pay for every cubic inch of air he and his men breathed, and every square foot of ground they trod upon. The object of the King of the Belgians appears to have been entirely disinterested simply to do what he could to render accessible to commerce and civilisation, and thereby develope the resources of the great interior of Africa. For this purpose the Congo formed a splendid channel of communication, only unfortunately, its lower course for many miles is obstructed by impassable cataracts. To surmount this obstruction has been the object of Mr. Stanley's work. He states that already he has carried a well made road, 15 ft. wide on an average, from below the cataracts, 230 miles along the north bank of the river, far beyond Stanley Pool, and therefore well into the navigable upper waters. To assist him in this undertaking he has not only had native workers, but relays of young Europeans as superintendents; and for this work he finds Englishmen better than any others, and would be glad to have a fresh supply to send out. So substantially has this road been constructed, that it has stood the deluges of rain that break down upon it from the mountain sides, and has borne the heavy traffic which the transport of engineering plant to the upper reaches has rendered necessary. Causeways have been laid where necessary and bridges built, and the road has, by means of excavations, embankments of stone, and layers of earth, been carried right round the face of a mountain which comes sheer down to the river at one place. On rounding the mountain Mr. Stanley states that the road enters an avenue of exquisite beauty and coolness which has been cleared through the forest. So thickly timbered is the country in some parts that thousands of trees have had to be felled, and their roots either grubbed up or levelled. At intervals along the road stations have been planted, and already there is a regular service of couriers between the stations, and by them a growing trade is being established. As to what are the possibilities of commerce along this route, he states that during the progress of his work a million yards of Manchester goods have been distributed through the country in payment for labour and other services performed by the natives. One of the articles of transport along the new road was a fine steam launch, with which Mr. Stanley has done some good exploring work some 400 miles above Stanley Pool, quite 700 miles above the mouth of the river. When he feels at liberty to publish an account of his work (at present his first duty is to his employer, the King of the Belgians), it will be shown, the correspondent believes, that some first rate exploring work has been done. The launch, for example, was taken up a new river, opening from the south bank of the Congo, some distance above Stanley Pool, and which, it was found, led into a fine lake. The lake was covered with fishermen's canoes, whose occupants looked aghast at the snorting monster puffing out smoke, and fled in dismay. One, however, was caught, and after being soothed down and kindly treated, was sent off loaded with presents to his wondering fellows peering from among the bushes on the shore. In Mr. Stanley's opinion the soil is capable of unlimited development for crops of all kinds, and, by judicious use, the supply of caoutchouc in the forests is inexhaustible. The greatest difficulty to the utilisation of the river throughout its navigable length is the almost untamable cannibal tribes who inhabit the upper reaches between Stanley's furthest point and the neighbourhood of Nyanginé.

Reviews.

PLAIN WAYS IN SCIENCE.*

By the Editor.

MR. WILLIAMS says he is not aware that the reprint of his scattered essays demands any apology. Evidently he is not aware that Mr. Christie, the Astronomer-Royal, considers there is "no practice more reprehensible," and that an anonymous writer in the *Atlantic Monthly* (afterwards identified as Mr. Edward Holden, then of the Washington Observatory, now chief of the Ann Arbor Observatory, Michigan) compares this habit to highway robbery. For my own part, I share Mr. Williams's opinion; nay, I go a little further, considering that essays which will not bear reprinting were probably not worth writing. As for the time of making such reprints, surely, as Mr. Williams says, they are likely to be much better done by the author himself than by his friends after his death.

The volume before us is full of interesting matter. Mr. Williams has not a particle of respect for mere authority, so there is no lack of novelty in his views. Some of his new theories are open to exception; but they are all well worth considering. I had marked a number of the essays in the present volume for notice as interesting and valuable; but have finally decided to speak only of the theory or theories advanced in Mr. Williams's "Fuel of the Sun," here concisely presented in the opening essay (thirty-four pages in length), and touched on in the second, a much shorter paper, relating to Dr. Siemens's "Theory of the Sun."

The new theory opens with the argument that Wollaston was wrong in regarding the atmospheres of the earth and other members of the solar system as limited. Mr. Williams attaches great importance to this point, considering that if he is right, all our standard treatises on pneumatics and meteorology must be remodelled. I cannot, for my own part, see why. I doubt very much whether Dr. Wollaston's paper has ever been held to be of great importance, or whether it has ever been regarded as demonstrated that the planetary atmospheres are limited. Certainly the atomic theory, as it has been maintained for many more years than have passed since Mr. Williams's theory was advanced, is inconsistent with Wollaston's opinion, and still more obviously with the reasoning by which Wollaston attempts to establish his opinion. The rather daring theory of Le Sage as to the true cause of gravitation may be cited as an illustration of what is undoubtedly the case, that many before Mr. Williams have regarded interplanetary and interstellar space as occupied by matter.

As for the consequences of the opinion maintained by Mr. Williams (most probably right), he is, I take it, quite mistaken in supposing them to be of great importance. He finds the objections urged against his views, and Dr. Siemens's later ones, invalid when once the atmospheres of the heavenly bodies are regarded as unlimited. I have myself received more than one letter pointing out that this is so. (Dr. Siemens himself is of course persuaded that it is.) But the argument is based on the mistaken idea that because there is no definite limit to a planet's atmosphere (or *if* there is no such limit), the atmosphere which at any instant envelopes a planet is freely interchangeable with the interplanetary atmosphere. But this would not be the case. Interchange could only take place in accordance with dynamical laws, and these would not permit of more than an infinitesimal interchange between the atmosphere immediately surrounding a planet and the attenuated atmosphere beyond. Mr. Williams recognises this as soon as he tries to set his perpetual solar machine working. "The sun will carry its own special atmospheric matter with it, but it cannot carry the whole of the interstellar medium. There must be a limit—graduated, no doubt, but still a practical limit—at which its own atmosphere will leave behind, or pass through, the general atmospheric matter." This admission, though convenient where it is made, carries death with it to Mr. Williams's theory, for it leaves things practically as they would be if Mr. Wollaston's theory were unquestioned.

Mr. Williams conceives the sun as rushing along through space, gathering in the atmosphere of space as it goes, compressing that atmosphere with all the energy with which a normally limited atmosphere would be permanently compressed, and so by its gravitating energy producing intense heat, instead of that merely constant pressure which would naturally result in the case of a constant atmosphere. But neither the onward rush of the sun through space, nor that swaying of the sun around the common centre of gravity of the solar system, which Mr. Williams regards as an all-important point in his theory, could produce any such effect. If we imagine the sun without his atmosphere, drawing that atmosphere in from surrounding space, he would unquestionably, in drawing it in, produce all the heat in which Mr. Williams believes. And that heat might be stowed away, so to speak, in dissociating the aqueous vapour so gathered in, to be presently distributed as the elements recombined. But with that first ingathering of atmosphere would be the end of this particular source of solar heat. The heat thus stored could be given out, but no more, or only so much more as corresponded to the exceedingly slight interchange taking place at the outskirts of the solar atmosphere. Mr. Williams speaks as if the whole of the long cylinder of interstellar atmosphere actually traversed by the sun were gathered in and compressed to the full tension of the solar atmosphere. But this could not happen. The sun would travel through that atmosphere, losing from his own (and taking up from outside to replace) only so much as friction at the outskirts of his atmosphere would displace.

If there could be any doubt, when the question is viewed as a hydrodynamical problem, that this is so, it should be removed by the consideration that were the processes conceived by Mr. Williams to take place, one side of the sun would inevitably present an appearance differing in the most striking manner from that of the other side. On the forward hemisphere, there would occur a constant ingathering of so much atmosphere as, when compressed by solar attraction, would produce the heat which Mr. Williams's theory requires. (For note that the mere *state* of compression does not cause heat, but only the forcible compression of vaporous matter which had been uncompressed). All the heat thus generated on one side would be used up in dissociating the aqueous vapour of the atmosphere so gathered up. On the other hemisphere the converse process would be taking place. The dissociated gases would there rise, would combine, with intense emission of heat, and the products—the cinders left after the solar firing—would be flung away in the wake of the advancing sun. (At least Mr. Williams's theory requires that this should happen.) Now,

* *Science in Short Chapters.* By W. Mattieu Williams, Author of the "Fuel of the Sun," "Through Norway with a Knapsack," &c. (Messrs. Chatto & Windus, London.)

[illegible] season of [illegible] six months [illegible] fairly expect that [illegible] at [illegible] on so [illegible] appearance. [illegible] difference [illegible] it [illegible] shove [illegible] the earth during the spring of the [illegible] and the other side where he is [illegible]. Both sides look exactly alike.

[illegible] of Mr. Williams's theory which [illegible] against criticisms of mine. I had [illegible] round the sun could never [illegible] a result of ejections from the [illegible] Mr. Williams (though that was not [illegible] "The Fuel of the Sun," [illegible] if these were only simple ejections, but if, [illegible] ejected, it explodes like a rocket, [illegible] around, a ring of meteors might [illegible] he cites the behaviour of the coloured [illegible] of the [illegible] as showing that this actually [illegible] true they often, after shooting up from [illegible] spread laterally, but there is nothing in [illegible] in every case in which gaseous [illegible] through a region of high pressure into a [illegible] That matter shot to a height of say [illegible] sun's surface, should *there* explode laterally [illegible] outward to circle around him, the matter [illegible] itself into opposite portions, each [illegible] from the point of explosion with a velocity of [illegible] per second. Nothing of this sort, or [illegible] anywhere near this, has ever been seen. Moreover what is there except expansive action to produce [illegible] in the ejected gases? and how can [illegible] do more than extend the expanding [illegible] density is equal to that of the atmosphere [illegible] at the same level? In the case of terrestrial [illegible] there is an enclosing case which holds the [illegible] until, on ignition, the gases are formed [illegible] expansive action, drive out the particles of [illegible] form the luminous display. The circumstances are therefore favourable to the forcible expulsion [illegible] different in the case of the gaseous matter [illegible] when the outrush is over. For the [illegible] outward on these occasions [illegible] any way. It is [illegible] the spectro[illegible] up a stream of dense gas in a rela[illegible] atmosphere and as soon as it can (which is [illegible] before it reaches a higher and still rarer [illegible] laterally. There is nothing ex[illegible] action, any more than there is in the [illegible] clouds, or (which more nearly [illegible] the outspread of cloud above a [illegible] of the gases which had been [illegible] If there were the enormous lateral [illegible] Mr. Williams's theory, the spectro[illegible] have recorded them; but while [illegible] down in the solar [illegible] toward and from the [illegible] never shown any trace of [illegible] high above the sun.

[illegible] worth studying in Mr. [illegible] to me, for [illegible] but the evidence he [illegible] of the most careful [illegible].

M[illegible] that [illegible] have been and are [illegible] writers on astronomical and physical matters, "without corresponding acknowledgment"; and he tells us that in due time "an appendix to the 'Fuel of the Sun'" will be published (to a new edition, I trust), giving the particulars of such adoption. I doubt the wisdom of this. These questions of priority are fit only to occupy very small minds; and I am sure Mr. Williams agrees with me in regarding all egotism as silly:—even the appearance of it is a thing to be avoided. But if he does what he proposes, he will have to be careful lest peradventure he should find the boot unmistakably on the other leg. He has a clear case against Dr. Siemens, though I feel well assured Dr. Siemens was not aware, when he published his theory, how fully all that was sound in it, and a great deal also that is unsound, had been anticipated by Mr. Williams. But in some other cases, where he hints a suspicion that his views have been adopted without acknowledgment, he will find priority (*valeat quantum valere debet*, which is not saying much) with others. For instance, the theory that the larger planets are miniature suns, "surrounded by a sphere of vapour, the outside of which we see," he includes among his startling conclusions, "utterly at variance with general astronomical opinion when he reached them." When he *reached* them I do not know, but I do know when he published them; and I know that several months before, in the winter of 1869, I advanced that theory in a series of lectures delivered at the Royal Institution, Manchester (in the syllabus of which the theory was stated in so many words), while for at least a year before that, the probably intensely-heated condition of the giant planets had been dealt with in the MS. of the work afterwards published under the title of "Other Worlds than Ours." Mr. Williams could not be expected to know about the Manchester lectures, but he must know enough of the conditions under which books are published to be well aware that the chapters on the giant planets in the middle of that work were written, and even in type, before his "Fuel of the Sun" was published. The theory was announced by me long before. Not that it matters in the least, only: if such questions *are* to be raised, we may as well raise them by the right end.

THE DOOMED COMET.*

This little pamphlet, price sixpence only, gives a good deal of interesting information about cometic astronomy. It deals chiefly, in the first part, with the comet now shining so conspicuously (when the weather is clear) in our morning skies. In the second part, it discusses the possible effects of the comet's absorption by the sun; and, in passing, criticises the theory of sun-spot influences with an engaging frankness which we fear will prove somewhat distasteful to the believers in that theory. Mr. Oliver arrives at the conclusion that there will be "slightly intensified meteorological phenomena," whenever the comet is absorbed. He believes that the British Isles will be affected in "a way such as to induce warmer and drier weather, or in other words, good seasons," opposite conditions prevailing (with important local variations, however) in Eastern Europe, India, Australia, and North America. We (the Editor) wished we knew enough to guess a tenth of what Mr. Oliver seems somehow to know. Mr. Oliver says, by-the way, that we have twice misled the public on the subject of this comet. We doubt if we have misled them once. What we said erroneously in KNOWLEDGE of Oct. 6 was corrected in five daily papers, having an aggregate circulation of half a million, on the morning of Oct. 7. As

* *The Doomed Comet and the World's End.* By J. A. Westwood Oliver. (Wyman & Sons, London.)

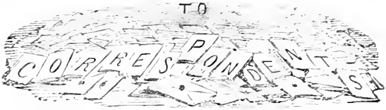
for the "glaring mistakes" in our essay on "A Menacing Comet," we should be obliged if Mr. Oliver would point out what they are. We apprehend he mistakes the mistakes we corrected, for mistakes we had made. We see nothing in the essay to correct; when we do we shall say so!

A Mysterious Well.—James Beatley, of Huntingdon, L.I., has a well on his premises that is both a curiosity and a puzzle. The well is twenty-three feet deep, and is dry every year from Jan. 1 to the first week in March, as regular as the days of the year. It will be as full the day before it dries up as at any time during the year, and on the following morning not a drop of water is to be seen where a depth of three or four feet existed before. About the first week in March the well fills again in a few moments, and the water remains for the remainder of the year.

Professor Tyndall on Dr. Siemens' Solar Theory.—It would give me extreme pleasure to be able to point to my researches in confirmation of the solary theory recently enunciated by my friend the President of the British Association. But though the experiments which I have made on the decomposition of vapours by light might be numbered by the thousand, I have, to my regret, encountered no fact which proves that free aqueous vapour is decomposed by the solar rays, or that the sun is reheated by the combination of gases, in the severance of which it had previously sacrificed its heat."—*Longman's Magazine.*

Coal in British India.—Coal of good quality for locomotive purposes is systematically worked in the Bengal coalfields, which extend for about 100 miles to the west of Burdwan. Collieries exist also at Wahrora and Mohpani, in the central provinces. A very valuable coalfield is known to exist at Makum, in Upper Assam, which will doubtless be opened out when the Assam Light Railway is completed. The total output of Indian coal in 1880 was 1,016,040 tons, of which by far the greater amount was raised in the Raneegunge coalfield. Madras finds it cheaper to use patent fuel from England than to depend upon Indian coal brought from long distances by land. The total quantity of English coal, coke, and patent fuel imported into India during 1880-81 was 683,768 tons, valued at £1,239,805.

An Electric Tricycle.—The improvements in the storage of electric energy and in electro-motors have so far advanced that tricycles can be lighted and propelled by electricity, as was seen from the tricycle ridden last week by Professor Ayrton in the City. The Faure accumulators in which the energy was stored for the lighting and driving were placed on the footboard of the tricycle, and the motion was produced by one of Professors Ayrton and Perry's newly patented electro-motors, placed under the seat of the rider. Using one of these specially made tricycle electro motors and the newest type of the Faure accumulators, the total dead weight to be added to a tricycle to light and propel it electrically is only 1½ cwt., a little more than that of one additional person. In the tricycle ridden by Professor Ayrton the ordinary foot treadles were entirely absent, but with ordinary electric tricycles it may be desirable to leave the treadles, so that while electric propulsion alone is used on the level, the rider can, on going up a steep hill, supplement it by using the treadles, instead of, as at present with the ordinary non-electric tricycle, having to get out and ignominiously push his tricycle up the hill before him.



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

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⁂ All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

HAS THE MOON AN ATMOSPHERE?

[614]—This question has been a debatable one with astronomers, though generally answered in the negative; there, however, seems to be, from what Mr. Ranyard has to say upon this subject in his paper on pp. 215-216 of this volume, every probability that the question as to the existence of a lunar atmosphere will soon be definitely settled. At the conclusion of the highly-interesting paper above referred to, Mr. Raynard makes a few remarks upon a curious phenomenon to be seen at the time of the new moon, viz., a faint line of light round the dark limb of the moon; and requests observers to take notice of it, and send the results of their observations to Knowledge. Unfortunately, since the publication of Mr. Ranyard's paper, cloudy weather has prevented me observing the moon when sufficiently near conjunction; and as I think this phenomenon, if carefully observed, is likely to throw some light upon the question heading this letter, I venture to call attention to it, because in a climate like ours it is necessary that there should be several observers, as it often happens that one observer will see some phenomenon that an observer at another place is unable to observe on account of bad weather.

In his paper, Mr. Ranyard suggests that this "line of faint illumination" may possibly be due, either to "a dispersion of the sun's rays within an atmosphere," or else "caused by a phosphorescent light from the lunar surface." With regard to the first of these suggestions, I would like to ask whether an atmosphere of sufficient density to make itself visible as a "line of light" would not have some effect upon the occultations of stars? Respecting the latter suggestion, I should like to know whether any observer has noticed the "line of faint illumination" along the dark limb of the morning moon? B. J. Hopkins.

[After what Zollner's photometric observations have proved (to all intents) as to the average slope of lunar mountains, it is tolerably clear that that arc of light should be seen whether moon has appreciable atmosphere or not.—Ed.

ANCIENT MONUMENTS.

[615]—In the Government list of ancient monuments to be protected (in No. 47, Sept. 22), I am sorry to observe that one interesting relic is omitted. It is a cromlech called Arthur's stone, in Hertfordshire, about 15 miles W. of Hereford, on the ridge that bounds the Golden Valley (Valley of the Dwr), to the N.E., and close to the picturesque little village of Dorston (Dwr's town, or the town on the Dore). Originally it was covered with stones and earth, forming a mound, and is situated where a lane crosses an ancient British road that ran along the ridge, and is crossed farther south by a Roman road that led to Abbey Dore. It consists, like Kit's Coity House, of a stone supported by several others, but the supporters are more numerous, and smaller, and the top stone much larger than at K. C. H. There is to the N.E. of this relic about 100 yards, just as at K. C. H., another large stone lying down. There is a fine view from this spot of the whole Golden Valley, with its Norman castles, its Abbey, and ancient tumuli of the Black Mountains, that separate Herefordshire from Brecknock, and in the extreme S.W., the Great Skirrid, Horned, or Holy Mount. A line drawn through the long axis of the top stone if extended would just touch the Skirrid. J. E. S.

[illegible]

Answers to Correspondents.

[illegible]

[illegible] may do so for aught we know to the contrary.—Only A Woman, J. H[illegible], J. W. B., R. M. N., Saml. Y., T. V. D[illegible], Wm. [illegible], A Father, G. Y., D. O., Harvey, and [illegible] others. We are glad to find so large a portion of our readers agree with us about the portraits in question, though, indeed, we do not suppose anyone who holds the women of his family in just regard could well do otherwise. As two of you write, it is not a question of the propriety or impropriety of certain pictures. It would be prudery, indeed, to object on such grounds. There are several pictures in the National Gallery to which "nice" persons (that is persons with nasty ideas) might object with far more reason. But no sensible person cares about those. Nor does the objection to these pictures reside in the evidence they afford of immorality among princes. There is immorality everywhere; and it is a matter of no more moment that King This or Prince That, or Grand-duke So-and-so neglects his wife, and finds himself more at home with persons of lax morality, than it is that the same should be the case with Brown, or Jones, or Noakes, or Styles. What every [illegible] who thinks on the subject must feel, is the [illegible] in the selection of pictures such as these, as [illegible] persons in whom the nation, *as a nation*, [illegible] interest.—T. Jardine Perkins. How do the above [illegible] you by way of explanation? Of course, you are right [illegible] that the gallery is not a Female Excellence Gallery, but a National Portrait Gallery. That is the trouble. You are "loth to believe that I do not consider these women's portraits national." Do you? They are just as national to my mind as would be portraits of any other persons of more or less lax principles, acquaintance with whom had happened to suit any of our kings, as, for instance, portraits of the fellows employed by Hubert to torture Prince Arthur, or the persons selected by Richard III. for his villanies. I take it a National Portrait Gallery should contain pictures of all statesmen, whether their influence was good or bad; of soldiers and sailors of renown; of poets, historians, and all men great in literature, art, or science; of kings, princes, and others of high position through their birth or family, with special place for those among them whose influence was used for the benefit of the nation; nor should the circumstance that any one, otherwise great, had been guilty of offences, even of deep dye, cause their portraits to be regarded as objectionable in a National Portrait Gallery. All women who have had high position in the nation, and all who have been famed in art, or science, or literature, should, of course, be there. And certainly, also, the mothers, wives, sisters, and daughters of famous men should in many cases have a place, especially where they had had much influence on the career of such men. But what earthly interest there can be to any [illegible] mind in the domestic irregularities of princes, or why one particular class of irregularities should be selected as worthy of national celebrity, I think you would find it very difficult to show. How would it be if the queen and each woman in the land who ran the least risk from her position of having her portrait put along with these "beauties," were to leave a [illegible] injunction in her will that she should not be exposed to such indignity? As for your threat, here is a little parable for you:—"Passing down Newspaper-row, in New York city, one morning, the late Horace Greeley met one of his readers, who very excitedly exclaimed, 'Mr. Greeley, after the article you published this morning, I intend to stop your paper!' 'Oh, no,' said Mr. Greeley, 'don't do that!' 'Yes, my mind is made up; I shall stop the paper.' Late in the afternoon the two met again, when Greeley remarked, 'Mr. Thompson, I am very glad you did not carry out your threat this morning.' 'What do you mean?' 'Why, you said you were going to stop my paper.' 'And so I did; I went to the [illegible] and had it stopped.' 'You are surely mistaken. I have just come from there, and the press was booming.' 'Sir,' said Thompson very pompously, 'I mean I intended to stop my subscription [illegible] paper.' 'Oh, thunder!' ejaculated Greeley. 'I thought [illegible] stop the running of the paper, and knock me out [illegible]. My friend, let me tell you something; one man is just a [illegible] in the ocean. You didn't set the machinery of this [illegible], and you can't stop it; and when you are underneath [illegible] upon the ground will wag on the same as ever.'"—[illegible] You are one of a very small minority. If the pictures [illegible] there to show how depraved the nation has been at times [illegible] there has not been any great change in the nation [illegible] that you should rather have written "court," than [illegible] there would be no serious objection. But that is very [illegible]. I wish, by the way, that every reader of [illegible] had had the opportunities I have had of learning how [illegible], American, and Colonial visitors of the higher types of character [illegible] these pictures. That they regard them as insults to the [illegible] hardly be said.—W. B. Bird. That allusion would be [illegible] no doubt, if not justified by the utter rudeness of what it [illegible]. As regards Kew Gardens, how do you get away from

'Arry and 'Arriet *now?* What change have I proposed that would add to their opportunities of being annoying? I am glad to say that not one letter in fifty which has reached us takes your view about arrangements *which keep out all alike.* I think, for my own part, the wall is the chief offence. It deprives the public of the general view of the grounds, which is their chief beauty. Inside, there is much that is in such bad taste,—inartistic effects, tawdry colour-combinations, hideous false ruins, and so forth, that the public lose less by the late opening than they otherwise might.—Elt. H. Jules. The rainbow can be photographed after a fashion; only the violet and blue part come out well. It is in one sense true that the rainbow exists only in the eye of the observer; so does every image of optical effects; but the very fact that there is an image in the eye shows that an image would be formed on the photographic plate.—Jas. Deas. Undoubtedly a solar spot, unless you saw it move, in which case it was probably a distant bird.—D. M. J. Many thanks for your very kind expressions about Knowledge. You are quite right; when we asked the opinion of our readers about the weather chart, we received so many letters from those who otherwise would not have written to us, and these letters were so kindly written, that we learned how very small a part of our readers the grumblers are.—A Subscriber. Prof. Young's book on the sun is now published by Messrs. Kegan Paul & Co.—N. W. S. You will find that the solution involves what I said. The illumination varies as the square of the distance inversely, and also as the sine of the angle LBA directly; but the sine of this angle varies inversely as the distance LB. This introduces the inverse distance yet a third time, altering the inverse square to the inverse cube.—Sciolist. I stop at your first statement. The comet of 1843 may, you say, have obeyed another sun, and what happened may have been due to some change in that other sun (one of its foci, you say). Are you aware that before that comet could have felt the influence of any other sun appreciably (even though that other sun were the nearest of all the stars) some five millions of years would have to elapse? Edina. A simple way of ascertaining whether a room is damp or not is to bring into the room a polished glass or mirror at a temperature cooler than that of the room, at a time when the room has for an hour or so been free from living occupants (whose breath might otherwise moisten the air). If the room is damp, a slight mist will form on the glass.—C. G. W. Thanks for your letter about the comet. You will see that we show our readers where to look for it.

ELECTRICAL.

Dentist. I do not remember having read or heard that electricity has the power you mention, but I certainly should recommend you not to try it in the way you suggest. The shocks from a coil are exactly the reverse to anæsthetic in their influence, even when applied to the least sensitive parts of the body. When applied to any of the organs of the head, they develope more or less intense pain, and, by virtue of their intermittent nature, there is a constant tendency to motion. You propose that the patient's hands shall rest on the arms of a chair in connection with one of the coil-wires, the other wire being connected to the forceps. The forceps being insulated (this you may do by encasing the handles in vulcanite, or by wearing a thick india-rubber glove), you would apply them to the gum in the vicinity of the tooth to be extracted. Has it never occurred to you that every time a shock is imparted to a dead body (as, for instance, to Galvani's frog) that body is subjected to a convulsive movement? Would not the effect be even greater in the case of a living body, especially one unaccustomed to such influences? The battery of which you enclosed a sketch is what is generally known as the "Bottle Bichromate" (on account of its shape), and is expensive because there is usually a deal of work about it. For a simple or less expensive form see next answer.—J. H. Ward. Pleased to hear you succeeded with coil. You could scarcely get a bichromate cell by following the instructions given in Knowledge for June 23, seeing that those instructions were for making a Leclanché cell. The number of cells required to heat two inches of platinum wire would depend on the diameter of the wire. To make a simple bichromate cell with two zinc and three carbon plates, the plates may be separated by means of strips of paraffined wood, ¼ to ⅜ of an inch in section. The strips may be so arranged as to allow you to fix a clamp across the two zincs. The carbon plate in the centre should not be in contact with this clamp, but a conical-shaped hole should be scooped out, into which a copper wire should be fixed by pouring in a little molten lead. The external carbon plates may be treated in the same way, and the three wires clamped together, or a clamp screwed on to them, and a wire from the central plate attached to it. A stout india-rubber band will hold the set together, little pieces of paraffined wood or ebonite being placed between the plates at their lower extremity.—W. G. Pinfield. The source of electricity in the dynamo machine is to be found in the steam-engine which drives it. Friction has nothing to do with the generation of the current, a question which is entered into in previous articles in Knowledge on induced electricity. There should be no wear, unless it be that due to friction at the bearings.

Our Whist Column.

By "Five of Clubs."

WHIST ODDS.

A correspondent, "A. B.," sends the following reasoning (given in a letter to the *Asian*) for analysis. The writer is showing how the odds on the rubber, after one game has been played, are calculated:—"Supposing *A* to have won the first game, there are four different ways in which two games can be played, and only four:—

	2nd game.	3rd game.	
(1)	*A* wins	*B* wins	*A* wins the rubber.
(2)	*A* wins	*A* wins	*A* wins the rubber.
(3)	*B* wins	*A* wins	*A* wins the rubber.
(4)	*B* wins	*B* wins	*B* wins the rubber.

From this we see that in three of the cases *A* wins the rubber, and only one in which *B* wins. Hence the odds on *A* should be 3 to 1." Of course, in cases 1 and 2 the third game is not played, but is only given to show the different ways in which two games can be played.

On this, A. B. remarks, "It seems to me that the first two cases are really one and the same, as the third game is not played; and that, therefore, only three ways are to be considered, viz.:—

Supposing *A B* to have won the game—

2nd game.	3rd game.	Rubber.
A B win	—	*A B* win.
Y Z win	*A B* win	*A B* win.
Y Z win	*Y Z* win	*Y Z* win.

which would make it 2 to 1 on *A B*; but I suppose I am wrong in my deduction.

The reasoning of the *Asian* correspondent is correct. We must consider both ways in which the two games *might* be played for *A B* to win, although in one case there is no occasion to play the second. The correctness of the result may, perhaps, be best shown thus:—

Suppose there were $4n$ trials to determine experimentally the true odds, n being some very large number. Then we knew that in about half, or $2n$, of these trials *A B* would win the first game. In all these $2n$ cases (about) *A B* would win the rubber. In the other half, or about $2n$ cases, *Y Z* would win the first game, and a third game would have to be played. Of the $2n$ (about) third games thus played, *A B* would win about half, or n games, and in each of these cases they would win the rubber. Thus in all they would win the rubber in about $2n+n$ or $3n$ cases out of the $4n$, while *Y Z* would win in about n cases. Thus the odds in their favour are $3n$ to n, or 3 to 1.

Note, that all the law of probability assures us of is that *A B* will win (the players being assumed of equal skill) in about $3n$ cases out of $4n$, or in $3n \pm r$ cases, *Y Z* winning in $n \mp r$ cases, where, if n is very large, r will be very small compared with n. Thus the proportion of wins to losses will be $3n \pm r$ to $n \mp r$, or $3 \pm \frac{r}{n}$ to $1 \mp \frac{r}{n}$, where $\frac{r}{n}$ may be made as small as we please by sufficiently increasing n.

Editor.

Erratum.—Page 367, col. 1, line 6 from foot, for "Ace, King, Knave, nine," read "King, Knave, nine, five."

ANSWERS TO CORRESPONDENTS.

Walter.—The law is explicit. It says, "on his own or any other pack." Therefore, if the trump card is placed face downwards, quite apart from the dealer's cards or any of the others, it is not a misdeal.—A. Wellesley. Your suggestion seems to us excellent. Will see what printers say to it, and follow it if possible.—Vacnol. It would scarcely have been right, though it would have turned out well for Mr. U. (who was *Y*, by the way,—and we think *YY* to play as he did), to have played the King second-hand to trick seven of last week's game. The presumption was that our Editor did not hold the Ace and four others, the usual lead in that case being the Ace. If he did not, *Y Z*'s game was sure; for from the play *Y* knew that *Z* held the winning Heart and the winning Spade, so that the trick wanting

Our Chess Column.

By Mephisto.

would ... Queen ... check and win Black's Queen, but in spite of this Black would win.

If	5. K to B4	5. R to QB6(ch)!

(Of course, if ... R Black wins by P Queens with a check.)

6. K to Kt5	6. R to Bsq
7. R to B8	7. K to Q3!

This move wins whether White replies with (*a*) 8. R takes R, or, (*b*) P to K8 (Queen).

(*a*) If	8. R takes R	8. K takes KP
	9. R to QBsq (best)	9. P to B6
	10. R to Ksq	10. K to Q3
	11. K to B4	11. P to B7 and wins.
(*b*) If	8. P to K8(Queen)	8. R takes Q
	9. R takes R	9. P to B6
	10. K to B4	10. P to B7 and wins.—Ed.]

Referring to the game on p. 70, and further remarks on p. 302, I am not quite sure that 20. B to QR3 would result in a draw, as my analysis, if sound, will show. Experto Crede.

	20. B to R3
21. Kt to B7(ch)	21. K to Qsq
22. Kt takes B	

[Experto Crede now proceeds to show in an interesting manner that to any of Black's replies, such as 22. Kt takes Kt, or K to K sq, or Q to B6, or Kt to K2, or B to B7, B5, or Kt 6, White has a winning rejoinder. But all these numerous replies do not include the right one, which is

		22. Q takes P
If	23. B to B7(ch)	23. K to K sq
	24. Kt to Q6(ch)	24. K to B sq

Now the Queen on B7, by defending the Black KBP, prevents the mate, and White must therefore be content with allowing Black to draw after Q takes R by Q takes BP(ch), as indicated on p. 302.—Ed.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

John Simpson.—We have no hesitation in pronouncing your Problem to be a very fine composition, in which opinion we hope our readers will join.

Square.—1. The fact of King having first move is not a detraction from the merits of a Problem. The action of the King being very limited, it is less likely that the idea will be discovered than if the first move has to be made by the Queen, as this lady is always first suspected with having evil designs on the hostile King, on account of her command of the board.

J. B. B.—Thanks for Problem, which, however, is too simple.

W. M—d, F. J. C., and Ferrow.—Problems incorrect.

J. A. Miles.—Problems thankfully received. We mistook Eichhardt for "Eichstadt." Could you send us his four-mover, praised by Staunton, wherein a mate is obtained with Knight, after sacrifice of Queen? We should be much obliged for your kindness.

I. O. U.—There is an Elementary book of Problems by J. P. Taylor which contains fifty two-movers. You can get it at Morgan's.

P. P.—It is found by experience that the study of Problems does not much improve chess play, but it affords great pleasure. To play over games comprehensively annotated is more likely to improve play. You should try a little of both.

Correct solution received Problem No. 58:—T. T. Dorrington, W. P. ... (yes), G. W., F. W. Cooper, H. Jacobs, W. C. ...

... will be paid for copies of Nos. 31 and 32 of Knowledge. Apply or address, Wyman & Sons, 74 to 76, Great Queen Street, London, W.C.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, NOVEMBER 10, 1882.

CONTENTS OF No. 53.

Science and Art Gossip.

EARLY on the morning of Oct. 27 some burglars entered the premises of Mr. John Browning, 63, Strand, by climbing a water-pipe 35 ft. high, taking a large square of plate glass out of a skylight, and lowering themselves 20 ft. by means of a rope. They then carried off binoculars, opera-glasses, gold spectacles and folders to the value of about £500. As nearly the whole of the articles bore Mr. Browning's name and address, and he has offered £50 reward, we hope he may recover his property.

ON Nov. 13-14 the earth crosses the orbit of the famous November meteor system known as the Leonides, but it is not likely that any shooting stars of the system will be seen, the gemmed part of the meteor ring being somewhere near the orbit of distant Uranus.

DR. HIND has calculated the elements of the comet observed by Dr. Schmidt, of Athens, on Oct. 9, 10, and 11, and finds an orbit presenting a remarkable general resemblance to that of the great comet. But the likeness is of such a nature as to suggest rather a past connection between the two bodies, than that they are now travelling in the same path.

MAJOR HERSCHEL states that on Monday morning, Oct. 30, he looked in vain for the great comet, though he watched for it for a full hour. "At last," he says, "when all the small stars of Hydra gradually settled themselves in my recollection in their right places, and I knew *exactly* where the whole length of the comet *must* be, I fancied at times that I could make out a faint illumination in the proper place; but not even then with the binocular could I find the head: nor could I, without previous knowledge, have been able to testify to the presence of the tail." This was only by reason of moonlight and a vaporous sky; for, on the morning of the 31st, the comet was well seen, and on Sunday morning, Nov. 5, the nucleus was conspicuous, and the long tail well seen without the aid of any glass.

DR. HIND announces the place given by M. Cruls for the comet he saw at Rio Janeiro on Sept. 12, differed by 5° 43′ in right ascension, and 1° 25′ in declination from that occupied by the great comet at the time. Observe our query mark in the diagram at p. 327.

THE letter of Darwin's which recently appeared in the *Academy*, and has now been quoted and requoted in many professedly religious papers, was, it appears, a retranslation from the German. The words of the original English letter are thus given by Professor Hæckel:—

To Nicholas Baron Mengden.
June 5, 1879.
Down, Beckenham, Kent.

Dear Sir,—I am much engaged, an old man, and out of health, and I cannot spare time to answer your question fully—provided it can be answered. Science has nothing to do with Christ; except in so far as the habit of scientific research makes a man cautious in admitting evidence. For myself, I do not believe that there ever has been any Revelation. As for a future life, every man must judge for himself between conflicting vague probabilities.

Wishing you happiness,
I remain, dear sir, yours faithfully,
CHARLES DARWIN.

One scarcely knows which most to wonder at, the impertinent curiosity which elicited the letter or the bad taste which led to its publication. If we were not assured that every reader of KNOWLEDGE has already seen the letter as first less correctly given, we should not now publish the correct form; for, a man's views on such matters are no concern of others, unless he himself chooses to publish them.

WE are assured that the Temperate House Gate of the Kew Botanic Gardens was to be restored, "with the full concurrence of Sir Joseph Hooker." Otherwise, we might almost infer from the look of the place, that the Lord of the Manor was suffering under a fit of baronial sulks. The bricking-up has been stopped, but as yet that is all.

YET he should be cheerful. We were doubtful about the morning sport within his demesnes. But we learn that the sport is good. With gardeners to beat the bushes, many rabbits are shot. Query, are the men thus employed entered in the books as gardeners or as gamekeepers?

THE Holborn Restaurant, which will be one of the finest in the kingdom when the alterations now in course have been completed, is to be lit throughout by the Edison Electric Light Company. About 1,000 lamps in all will be used, partly of eight and partly of sixteen candles.

To produce "crackle" surface glass, a French inventor, M. Bay, covers the surface of a sheet of glass with a paste made of some coarse-grained flux, or easily fused glass, and placed on a table in a muffle, and subjected to a high temperature. When the coating is fused the sheet is withdrawn and rapidly cooled, and the superficial coating separates itself and leaves the irregular surface. By protecting some parts of the glass from contact with the flux, designs and lettering may be left in smooth glass.

WE have received, says the *Southampton Times*, a copy of Messrs. Adams & Stilliard's photographic group of the members of the British Association who sat singly at their studio during the brief and busy visit of the British Association at Southampton. The general aspect of the fifty members comprising the group is one of dignified ease—characteristic of the men individually. They do not appear to be having their portraits taken, but rather to be thinking out some problem at their usual work, quite regardless of criticism. Some of the heads give us the impression of power, repose, and precision, especially those of the President (Dr. Siemens), Mr. Hawkesley, Captain Abney, Mr. Proctor, Sir William Thomson, and Sir Henry Bessemer. There is the genial illustration of thought in Lord Mount Temple, Dr. Crosskey, Mr. Tate, C.E., the Rev. Adair Pickard, and others. Nervous, eager thought and activity are depicted in Professor Cayley (President-elect), and the Rev. Canon Wilberforce; and [illegible], in Colonel Sir Charles Pearson and Captain Bedford Pim, R.N. But we are getting near home, and must be cautious. The reader has ample study left in the fifty heads. Others are not less exact and powerful in various directions, as his Excellency Don Arturo de Marcoartu, Mr. Hyde Clark, Professors Leone Levi, Acland, Tilden, Gamgee, Lawson Tait, Lodge, and Pearce. The key is a tracing from the larger group in outline, with the names, &c., inserted, to avoid all labelling or reference to numbers on the photo.

SWAN INCANDESCENT LAMPS are being adopted very extensively on the large oceanic passenger steamers, the latest being the [illegible] of the Guion Line. There will be about [illegible] lamps in the ship, every part of the passengers' and others' quarters being lighted by them, to the exclusion of oil and candles. Special attention is being paid to the illumination of the engine-room. Lamp sockets are fitted near various parts of the engines that require occasional attention, and the men are provided with loose lamps in very strong [illegible], and of such a size that they can be carried in a jacket pocket, and fitted into the sockets when required. Lamps with flexible heads are also supplied, and can be coupled to the same sockets.

THE specific volume of the different constituents of green woods has been estimated by M. Hartig to be as follows, per 1,000 parts:—Hard green wood, fibre stuff, 441; water, [illegible]; air, [illegible]. Soft green wood, fibre stuff, 279; water, [illegible]; air, [illegible]. Evergreen wood, fibre stuff, 270; water, [illegible]; air, [illegible]. A certain amount of water—7 or 8 per cent. really is included with the fibre stuff, showing that about one third only of the mass of the wood is solid stuff; the remainder is either water or air space. This is quoted in one of the articles on painting in the *Railroad Gazette*, to show how necessary it is that wood should be in a normal state of dryness before painting.

MR. CHAMBERLAIN said last Tuesday week, in replying to deputations from Birmingham and Sheffield, whose object was to point out the difficulty in which they were placed, while desirous to prevent any company obtaining a monopoly, said that if the local authorities could not undertake the work themselves, they ought, in their own interests, endeavour to make some arrangements with an electric lighting company. It was impossible for the Board of Trade to postpone the issue of Provisional Orders. The Electric Lighting Act did not contemplate monopoly on the part of any one; and in the event of a public company obtaining a Provisional Order, and not satisfactorily carrying out the lighting arrangements of a locality, the Board of Trade would be prepared to consider any application from the local authority, or other body, for a second Provisional Order.

DECEMBER [illegible] has been appointed by the Board of Trade for applications to be made for Provisional Orders under the Electric Lighting Act, but licences may be applied for and granted after that date.

THE Idaho *Statesman* says:—"The activity of volcanic action in the Snake River lava beds, near the line of the Oregon Short Line Railroad, is driving many of the graders from the work. In an area of about twenty-two square miles, at short distances apart, smoke and flames of peculiar odour, colour, and shape issue from the chasms and seams in the lava. The irritating sulphurous vapours in themselves cause many to quit work, while the unusual agitation of the boiling springs and the general commotion all over the fields of lava has caused a superstitious fear to take hold of many of the railroad hands, and they are leaving the section terror-stricken. The whole area has the appearance from a distance of being on fire."

"To talk of the athlete who sat for Phidias's Theseus," says the *Quarterly Review*, "is radically to mistake the character of that master. The figures of the Ægina pediment were not copied from figures of athletes, but all from one ideal, representing in the mind of the sculptor the warrior in the abstract; while Phidias has a variety of ideals" [this is well said] "instead of one, varying them according to the character of the being he has to represent. But his procedure is not radically different; he works not by sight, but by measurement and his idea of a perfect form. . . . . We must remember that the Greeks wore extremely little clothes at any time, and that when they went to exercise in the gymnasia, they threw off even these, and remained quite naked. A sculptor, therefore, had only to pass a few hours in a gymnasium, to see hundreds of vigorous and active forms posed in all kinds of attitudes and engaged in every form of exercise. The nude male form would become as familiar to him as the clothed human form is to us; he would judge the beauty of individuals with rapid decision, and form from the comparison of many a sort of canon or standard of beauty."

THE formation is announced of the "French Electrical Power Storage Company," with a capital of £1,075,000. This is for the manufacture and so on of the Faure accumulator, of which a great deal has been said in this country, but of which exceedingly little has been seen. Mr. Simon Phillipart, well known in connection with the Faure battery in this country, is the first-mentioned subscriber in this big capital French company, a capital which most people would say it is utterly impossible to employ in Faure battery making.

THE Postmaster-General has just contracted with Messrs. D. J. Dunlop & Co., Port Glasgow, to build for the service of the Post-office an iron screw steamer, specially constructed for the laying and repairing of telegraph cables. This vessel has long been much wanted, and will be built from designs by Mr. Joseph H. Ritchie, Fenchurch-street, London. The principal particulars of the vessel are:—Length, 210 ft.; breadth, 33 ft.; depth, 20 ft.; to be propelled by a pair of engines, having cylinders 30 in. and 58 in. diameter, with a length of stroke of 48 in. To meet the requirements of the special work to be performed, the steamer will be fitted with three circular telegraph cable tanks and a double bottom for water ballast, with fittings adjusted to trim the ship as the cable is paid out.

ERRATUM.—Page 375, col. 2, line 40, for "Sey" read "Ley."

THE MIDLAND ACCIDENT.

By R. A. Proctor.

THE terrible accident on the Midland Railway has led several of our daily and weekly papers to speak of the dangers of the American railway carriages. Those who have so written can simply know nothing of the American system. Every car in America is well warmed either by hot-air pipes or by a stove, and this arrangement has been in vogue for more than a quarter of a century; yet such an accident as happened on the Midland has never been heard of in America, and could not possibly happen there. For three sufficient reasons. First, each car by day and by night is properly watched, being practically under survey of all the train servants not actually employed on the engine, but specially watched, if a "Sleeper," by its own conductor and porter; secondly, no one would be allowed either to smoke in his berth or to carry a reading-lamp—an American conductor who should be offered a dollar to allow this to be done would behave very much as an English officer who was offered a half-crown to tell his general's plans to an enemy; thirdly, there is not throughout the length and breadth of America a train which presents the absurdity of combined gangway or aisle cars like the Pullman and thwart boxes like our English carriages; the gangway down the middle of a Pullman is, in America, simply a part of a chain of gangways running the entire length of the train.

What was American in the car was the saving of life. No one who has ever travelled in America will believe that the fire was caused by the warming apparatus. It undoubtedly had its origin in one of two personal acts, which ought both, as Sala well remarks in the *Illustrated London News*, to be made criminal offences, punishable by fine and imprisonment. If an ordinary carriage had been set on fire in that way, there would have been no chance of escape for anyone in the compartment where the fire originated. But, in the Pullman, despite the additional risk introduced by the absence of all power of communicating with the driver, every one was saved except the unfortunate man in whose berth, it is too probable, the fire began (who was possibly asphyxiated before the fire fairly broke out).

I say that there was no power of communicating with the driver, because the ingenious arrangement actually adopted is equivalent to cutting off all communication, in the most probable cases rendering communication desirable. In British and continental trains an arrangement is adopted which *might* possibly tempt an unfortunate passenger murderously assaulted by another to lose all chance of effectual defence while trying to communicate with the driver. One pictures the poor wretch leaning out of window to feel for the rope while his assailant did for him effectively, or on the continent trying to break the glass which covers the communicator, instead of trying to break the force of his assailant's attack. But under no circumstances can one conceive any benefit arising from the attempt to use the ridiculously futile excuse for a means of communication with the driver.

Every one who has travelled much both in Europe and in America, will agree with Mr. Sala's remark that "our present locked-in, boxed-up, stuffy, and narrow compartments, are absurd, dangerous, and scandalous to us as a nation." Because when railway travelling was first introduced, stage coaches were in fashion, the idea which a "slow" railway projector naturally formed was to make a train consist of a number of rather large stage coaches; and this arrangement, which was feeble-minded enough then, has remained in vogue for more than half a century.

Let me briefly enumerate a few of the advantages of the American system, and then I will touch on their more or less imaginary disadvantages:—

First, you can get on board an American train, or leave it, when the train is moving pretty fast, in perfect safety. I have run after a train and got in the rear car (with a helping hand from a brakesman) when it had attained a rate of certainly twelve miles an hour. I have never left one travelling at that rate, but by the rear car it could be done safely enough—at no worse expense than a sprawl.

Secondly, when on board you can choose any car or any part of any car to sit in; you can go to the smoking-car if you want to; or, if you like, you can visit the baggage-van to see that your luggage is safe—all when the train is at full speed. I have walked the whole length of a train with both hands occupied by satchels, &c., stopping only when opening and shutting the car doors.

Thirdly, if pressed for time, you can, in nearly all parts of America, go on board without a ticket, and obtain one at the first visit of the conductor.

Fourthly, tickets are attended to while the train is travelling. There is no absurd stoppage at the last station but one, and proclamation of "all tickets ready;" but, without delay of any sort, all tickets are collected *en route*.

Fifthly, the travellers by the train form a single community, with a force of conductors, brakesmen, porters, and luggage men, so that if a disorderly or drunken person gets on board, he must behave himself, at the risk of being turned off the train (in bad cases while the train is moving pretty fast, so that his exit is hasty and undignified, yet not unpleasing to those he had thought to annoy).

Sixthly, you generally travel in much more real privacy and comfort than in an English first-class carriage, not secured by a lawless fee to the guard. I used to find quite a rest in a railway journey between my lectures in America, with a little two-seat compartment to myself, all the passengers sitting in similar compartments facing one way; I could read or reflect undisturbed. Who can say quite as much of an English first-class carriage, if there are two or three passengers on the opposite seats? It is true that part of this arises from the "stony British stare," which foreigners and Americans find so strange and so unpleasant. But "fix it how you will," you can never feel quite so much at ease facing several persons, as when all face the same way. On one very special occasion, in America, when I had to travel in an ordinary car for several hours under circumstances which would have made staring excusable enough (not to make a mystery where there need be none, I was one of a wedding party of two), I was struck by the careful courtesy with which a two-seat compartment seemed to be regarded as if it were a private sitting-room. I never more thoroughly recognised the innate courtesy of all Americans towards ladies than I did on that occasion. Of course, when travelling in an American car, a man may be addressed by a fellow-passenger more freely than in England. But it is easy to answer pleasantly; and if the conversation wearies, either to close it or seek another place.

Seventhly, all the carriages are well warmed, and warmed quite safely. I speak without any prejudice in favour of car-stoves; for in a railway accident in Missouri I made a much more intimate acquaintance with one than I cared for, and shall carry the marks of the encounter to the grave. But one cannot expect stoves to behave well when the car they are intended to warm is pitched over an embankment thirty feet high. Under all the usual conditions of travel, they are perfectly safe travelling companions, and many a time and oft I have missed them when shivering in an English first-class carriage despite wraps and the abomination known as a foot-warmer.

Eighthly, in all cars there is a retiring room: in nearly all there is a supply of drinking water; and in many there are conveniences for washing, brushing, and so forth.

If American trains only consumed their own smoke, they would be perfection: as it is, there is a very serious drawback to American railway travelling in hot weather. To reach your journey's end with collar, cuffs, and shirt-front, which had been clean a few hours earlier, reduced to smoke-stained, cinder-dust strewn clouts, is not a pleasant experience. The fault is one which might be easily corrected.

HOW TO GET STRONG.

(Continued from page 322).

THE DORSAL MUSCLES.

IN our last we mentioned the undue prominence given in this country to exercises which develope the dorsal muscles at the expense of the general development of the chest, and discussed the mistaken but very prevalent idea that rowing, as an exercise, is specially good for the chest.

Fig. 1. From a Photograph of a well-known Rowing Man.

We promised then to give some pictures showing, first the effect of much rowing exercise on the configuration of the chest, and secondly the proper shape of the chest when duly developed by the three classes of exercise which are good for it,—1st, exercises expanding it by acting on the breathing apparatus itself (the most healthful exercise of all); 2ndly, those which strengthen and develope the pectoral muscles; and 3rdly, those strengthening and developing the dorsal muscles. Exercises of the two latter orders do not necessarily develope the chest at all, except indirectly by their action on the breathing: they simply enlarge the muscles which cover the chest in front and at the back.

We were not able to fulfil our promise so soon as we had intended, because the Comet and the Transit of Venus, and some other matters which could not be put off, interfered. We do so now, however, at the first opportunity afforded.

Fig. 1 is from a photograph (the face altered, however,) of an eminent American oarsman. The weakness of the chest muscles and upper arms of this powerful sculler will be noticed at once; but this is a much less serious defect than hollow, overhung chest, and epecially the depressions

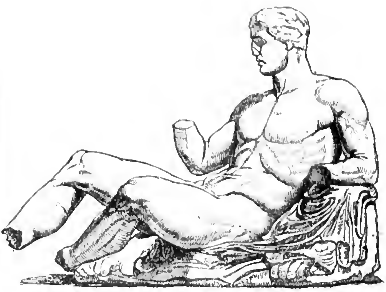


Fig. 2. The Theseus (supposed) of the Parthenon.

over the collar-bones. This configuration of the chest we should be disposed to regard as peculiar—not, indeed, to rowing men as a class, but—to those rowing men who do not correct the unequal effects of their favourite exercise

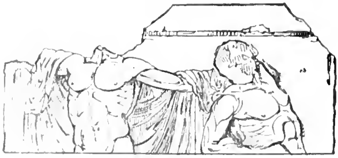


Fig. 3. From a Metope (Parthenon).

by the use of such chest-developing exercises as we have described in former numbers.

In comparison with Fig. 1 we give three well-known Greek figures, viz., Fig. 2, the Theseus of the Parthenon

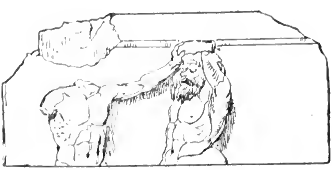


Fig. 4. From a Metope (Parthenon).

(as much of it as the unspeakable Turk left after his musketry practice at these noble sculptures), and Figs. 3 and 4, showing four chests in the upper halves of two Metopes from the same Temple. We would especially call attention to the wonderful diversity of chest development in these four chests. The left-hand figures in each are Lapithæ, and the contrast between their well-developed but elegant frames and the coarser types of the Centaurs is worth careful examination, both as an artistic and as an anatomical study. But the two Lapithæ are also distinguished from each other, as are the two Centaurs. Of the two former, the one in Fig. 3 is the more powerful, but the other in Fig. 4 is more perfect. We know nothing in ancient or modern sculpture surpassing in beauty this perfectly-developed trunk.

THE TRICYCLE AS AN AID TO PHOTOGRAPHY.

By John Browning,

Treasurer of the London Tricycle Club.

It is too little known what important assistance is to be obtained by using the tricycle when taking views by photography.

The use of the rapid dry gelatine plates has wonderfully simplified the apparatus required, and greatly reduced its weight, but an efficient set of apparatus, with say only three dark backs, containing six dry plates, with lens, camera, tripod-stand, and case, weighs from 10 lb. to 50 lb., according to the size of plates used. The lowest weight given will be about the weight of the apparatus required for taking views $4\frac{1}{4}$ by $3\frac{1}{4}$ in., known as quarter-plate size. The highest weight is that of apparatus for taking views $8\frac{1}{2}$ in. by $6\frac{1}{2}$ in., known as whole plate size. But the sizes most generally used when touring are 5 in. by 4 in., or $6\frac{1}{2}$ in. by $4\frac{3}{4}$ in. The camera and apparatus for taking the first of these sizes would weigh about 15 lb., and that required for the second, known as half-plate size, weighs, in case complete, about 20 lb.

Now, few persons are satisfied to take pictures less than the last-named size, and 20 lb. is a considerable weight to carry for even four or five miles. But it is a weight that would be taken but little account of on a tricycle.

Mr. Herbert Salmon, the energetic captain of the London Tricycle Club, has recently had a set of dry-plate apparatus, weighing 20 lb., arranged on a Coventry Rotary Tricycle. He has so contrived that the apparatus shall hang as much below the tricycle as possible, so as to lower the centre of gravity of the whole machine, and he has placed it close to the single driving-wheel, which increases its grip on the ground. Attached in this ingenious manner to the machine, it adds to its steadiness, and prevents the slipping of the driving-wheel. The benefit thus received goes far to neutralise the small disadvantage of the extra weight, for on a tricycle travelling at a pace not exceeding seven miles an hour, 20 lb. is a weight that may be neglected.

The form of the Coventry Rotary Tricycle seems best suited to carry photographic apparatus, when arranged as I have described by Mr. Salmon, because the tripod for supporting the camera can be strapped on to the long bar which carries the two steering-wheels, but by the exercise of a little ingenuity, nearly any tricycle can be made to carry the apparatus almost equally well. For instance, with any front-wheel steerer the case containing the camera, lens, and dark slides may be strapped just behind the rider, underneath the seat, while the tripod stand, which in all properly-contrived portable apparatus is now made so that it either folds or slides into half the length, can be strapped on to the main axle.

As an instance of what varied work can be done with the camera, I may mention that Mr. Salmon sent me, within a week or two after he had adapted his apparatus to the tricycle, a view of Merstham Church, some views of Lingfield, a portrait of a favourite pug dog, a group of members of the London Tricycle Club before starting for Eastbourne, and an instantaneous view of the sands from a cliff in the Isle of Wight.

In the last view every ripple in the water is sharply defined, and one tiny speck about the size of a small pin's head, when examined with a magnifying lens, is seen clearly to be a lady dipping a child in the sea.

Mr. Salmon had not had any previous experience in photography.

It is evident that many other uses may be made of a photographic apparatus besides those so briefly indicated. As well as views of any locality within twenty miles of the photographer, he could take interiors of churches, or other fine buildings, regattas, cricket matches, lawn-tennis parties, or portraits of friends or groups in their own houses or grounds. In all such cases the tricycle affords a ready means of conveying the photographic apparatus to the required spot.

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

By Amelia B. Edwards.

XIII. TEL ABOO-SOOLEYMAN.

No local landmark, no corrupt survival of its historic name, indicates the site of Pithom, or Pa-Tûm. There are, however, at the western extremity of Wady Túmilat two mounds which divide the honour of representing that city of sorrowful fame. The one is called Tel Aboo-Sooleyman; the other, Tel-el-Kebeer. Tel Aboo-Sooleyman—"the Hill of father Sooleyman," so-called after some native Sheykh—lies a little to the south of the western mouth of the valley, about ten miles from the mounds of Bubastis, as the crow flies. Tel-el-Kebeer—"the Big Mound"—now so famous as the scene of the victory of September 13, is situate some six miles along the valley as it trends from West to East. There is a small lake near Tel Aboo-Sooleyman, and there are several muddy ponds near Tel-el-Kebeer, all of which were anciently of larger extent, and which even now contain a considerable body of water when the canals are swelled by the annual inundation. Either the lake or the ponds might represent the "Pools of Pa-Túm," near which the Shasu, it will be remembered, sought and obtained permission to pasture their herds, in the VIIIth year of Menephthah (See No. 50 of Knowledge, p. 325). Before being allowed to pass the "fortress"—that fortress which the Hebrews were levied to build by forced labour—the strangers' names were entered on a "list," or register, just as the names of travellers are now entered in the official books at Prussian and Italian frontier-towns.

Tel Aboo-Sooleyman, for the reason that it is so much nearer to ancient Bubastis than is Tel-el-Kebeer, would best answer to the description given by Herodotus, who, writing of the canal, says (as before noted) that it was "derived from the Nile *a little above* Bubastis, near the city of Patumus" (Pa-Tûm). Now "above" means further south, all such phrases as "upper" and "lower," "above" and "below," having regard in Egypt to the course of the Nile; and a glance at our sketch map (see Knowledge No. 52, p. 357) will show how correctly, as regards latitude, the expression "a little above Bubastis" applies to the mound of Tel Aboo Sooleyman.

Nor must we forget the important evidence of that great topographical work which bears the name of the "Itinerary of Antoninus." In this Itinerary, all the home and foreign possessions of the Roman Empire towards the close of the First Century [illegible] are described. Every main road, cross-road, city, town, and military station is accurately set down, and the distances from each to each are given in Roman miles. Now, according to the Itinerary, we find the town of "Thoum" (Pa-Tûm) placed about half way between "Vicus Judæorum" and "Sile," on the road from the Roman fortress called "Babylon" (old Cairo) to the city of Pelusium, on the Eastern coast of the Delta; the distance between Babylon and Thoum being given as 54 Roman miles.

It would really be difficult for the writer of a modern guide-book more exactly to describe the situation of Tel Aboo Sooleyman. "Vicus Judæorum" is the Jewish city founded by Onias in the reign of Ptolemy Philometer, the mounds of which are now called "Tel-el-Yahoodeh" ("the mound of the Jews"); "Sile" is Salaheeyeh, now an important town, with a station which for the present terminates the railway line about 22 miles beyond Aboo Kebeer. Taking these two points, Tel-el-Yahoodeh and Salaheeyeh, on any good modern map of the Delta (say Map 1, in Baedeker's "Lower Egypt," which is a model of clearness and accuracy) and measuring by a straight line from the one to the other, the mound of Tel Aboo Sooleyman falls exactly half way, as if put there for the purpose. Again, the distance from Babylon to Thoum is stated in the Itinerary at 54 Roman miles. The Roman mile measured 1614 yards in length; the English statute mile measures 1760 yards. Fifty-four Roman miles would therefore equal forty-nine and a half English statute miles, *plus* 36 yards. The precise line of the old Roman road is no longer known; but the present caravan route from Cairo to Aboo Hammad, which takes an unusually direct course, is more likely to follow it than not. By this route, the distance between Cairo and Aboo Hammad, *viâ* Belbeis, is about 42½ miles, while from Aboo Hammad to Tel Aboo Sooleyman is 6½ miles more—49 miles in all; which brings us within one half mile of the distance laid down in the Itinerary of Antoninus.

I do not presume to affirm that these coincidences are conclusive, nor that so important a question can be decided by means of a pair of compasses and a map. Again, Tel Aboo Sooleyman and Tel-el-Kebeer are but a short distance apart, and it might be urged that the foregoing evidence is as much, or very nearly as much, in favour of the one site as of the other. Yet, if it be demonstrated that the treasure-city of Pithom can only lie under one or other of these mounds, an important step is gained. The positive philosophy of pick and spade may be left to do the rest; and before the end of the first day's work, a couple of score of stalwart fellaheen, told off, half to Tel Aboo Sooleyman, and half to Tel-el-Kebeer, would probably settle the question for ever.

Or shall we say, instead of a couple of score of stalwart fellaheen, the same number of stout British soldiers? A detachment will be permanently stationed for some time to come at Tel-el-Kebeer; and with abundant leisure on their hands, our men might find many worse ways of passing their idle hours than in looking for the treasure-cities of Pharaoh.

[illegible] of Nos. 1 to 8 of Knowledge [illegible] Wyman & Sons, 74 to 76, Great Queen Street, London, W.C.

"MUCH ADO ABOUT NOTHING."

IN these days of comic opera, of trashy sensational plays (devised to pander to a depraved taste), and of mawkish adaptations from the French, it is pleasant to find that overflowing audiences may still be attracted by good renderings of Shakespearean dramas. We find that though a play of Shakespeare's may mean bankruptcy to the manager, it may read triumphant success if the manager has just ideas of the great dramatist's work.

This is true, we take it, of all Mr. Irving's Shakesperean revivals, even those in which he has attempted more than he or his company could achieve. He may fall short of our conceptions of a Macbeth or a Hamlet, and still more completely of a Romeo; Miss Terry may not be Shakespeare's Juliet; other members of the Lyceum company may fail in rendering effectively the parts given them. But in every case the reading given, even when inadequate, has been the result of thought and labour. The aim has not been (as always where Shakespeare has failed to draw) to simply please the groundlings; we have had always the intelligent reading of a student and a lover of Shakespeare. Even Mr. Irving's shortcomings have had their part in his success. It may please his detractors to notice peculiarities of voice, or gait, or gesture, as if they were affectations. Those who have followed and watched his career regard these as they might regard some slight traces of the personal defects which seemed to debar Demosthenes from the career of an orator. That, despite certain seeming disqualifications, Irving should have become a powerful actor, makes him deservedly a far greater favourite than others who seemed born for the sock and buskin.

In Benedick, Mr. Irving has found a part which many who understand his genius have long since regarded as specially suited to his powers. It is a part in which actors whose fame rests chiefly on their efforts in tragedy, have achieved noteworthy success. It was this, perhaps, which led Charles Kean to attempt the *rôle*, in which, however, despite the able support of Mrs. Kean (his superior), he failed egregiously. But Kean was never successful outside a certain limited range of characters, chiefly tragic; Irving's power was first shown in comedy, and many hold that high comedy is still, and will always be, his strongest line. Benedick, quaint, witty, and humorous, now saturnine anon mercurial, but withal kindly and manful (witness his plain speech with the Prince in the first scene of Act II.), is a part admirably suited to Mr. Irving's humour.

The part of Beatrice is not quite so specially suited to Miss Terry's powers, but indeed her range is wider than Irving's, and Beatrice lies well within it. The secret of Miss Terry's success lies, we take it, in the power she has of putting herself in imagination in the position of the person she represents. Some actors and actresses—it is said the very greatest—possess a sort of intuition, teaching them how a person would look and act in given circumstances. We are told that Garrick, after a scene in which he had affected a whole audience to tears by his admirable personation of profound sorrow, would turn to a friend behind the scenes and laugh at the success he had achieved. It is not thus, we feel, with Ellen Terry. She seems to us never at her best till she has imagined herself into her part, so to speak, and simply looks and acts as her feelings dictate. It is thus, at any rate, she makes her earlier reading of a part; later, of course, she may find it easy to give equal force to her rendering without undergoing afresh at each representation the feelings which first suggested it.

It does not follow, we need hardly say, that because

Irving and Terry faithfully study a character, and earnestly give their reading of it, this reading is necessarily right. Actors will tell you that they should be, and are, the best judges of a dramatist's meaning; but repeatedly it has been seen that this is not the case. Great actors and actresses have often, ere now, taken commonplace views of noble characters, yet have commanded attention by their histrionic mastery of their self-imagined characters.

Whether Irving has formed the truest idea of Benedick's nature, or Ellen Terry of Beatrice's, may be open to question. Shakespeare's characters (like the men and women of real life) are many-sided; and much more time than any actor has yet given to their interpretation might well fail to reveal all that is in them. For our own part, we must admit that after some thirty years' acquaintance with Signor Benedick and fair Beatrice—an acquaintance renewed many times each year—we are as far from fathoming their real nature as we are from fully understanding the character of our acquaintances in actual life. Mr. Irving and Miss Terry may have been more successful. Yet frankly, we miss certain qualities in their presentation of Benedick and Beatrice which the real Benedick and Beatrice, as we seem to know them, possess.

Benedick is a brave and steadfast gentleman, apt to say more than he thinks against women, and especially against one woman (of whom he thinks more than he knows), but tender-hearted and gentle,* slow to think evil yet thinking less well of Claudio and the prince than he speaks (though better than they merit, for they are shallow and ungracious, cruel, vindictive, and morally cowards, both), keen to recognise villany, true in friendship, faithful and withal generous in love. Mr. Irving's Benedick is nearly all this, but not quite. We cannot quite forgive his raising a laugh among the groundlings, just after Hero's most cruel trial. There is not a word said by Shakespeare's Benedick on that occasion which is not meant solely to soothe and comfort the sorrowing and indignant soul of Beatrice.

And how of Beatrice herself? How of the lady whose heart has been wrung by the villanous wrong done to Hero? If Miss Terry had not so touchingly and powerfully depicted Beatrice in that most affecting scene, we might have forgiven her for so thoroughly misunderstanding Beatrice's admission of love a few moments after. For all would then have been of a piece—Beatrice misunderstood throughout the finest scene in the play and one of the finest scenes in all Shakespeare. But that she should so move our feelings by her just rendering of Beatrice's sorrow, and should then render a confession of love which was, in truth, an appeal for sympathy, this was passing strange. Can aught be clearer? "It were as possible for me to say I loved nothing so well as you; but believe me not; and yet I lie not; I confess nothing, nor I deny nothing: *I am sorry for my cousin.*" As Miss Terry says these words, she and Mr. Irving moved hither and thither almost as farcically as the Milkmaid and her Archibald in "Patience," and the pit and gallery laughed loudly. Yet there is scarce anything more pathetic in all Shakespeare. The brilliant Beatrice, who till now has been moved by love to scornful jests, is now so moved by sorrow that she no longer cares to hide her real feelings. "I confess nothing, nor I deny nothing; I am sorry for my cousin." If Shakespeare meant to raise a laugh here, then, say we, as Dogberry enjoins, he's not the man we took him for. That something of her old scoffing manner should remain, we can understand. That in one of her spirit sorrow should be close on bitter anger, we can forgive, and almost approve. She is just, even in her fiery indignation. She rightly judges the Prince and Claudio. "What! bear her in hand until they come to take hands; and then, with public accusation, uncovered slander, unmitigated rancour—Oh, God, that I were a man!" But "I cannot be a man with wishing, therefore will I die a woman with grieving." Yet this scene raised laughter more than once; and the fault was not wholly with those who laughed.

(*To be continued.*)

* Mr. Sala finds in Benedick's "I'll devise thee brave punishments for him" [Don John], evidence of cruelty. We always understood him to mean that he would show the rest how to punish Don John best by letting him see how happy they all were in spite of his villanies.

SATURN'S RINGS.

I GATHER from the editorial note appended to the very interesting letter by Mr. Ward, on page 376 of the last number of KNOWLEDGE, that Mr. Maunder is exercised in his mind with reference to an absolutely imaginary claim on my part to have restored to Cassini the credit of having first discovered the division between the two bright rings of Saturn. I rather fail, though, to see how he can insist upon the merit of such restoration (*quantum valeat*) being due to Mr. Lynn, if it be merely based upon that fact that "two years ago" that gentleman "pointed out that the sketch said to have accompanied Ball's paper in the 'Phil. Trans.' was omitted from several copies." Apropos of what, I would ask, was this fact pointed out? Was it in connection with the actual question of the discovery of two concentric rings round the planet—or what? In this method of treating the matter I am rather afraid that the man who is at least as much entitled as Mr. Lynn to the credit of having brought the question to a definite issue (I mean, of course, Mr. C. Leeson Prince), is in danger of being lost sight of altogether. It was he who first induced me to examine the evidence in favour of Ball's supposed discovery; and I know personally, as a matter of fact, that he has for years been greatly interested in the question of Saturn and its system generally. He possesses a valuable library of old astronomical works, with the contents of which he is thoroughly familiar; and it is very odd indeed to me (to put it as mildly as possible) if he received his first hint that Cassini was the real discoverer of the duplicity of the ring from Mr. Lynn, less than two months ago. Mr. Lynn and he talked the matter over, as did Mr. Prince and I a few hours afterwards, and, on careful reflection, we all arrived at the same conclusion—viz., that the Brothers Ball never saw a trace of the division which has so long been called by their name. Mr. Prince's modesty is equal to his acquirements; and he is about the last man in the world to make any reclamation on his own behalf. I therefore feel it all the more incumbent on me to point out that it is through his initiation of the discussion that a satisfactory conclusion has at length been arrived at. As far as I was concerned, I found it stated in my copy of Breen's "Planetary Worlds," that Huyghens was written to in 1665 by Wallis with reference to the (alleged) perception of a division in the ring by Ball; and, thinking that the recovery of the original letter could not fail to clear up definitely the question as to what Ball really had seen (or fancied he had seen), I wrote to KNOWLEDGE (p. 295) to ask if any one could inform me whether this letter was still extant, and if so, where it could be found. This is the legality of any connection with the matter. I know nothing about the astronomical magazine in which Mr. Lynn proposes to have presented his (or Mr. Prince's) con[illegible] to a select circle of readers; but Mr. Maunder can scarcely expect such magazine to enjoy an absolute monopoly of discussion of a question which has previously been privately debated as this question has been.

WILLIAM NOBLE.

Forest Lodge, Maresfield, Uckfield.

THE GRISCOM ELECTRO-MOTOR.

THIS little piece of apparatus illustrates a principle of the utmost importance to those whose business or pleasure it is to deal with matters electrical. It may be remembered that some few months since we explained the principles of dynamo-electric generators. It was shown that the armature or coil of wire revolving before the poles of the large electro or field-magnets, had a series of electric impulses induced in it. With a large machine, having an armature revolving at a high rate, the current induced as the result of the force expended in the steam-engine would be proportionately large, and capable of being applied to lighting, electrotyping, or any other of the many applications of electricity. But now we have to refer to a still further development of the principles of electric induction. If we pass the current produced in a dynamo machine, or its equivalent galvanic battery, into another similar machine, its armature will be found to revolve at a rate and with a force proportioned to the current traversing the coils. The explanation is simple—when the current enters the machine, a magnetic field which consists of a fixed ring of malleable cast iron, about $2\frac{1}{4}$ inches long and 2 inches in diameter. Two coils of comparatively thick wire are wound on the opposite sides of the

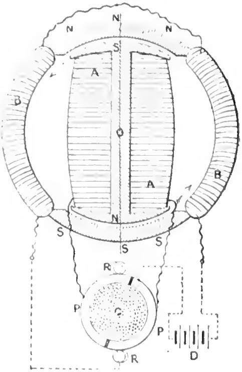


Fig. 2.

ring to within about an inch of each other, top and bottom. C represents the commutator, which, of course, runs on the same axis as the armature. It consists of a drum of insulating

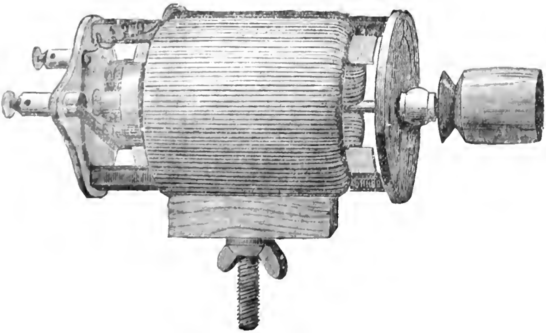


Fig. 1.

is created [illegible] the movable armature revolves before the poles of the field magnet. This, then, is what is known as the "reversibility" of the dynamo machine. The motor we are describing is only a small one with a resistance of about one Ohm, and is worked by a battery giving an electromotive power of about [illegible]. Fig. 1 is a perspective view, and Fig. 2 a vertical section view. A small Siemens armature (Fig. 2 A A) can be seen inside the field magnet (B B), material on to which a split-ring (PP) is attached. Instead of the ordinary slit springs to complete the circuit through the commutator, little rollers (RR) are used. One pole of the battery (D) is shown as being connected to the commutator, the other to the field magnet. The binding-screws used for this purpose are shown in Fig. 1 on the left-hand side, while at the opposite side is to be seen the little driving-wheel from which a band passes over the wheel of the sewing machine, lathe, &c. The little bolt and nut illustrate the method adopted for attaching the motor to the table or base of the machine to be worked. Fig. 3 illustrates the battery of six large single-fluid bichromate cells. Normally the zinc and carbon plates are kept out of the solution by means of a spring. When it is required to work, the machinist gently presses the treadle (drawn on the right of the figure), causing the plates to be immersed. By this arrangement there is a minimum consumption of the constituents of the cells, while the movements of the plates help to keep the solution in a state of agitation, and so prevent rapid polarisation. With the aid of Fig. 2 the reader may trace the course of the current from the positive pole of the battery through B B to the commutator, thence through the armature back to the commutator, and so on to the negative pole of the battery. The total weight of the motor is $2\frac{1}{2}$ lb., and the full speed of the armature 5,000 revolutions per minute, but it will be obvious on reflection that

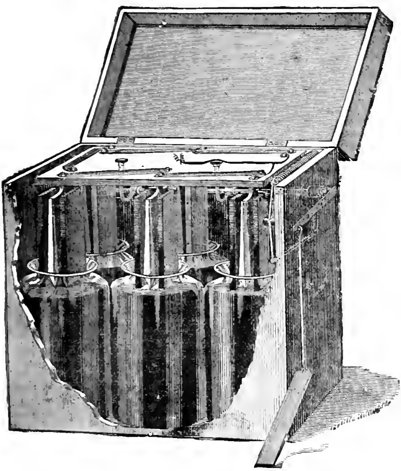


Fig. 3.

this speed may easily be moderated by varying the depth to which the plates are immersed. It is also worthy of notice that it is impossible for the sewing or other machines to be impelled in the wrong direction. With a greater current more work can naturally be accomplished, and we may mention that motive power equal to 1-h.p. is said to have been obtained. The current may be derived from a dynamo, when a number of the motors may be placed in the circuit. It promises, therefore, to be very useful in many small industries, more especially where the work to be done is small, and distributed over the various parts of a house or workshop, and under such circumstances, in fact, as would render the use of steam inadmissible.

This useful little motor, the invention of Mr. W. Griscom, of Philadelphia, is consequently almost universally admired for its size and simplicity, its cheapness and its efficiency, and we hope the efforts of the company in whose hands it is entrusted will be becomingly appreciated.

THE SUN'S FUEL.

WHILE thanking Mr. Proctor for his friendly notice of my "Science in Short Chapters" (KNOWLEDGE, p. 377), I must ask leave to correct his total misapprehension of my theory when he describes me as supposing that the sun, after having obtained his gravitation equivalent of the universal atmospheric matter, generates more heat by merely compressing on one side and rarefying on the other the same unaltered kind of matter. This would be quite on a level with the customary paradox of the perpetual motioners, and closely resembling what one would get by a pair of reciprocating pistons compressing the air of one cylinder by the elastic expansion of the other.

Mr. Proctor correctly represents my view of the effects of the original aggregation and condensation of atmospheric matter about the sun; but as regards my attempt to solve the great problem of the maintenance of solar energy, he has not even crossed the threshold of the argument, and has evidently "taken as read" my exposition of its essential points; for I cannot believe either that I am incapable of explaining, or he of understanding, what I intended to expound.

The threshold of the argument to which I allude, and at which Mr. Proctor halts, is that the heat evolved by this original aggregation and compression would dissociate the atmospheric compounds (notably water vapour), and thereby store a reservoir of heat; but beyond this, I have shown that the recombination and explosion of the whole of this is restrained by the limitation of radiation due to the "jacket" or envelope of the chromatosphere and outer atmosphere of the sun; this limitation determining the depth of the photosphere, or amount of surface combustion or recombination. Mr. Proctor has not penetrated even this, the vestibule of the argument.

A step further brings us to that "swaying of the sun around the centre of gravity of the solar system which Mr. Williams regards as an all-important point of his theory," and of which point Mr. Proctor altogether fails to grasp the significance. I maintain that this produces the irregular angular or rotatory velocities of the different portions of the solar photosphere which Carrington demonstrated (the equatorial portions making a complete revolution in 30·86 days, while those in latitude of about 50° revolve in 28·36 days), and that such irregularity, presumably shared by the outer vapour jacket, must produce vortices or cyclones on and about both borders of the equatorial solar zone; that these vortices must rip open that jacket thereabouts, and thus remove the restraint to combustion in such spots. The consequence of this (as demonstrated by the laboratory researches of Deville, Bunsen, and others) must be explosive outbursts in the trail of these vortices of a magnitude corresponding to themselves. This ripping open of the solar integuments, and consequent ejection of his dissociated entrails, is what we observe in the spots and prominences.

But what must follow the formation of this partial and local vacuum produced by such ejection? Evidently an inrush to restore the broken equilibrium of general gaseous pressure. I need scarcely work out the progressive steps of this restoration, first from the contiguous gaseous matter, then from the further distant, and finally from a *portion* of that cylinder of interstellar atmospheric matter which by the solar translation in space is (as I maintain), [illegible] itself upon the [illegible]: while an exact equivalent of the projected and exploding prominence matter will be left behind in the wake of the advancing luminary, if not projected too far for this.

Now we come to the source of renewed energy. It is simply a portion of the heat that has been radiated through past ages from all the suns of the universe, and which I maintain is not extinguished, but is diffused throughout the interstellar matter. This is concentrated by the solar inspiration, and balances that which has been lost by his previous radiations; for the ejected gaseous matter of the prominences will, when fully expanded to the rarity of interstellar atmospheric matter, be colder than it originally was, by exactly as much as it had radiated during its compression, and by the flaming of its recombination. Thus, to quote my own summary at the end of Chap. VI. of "The Fuel of the Sun," "the heat radiated into space is received by the general atmospheric medium: is gathered again by the breathing of wandering suns, who inspire as they advance the breath of universal heat, and light, and life; then by impact, compression, and radiation they concentrate and redistribute its vitalising power; and after its work is done, expose it in the broad wake of their retreat, leaving a track of cool exhausted ether—the ash-pits of the solar furnaces—to reabsorb the general radiations, and thus maintain the eternal round of life."

The primary agent which I describe as effecting this is the explosive projecting force of the prominences. Mr. Proctor entirely omits this as regards its function in the maintenance of solar energy.

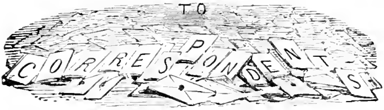
Knowing too well what an intolerable bore a man may become when ventilating his own theories, I refrain, at present, from discussing the other points raised by Mr. Proctor, but will do so hereafter, if his other self, the Editor of KNOWLEDGE, regards such discussion as likely to interest his readers. W. MATTIEU WILLIAMS.

[I consider that, apart from the interest which every discussion depending on important facts must needs have, common justice requires that Mr. Williams should be accorded space to explain and defend his theory. Referring to his present remarks, I note that he is mistaken in supposing I have "taken as read" any part of his theory. He may not mean it, but this is a truly painful accusation. I must try to show him how unjust it is. I might content myself by assuring him that I very carefully studied his "Fuel of the Sun," throughout, when it first appeared, and recently as carefully read the synopsis of the theory in his "Science in Short Chapters;" but this may, perhaps, not be sufficient. I would, therefore, invite his attention to the following passage in the former work repeated in the latter, "My hypothesis supplies a perpetual [illegible] of 165 millions of millions of tons of matter per second, without in any degree altering the density, the [illegible], or any other element of the solar [illegible]. If this does not correspond to the perpetual motion theory, when we remember that the [illegible] depend wholly on the velocity with which the sun travels through space, then either words [illegible] for many years past I have [illegible] the very axiom of mechanics. *Here is a perpetual* [illegible], due to the sun's rush through the interstellar atmosphere, so that his motion is perpetual though doing all this work. If I seem to halt at the threshold it is because this awful stumbling block lies there.

So again, with the effect Mr. Williams ascribes to the movement of the sun about the centre of gravity of the solar system. He thinks I fail to grasp the significance of this point. He says he "maintains that this produces the irregular angular or rotatory velocities of the different portions of the solar photosphere." But, as I read his book, he mistakes here: he does not *maintain* this—he simply *asserts* it. There is not even an attempt at proof. In his reasoning about it there are palpable flaws. For instance, he regards the disturbing effect of Jupiter as about 13 times that of the earth, that of Venus $2\frac{1}{2}$ times, that of Saturn a little above equal—the truth being that the tide-raising action (and the disturbance in the solar atmosphere must be akin to this) of Jupiter would be less than two-and-a half times the earth's, that of Venus a little more than twice, and that of Saturn about a ninth of the earth's. I do not know, by-the-way, how Mr. Williams was led to suppose that Carrington's researches assigned to the solar equatorial regions a slower rotation than to the regions in solar latitude 50°. He now repeats this mistake, which he originally made in the "Fuel of the Sun." A slower motion of the equatorial photosphere may perhaps agree as well with his theory as a more rapid motion. (Some theories are so fortunate!) Still it checks a mere stranger, at the threshold, or even in the vestibule, to find that an error taking off a fifth of the equatorial velocity of the sun, and thus *reversing* its relative motion, makes no difference in the theory, and is not now, after near thirteen years, thought worth correcting. I would venture, however, to slightly change the metaphor, comparing myself rather to a surveyor who desires concisely to describe the qualities of a building, and who might well be content, though he had surveyed the whole of it, to note only the unsoundness of the foundation.

I should be very sorry for Mr. Williams to suppose I ventured to criticise his book without having examined it carefully. I hope the above remarks will show that I have noted other points than those touched on in my review. I can give further evidence in the same direction if that will afford him any satisfaction; but I must ask permission to select my points. One cannot criticise every line of a book. One can only take samples here and there, unless the review is to surpass in bulk the work reviewed.—R. A. P.]

THE MISSISSIPPI.—Some interesting and extraordinary *data* have just been compiled respecting the Mississippi. It appears that it boasts no fewer than 55 tributary streams, with a total length of navigation of 16,571 miles, or about two thirds of the distance round the world. Even this, however, represents but a small amount of the navigation which will follow when the Federal Government has made the contemplated improvements in the Upper Mississippi, in the Minnesota, Wisconsin, and other rivers, in which it is now engaged. But while the Mississippi has 16,571 miles navigable to steamboats, it has 20,221 miles navigable to barges. This navigation is divided between 22 states and territories, in the following proportions: Louisiana, 2,500 miles; Arkansas, 2,100; Mississippi, 1,380; Montana, 1,310; Dakota, 1,280; Illinois, 1,270; Tennessee, 1,260; Kentucky, 1,260; Indiana, 840; Iowa, 830; Indian Territory, 720; Minnesota, 660; Wisconsin, 560; Ohio, 550; Texas, 440; Nebraska, 400; West Virginia, 390; Pennsylvania, 380; Kansas, 240; Alabama, 200; and New York, 70. Nearly all sections of these states and territories can be reached with ease. Louisiana, Arkansas, Mississippi, Montana, Dakota, and the Indian Territory possess more miles of navigable stream than miles of railroad, all of which are open to everybody who wishes to engage in commerce.



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of KNOWLEDGE; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

⁂ *All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

THE FINLAY COMET.

[618]—Justice to a painstaking and alert astronomer—Mr. Henry C. Maine, A.M., of Rochester, N.Y., U.S.A.—leads me to ask you to give insertion, if you so please, in your valuable paper, to the following concerning his discovery, on Sept. 30, of the disruption of the Cruls comet [the Finlay comet] into three parts :—

Sept. 24. Seven days after predicted perihelion the nucleus was intact.

Sept. 25. Nucleus seen as bright disc; dark channel behind the nucleus.

Sept. 30. Disruption of nucleus into three parts discovered.

Oct. 1. Discovery announced in Rochester, N.Y., *Democrat* and *Chronicle*.

Oct. 5. E. E. Barnard, Nashville, Tenn., verified the separation of nucleus into three parts, and made micrometric measurements.

Oct. 5. Cincinnati observers made similar observations.

Oct. 7. Washington naval observers saw three distinct condensations of light in nucleus, but no separation.

Oct. 8. Professor Schmidt, Athens, announced discovery of small comet, 4° S.W. of Cruls', and moving in same direction. Professor Lewis Swift, Ph.D., F.R.A.S., Director of Warner Observatory, Rochester, said this was probably part of the great comet; and, if so, would confirm the disruption.

Oct. 8. Mr. Maine predicted that on Oct. 9 an elongation and separation would occur.

Oct. 9. The prediction of the 8th verified by Mr. Maine.

Will you be kind enough to give me your opinion of the disruptive theory? [*What* disruptive theory?—ED.] If you have already done so, please refer me to the issue wherein it can be found, and oblige,

SPEC.

CREMATION.

[619]—The *Standard* of Oct. 12 gave an account of what the writer calls "the first two cremations which have taken place in our country in modern times—viz., the cremation of the body of Mrs. Hanham, wife of Captain Hanham, and that of the remains of Lady Hanham, wife of the late Sir James Hanham, Bart., of Dean's-court, Dorset, both of which took place in Dorsetshire on the 8th inst." After describing the manner in which the process was carried out, the writer states that "the ashes of each body were collected with great care, and placed in a large china bowl, in which [he says] they will remain until urns of an approved form are ready, when they will be moved to a mausoleum." Now, will you allow me, through the medium of your valuable magazine, to suggest to the advocates of cremation a far neater and more appropriate mode of disposing of the ashes of a corpse cremated? These ashes, I think, consist wholly, or principally, of phosphate of lime, and therefore have only to be treated with sulphuric acid to convert them into sulphate of lime—*i.e.*, gypsum, or plaster of Paris. With this substance a model can be cast in a mould previously prepared, and representing either the full figure of the deceased, or simply the bust, or the likeness can take the form of a medallion. Whichever form of memorial is adopted, a glass case would be sufficient protection for it, and the costly urn can be dispensed with as unnecessary, whilst the remains of our loved ones will themselves be gathered into the form of a compact and lifelike memorial, which itself will be composed of the veritable "ashes of the dead."—In expectancy,

A BROTHER CINDER.

CORSET WEARING.

[620]—Various reasons have been brought forward in favour of the wearing of stays by two recent correspondents, which, if true, are much in favour of using that support.

Corset wearing undoubtedly developes the upper part of the lungs, but at the expense of the lower, and to the great diminution of the total breathing space; while Dr. Chadwick admits that the compression of the lower part of the chest may directly lead to consumption. The greater relative frequency of this disease among men is from their exposure to greater vicissitudes of temperature, and is not connected with the present question.

Your other correspondent, E. H., remarks that there is about three times as much breathing space as is needed in ordinary respiration. But the full amount may be required at any moment of increased exertion, and, if unattainable, may result in serious injury to the individual. I have known a lady remain in a fainting, semi-unconscious state for an hour from this cause after the exertion of dancing.

Dr. Chadwick avers that a woman is better in health while wearing a corset than without one, a statement with which I certainly disagree, at the risk of adding to the differences of doctors. If a woman long used to the support of stays leave off wearing them, she will doubtless feel their loss; but if unused to such artificial support, the wearing them will add to their ills, and probably produce ailments she never experienced before; though, if begun in youth, their development may be very slow and gradual. All analogy would lead to the conclusion that the compression of *any* part of the body, whether the waist, the foot, or any other part, is harmful, even as it is unnatural. It is only disease, including debility, that needs support. The figure is rendered inelegant, rather than elegant, as would be plainly apparent were an undraped statue of a modern corset-wearing lady compared with the Venus of the art galleries. In the mass of coverings enveloping the body in the present day the true natural and artistic form has been lost, and an artificial one, varying with fashion, introduced.

The ancient Greeks, who knew not the corset, had a true knowledge of the beauty of figure, and their lighter and simpler vestments covered, without distorting, the human form.

Fashion's most notable result, if not object, is the crippling of the human body, as the proverb boldly says, "il faut souffrir pour être belle," and seeks to displace natural beauty and grace for a constant desire for change and exaggeration. The remedy is to clothe the figure so as not to destroy or contradict the outlines of the body, but rather to show them clearly; and at the same time to allow freedom of movement and growth.

To help individual action in this matter, the Rational Dress Association has been formed, which deserves the support of every intelligent lady in its endeavours to combat the stupid vagaries of fashion, to show how to dress rationally, and to restore the pristine beauty of the human figure. This will be a gradual work; nor is sudden change desirable, but reason and science, which is applied truth, must eventually succeed.

RICHMOND LEIGH, M.R.C.S.

Park-road, Liverpool.

LIFE HISTORY OF A PLANT.

[621]—In the article so entitled in No. 52 of KNOWLEDGE I read that the quantity of water exhaled by the leaves during transpiration "depends on the state of the atmosphere, which when moist almost wholly prevents exhalation; on the other hand, in very dry weather exhalation takes place too rapidly, and the plant withers." In McNab's "Outlines of Physiology," p. 100, I read the result of his experiment on a cherry-laurel, which in sunlight and in a saturated atmosphere lost 25·96 per cent. of water in an hour, and in sunlight and in a dry atmosphere lost only 20·52 per cent. of water in an hour. He goes on to state that a "saturated atmosphere and sunshine can only occur very exceptionally, as in tropical climates and in greenhouses; but still, if when they do occur together the above is the result, are the two statements not contradictory? or should the words "in the absence of sunlight" be added to the first quotation? As this is a matter about which I have long been perplexed—for in most botany books I find the same statement as that made by Dr. Prevost—I shall be very glad if any botanical reader can help me to reconcile the two quotations. Another point on which I would ask for explanation is the following:—In the last sentence of the same article it is implied that no waste goes on in a plant—indeed, this is made a point of distinction between animals and plants; but what, then, is the CO_2 which is evolved in the process of respiration? Is not the respiration of plants similar to that of animals? and of the carbonic dioxide exhaled, does not the carbon result from the decomposition of organic compounds? These questions are asked purely with a view to gain information, if possible, and not in any spirit of criticism.

ALISMA.

Answers to Correspondents.

**** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post. 2. Letters sent to the Editor for correspondents cannot be forwarded; nor can the names or addresses of correspondents be given in answer to private inquiries. 3. Correspondents should write on one side only of the paper, and put drawings on a separate leaf. 4. Each letter should have a title, and in replying to letters, reference should be made to its number, the page on which it appears, and its title.*

[illegible] Thanks for your note, but we cannot very well [illegible] for letters about meteorological short- [illegible] had after all [illegible] very little. H. H. The Green- [illegible] has an object glass by Merz, 12 inches in diameter; [illegible] about 18 feet. It is mounted in what is called [illegible] I am not very proud of the little book you [illegible] one of these days to publish a much improved version. [illegible] You write in the [illegible] of a Hampden or Parallax. [illegible] think you have on more than one occasion shown me to be [illegible], and you evidently think I think so too. Well, I don't. I [illegible] you were simply jesting in your support of Siemens' theory [illegible] had admitted that it is unsound). And now with regard [illegible] matters. You had said that a straight band of [illegible] appear to be curved, which (you admit) I [illegible] in the sense in which you use the words, as well as you can [illegible]. It should have been clear to you that I used the words in a different sense. I used them, in fact, in their ordinary sense. A [illegible] really straight appears to the eye to pass upwards from the horizon (in the particular case I dealt with) to a point [illegible], and then to descend again to the horizon, [illegible] that any one looking at it says it seems to form an [illegible] I spoke of this band as appearing curved to the eye. Then [illegible] this appearance [illegible] is brought about,— [illegible] the varying distance of the [illegible]. On this you offer a comment which im- [illegible] that is really straight, it really looks straight [illegible] interpreted. So you might [illegible] really an illusion, because [illegible] we shall perceive that it [illegible].—F. A. D[illegible]. You will have [illegible] that aspect of your [illegible] was very fully dealt [illegible] to me the views you have (correctly) [illegible] Professor Tait's are, as you may judge, [illegible] W[illegible]. Nay, but the projectile [illegible] in both cases. All that [illegible] given to it is that it [illegible] the ground but it travels that [illegible] quite correctly inter- [illegible].—F. H. H[illegible]. [illegible] The evidence is all in [illegible] unpardonable. We [illegible] parts [illegible] such [illegible] It may seem easier to [illegible] were [illegible] created. I cannot [illegible] creation very difficult to [illegible] rejecting it. But as that [illegible] we find [illegible] the Creator does provide or [illegible] we must accept what we see. I can imagine an [illegible] far more natural to suppose [illegible] just as he saw it; and that he [illegible] and leaf, and had had [illegible] that short-lived and [illegible]. How do you mean [illegible] every copy of the [illegible] to make up a few [illegible] having long since been [illegible] the earlier numbers [illegible] thus bound, spoiling [illegible] for threepence a [illegible] that price. Surely [illegible] than you seem to [illegible] glass. (2) [illegible] decided. [illegible] number of miles, [illegible] depression [illegible] tangent to [illegible] the other end; [illegible] is not quite [illegible] average state [illegible] instead [illegible] marked for insertion. As regards nutation, where is friction to come in?—A. McD. No; the points at which the different planets reach the parts of their several orbits where they are nearest the sun are not in the same direction as seen from the sun. In the pictures of the orbits with which I illustrated my article on astronomy in the *Encyclopædia Britannica* I have shown the position of all the major axes of the orbits.—HENRY M. You are, of course, right. Our answer was written correctly, however. We wrote that Carlyle's statement was quite incorrect; no motion brought about by internal reactions alters the position of the centre of gravity. The word was printed "any." Unfortunately when correcting proof a momentary lapse of attention caused us to make wrong what was right and leave wrong what was already wrong.—P. Q. R. Please notice preceding reply.—W. P. DANGERFIELD. You quite misunderstand my meaning. It is not at all from any straitlaced views about morality that I find reason to object, but because a tacit assumption is made that rank should make a difference in our estimate. But have you read the story of these intrigues, and can you still speak of affection as in question?—W. S. BROOK. There is no such law. The farther the ball is from the bat the less is its velocity. T. R. ALLINSON. It is very pleasant to have such kindly words from so valued a correspondent. W. S. I really do not know why each year seems to pass more quickly than the last. It certainly is so—worse luck. I do not see that you can do better than to study "Darwin's Origin of Species" (later editions, of course). Time, time, time.—AN OLD PAULINE. The writer was, I believe, divided between the question of grammar and that of rhyme. What would you have had him do? If he had used the tense of the original you would have ridiculed that unjustifiable future. He knew quite as well as you could tell him, that with the correct tense for a present statement the line would no longer scan correctly. But Grammar before Gradus, Syntax before Prosody. As I am the writer in question, I may claim to know why I changed the tense, despising the quantity. If you would have given the line as it stands in Horace without some antecedent words, to change the tense, then would you have deserved the punishment you suggest for me. J. WATSON, JUN. We really cannot insert your defence of spiritualism.—H. L. J. Cannot insert a recommendation which, however fairly given, would open the door to any number of gratis advertisements. J. W. B. Yes, if you do not take the square of the distance; but then you ought to take the square of the distance.—J. P. K. The mistake was the result of an unfortunate chance, the letter getting separated from the enclosure.—A CONSTANT READER. Read "offended" for "offensive" and I agree with you. "Forgotten," no; that is not one of those things which should "be washed in Lethe and forgotten," at least by the wise. I am but one of thousands who noted it as a thing well worth remembering, not for a few years, but for generations. It revealed *so much*. By many it may be remembered as an injunction, not so by those who, like myself, would not cross a street or a room to see a procession of all the Emperors and Kings in the earth's four quarters, unless some of them chanced to be persons who had benefited their kind; (not that I have a particle of feeling against them; they simply do not interest me). You speak of "cowardice in attacking those who from their position cannot reply to such attacks." Pardon me if I remark that you must *know* this is absurd. "Persons who from their position can say what they please," even when addressing the race which stands easily first in power and influence throughout the earth (which I suppose you will admit to be true of English-speaking nations) would be much nearer the mark. Also (a mere detail), there was no attack. I simply repeated a warning which was *meant*, I take it, to be noticed. You are slightly mistaken about the "majority" of readers; say, rather, one in a hundred. J. A. FRASER. It is a simply organic substance, the Nostoc of German fable. The superstition that it is a fallen star is, as Humboldt somewhere remarks, a very old one. Dryden, speaking of Chapman's "Bussy D'Ambois," says:—"I have sometimes wondered in the reading what has become of those glaring colours which amazed me upon the theatre; but when I had taken up what I had supposed a fallen star I found I had been cozened with a jelly, nothing but a dull cold mass, which glittered no longer than it was shooting." T. H. M. I have very little doubt that if the comet were to rush straight into the sun, it would very appreciably increase his heat. But if it *is* to be absorbed, the process of absorption will necessarily be gradual.—A. BLAKE. There is no saying what would happen if a whole army of comets were to arise and swoop upon the solar system. If the skies fell, we might or might not have more larks than usual.—M. W. BROWN. So many were against the weather charts that it would be unfair to resume them. We did not give the names of a tithe of those who were opposed to them. As to the other question, I imagine the ordinates are drawn, and then through their extremities a curve is drawn freehand. This would be near enough. SIGMA. I should say Alpha, certainly. His fittings are much more satisfactory.

Our Mathematical Column.

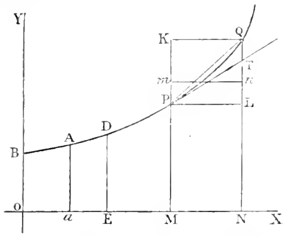
EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

By Richard A. Proctor.

No. XII.

I PROPOSE now to give two geometrical illustrations of a differential coefficient, which, when their nature is rightly understood, and especially the circumstance that the various values of a function can *always* be expressed by means of a curve, will be found of great value in indicating the real meaning at once of differentiation and integration.

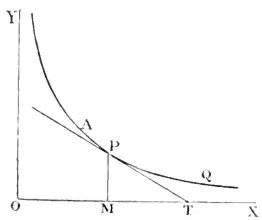
Let O be the origin, O X and O Y, at right angles to each other, the axes of x and y.



Then the x we have been dealing with—our independent variable—is measured along O X, and y the dependent variable along O Y. So that when we write $y=f(x)$, *i.e.*, y is such and such a function of x, we may represent any values of x by O M, O N along O X, calculate the resulting values of y, and set up corresponding lines M P, N Q parallel to O Y. If we suppose this done for all values of x, we get in every case a curve such as is supposed to be shown in part in A P Q, the ordinates as M P, N Q representing the values of y corresponding to the values of x represented by the abscissæ, as O M, O N respectively.

Supposing, then, that when $x=$ O M, $y=$ M P, we may take M N to represent a finite increment of x or Δx, and get N Q for the corresponding value of y. Draw P L parallel to O X, cutting off N L = P M from Q N, this new value of y,—or $y+\Delta y$. Then P L $=\Delta x$ and Q L $=\Delta y$. And what we have represented by $\frac{\Delta y}{\Delta x}$ is the ratio Q L : P L, or the tangent of the angle Q P L, when P Q is a secant line. If now we imagine N brought nearer and nearer to P M, it is manifest that the secant line P Q draws nearer and nearer in position to the tangent line P T, and the ratio Q L : P L approaches nearer and nearer in value to the ratio T L : P L, the trigonometrical tangent of the angle which the geometrical tangent to the curve A P Q at P makes with the axis of x. Hence the differential coefficient $\frac{dy}{dx}=$ tangent of the angle T P L.

Here we have at once an illustration of the geometrical meaning of a differential coefficient and a useful application of the differential calculus.



The reader of treatises on elementary plain coordinate geometry knows how important a process is the determination of the equation to the tangent at a given point of a curve, and how cumbrous is the method which has to be employed for its determination by elementary methods. With the differential calculus the process is simplicity itself.

Thus, suppose A P Q is a part of the rectangular hyperbola whose equation is

$$x\,y=a^2$$

and that we require the equation to the tangent P T at a point P, whose ordinates are O M $=x_1$ and P M $=y_1$. We have

$$y=\frac{a^2}{x};\ \frac{dy}{dx}=-\frac{a^2}{x^2}, \text{ whence tangent P T X}=-\frac{a^2}{x_1{}^2}$$

and the equation to P T is, therefore,

$$\frac{y-y_1}{x-x_1}=-\frac{a^2}{x_1{}^2}=-\frac{y_1}{x_1}{}^2$$

or,
$$x_1 y+y_1 x=2x_1 y_1=2a^2$$

Again, the equation to the ellipse with origin at centre and major axis as axis of x, is

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$$

or,
$$y=\frac{b}{a}\sqrt{a^2-x^2};\ \frac{dy}{dx}=-\frac{b}{a}\frac{x}{\sqrt{a^2-x^2}}$$

Wherefore the equation to the tangent at a point x_1, y_1, on the curve is

$$\frac{y-y_1}{x-x_1}=-\frac{b}{a}\frac{x_1}{\sqrt{a^2-x_1{}^2}}=-\frac{b^2x_1}{a^2y_1}$$

or,
$$a^2y_1y+b^2x_1x=a^2y_1{}^2+b^2x_1{}^2=a^2b^2$$

i.e.,
$$\frac{y_1y}{a^2}+\frac{x_1x}{b^2}=1.$$

Our Whist Column.

By "Five of Clubs."

DEAR FIVE.—I have just been looking over your notes on the play of the illustrative game (p. 367, No. 52) which I sent to you two weeks ago. It seems to me that your remarks on Z's play may seem to him rather *uncompromising*. Suppose he should be a reader of Knowledge and recognise the game. Might it not seem to him that, as a visitor, he should have escaped comment?—Faithfully yours, Editor.

Dear Editor,—Impossible to annotate a game fairly without noting errors of play. But are you in earnest? Who was it sent me a question two weeks ago, *relating to play at the very same* meeting of your club, and telling me to "be as severe as I pleased in pointing out error," &c.? Such mistakes are made in moments of carelessness by the best Whist players, and no true lover of the game objects to comments on them, if sound. If unsound, they can always be refuted.—Yours faithfully, Five of Clubs.

Dear Five.—Well, you certainly responded plainly enough to my request for plain speaking, and rapped P. A. R. (R. A. P. inverted) at p. 347, pretty severely. But not every one enjoys as I do a fair and well-delivered thrust. Let us hope our visitor shares your editor's tastes. I agree with you that no player ever passes an evening without laying himself open to some criticism. Still, it would pain me very much if any one's feelings were at all to suffer under your comments. I will see if I can recall the game in which I blundered so egregiously, and you shall criticise that if you like.—Faithfully yours, R. A. Proctor.

The Whist Editor of the *Australasian* has been good enough, at our antipodes, to watch the progress of our Whist Column, in the hope that we had taken up the mantle of the "Westminster Papers;" and now he is disappointed that we have not adorned ourselves with that garment. Considering we very definitely indicated a quite different purpose, this is not very much to be wondered at. We proposed from the beginning, or rather at the beginning, to describe the elementary principles of Whist, such as the leads, play second, third, and fourth in hand, the return of the lead, and such matters, showing how inferences may be formed as the play progresses, and the importance of making and remembering such inferences, leaving to a later stage the principles which guide the general conduct of the hand and may lead the practised player to depart as the game progresses from the mere conventional line of book play. In a word, we proposed (and still propose, for much of this initial matter remains still to be written) to teach the beginner those rules which every Whist player ought to know, and which beginners ought, for the most part, to follow closely. The "Westminster Papers" had a quite different purpose.

In carrying out our plan, we had occasion in the number for June 30 (Vol. II., p. 84), to give a game specially to show how [illegible] many words we said that was [illegible] We had nothing to [illegible] several players, only with [illegible] were played. The Whist [illegible] assumes, however, that we [illegible] considering the score [illegible] play a forward game after [illegible] his own and his partner's [illegible] this preposterous assump- [illegible] us for not doing what we [illegible] acknowledge that "Five of [illegible] the details and the [illegible] the "lead," and [illegible] also we pro- [illegible]

[illegible] example, he cavils with [illegible] completeness, but only [illegible] suppose he is telling [illegible] the first round.

[illegible]	[illegible]	[illegible]	Z
[illegible]	[illegible]	D. [illegible]	D. Seven.

[illegible] saying correctly, [illegible] for trumps," we [illegible] real state of the case is too [illegible] knows thus far that Y [illegible] the *Australasian*, who [illegible] hardly think either we [illegible] our readers, could fail to [illegible]

[illegible] that in touching on the [illegible] Z forced to make the odd [illegible] to retrieve matters [illegible] We gave very little atten- [illegible] we plainly said) in [illegible] we proposed gave only a [illegible] odd trick would have been [illegible] forced at trick ten. We [illegible] point. The error would [illegible] the general [illegible] only inferences, [illegible] from A B's point of [illegible] importance, and [illegible] *play*, we [illegible]

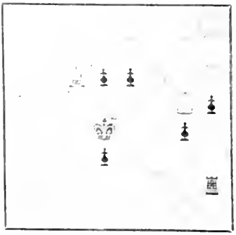
Our Chess Column.

By Mephisto.

PROBLEM No. 59.

[illegible]

BLACK.



WHITE.

[illegible]

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Experto Crede. You still maintain that in the position of the Anderssen Kieseritzky game referred to last week, of which a diagram is given on page 302, White ought to win in spite of 20. — / B to QR3 by 21. Kt to B7 (ch) / K to Q sq 22. Kt takes B / Q takes RP 23. B to B7 (ch) / K to K sq 24. Kt to QKt1. We are sorry that we cannot testify to the soundness of your laborious analytical effort, for if Black now replies with 24. Kt to QB3, he still has a good chance of drawing the game, for supposing 25. Kt takes Q / B to B4 26. B to Q6 / B takes B 27. Kt takes B (ch) / K to Q sq 28. Kt takes P (ch) / K to K2, &c.

J. A. Miles.—Best thanks for problem. It is the one I wanted.

Berrow. Thanks for problems. Our notice last week referred to a former one.

G. H. T.—Thanks for problems, which will be examined. Hope soon to find you an opponent.

Leonard P. Rees. F. J. C. problems received with thanks.

Notice to Composers.—In such instances, when we think problems unsuitable for publication, we think it only fair that composers should be informed of the faults in their compositions, both to satisfy their curiosity, and also for their instruction. We propose returning every faulty problem by post, accompanied by a statement of our objections to it. For that purpose composers will oblige by writing their name and address on every problem sent to us.

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KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, NOVEMBER 17, 1882.

CONTENTS OF No. 55.

Science and Art Gossip.

SOME of our professedly religious papers are either illogical or rather uncharitable. The Newton of biology says (as *we* have said, by the way, since KNOWLEDGE was started) that science has nothing to do with the Christian (or any other) religion; *therefore*, say they, Darwin objected to Christianity: This is akin to Pat's logic—"Is not one man as good as another?" said the orator. "Of course he is," *acquiesced* Pat (as he thought), "and a good deal better."

BUT Darwin accepted no revelation, *therefore* either he was an atheist or had unworthy thoughts of God. How if the reverse were the case! if Darwin knew of no words ever written by man which he thought worthily represented a Being infinitely beyond man's conceptions? How if he agreed with Elihu, described as approving of Yahveh, in believing that "As touching the Almighty we cannot find Him out?" He may not have understood the Oriental imagery which ascribes to the Creator the qualities of Oriental despots. His mind, of essentially Western constitution, may not have been able duly to grasp these ideas. There are others equally unfortunate; but we ought not to be angry with them.

DR. FREEMAN says in *Longman's Magazine* that some features of American pronunciation are to be explained by the habit of forming an idea of the pronunciation of words from their appearance as printed. In illustration of this we note that we have heard Burns's line, "A man's a man for a' that," quoted with the "a'" sounded "ay;" and the word "pages" in a theatre bill pronounced "paggies."

MR. EDISON has lately advanced the opinion that fatal accidents from electric currents would continue to increase with the multiplication of over-house wires, carrying powerful currents, till some dreadful accident occurred to arouse public indignation and compel the placing of all such wires underground. In cases of fire, particularly, the breaking of a great number of wires, which would be thrown down in inextricable confusion by the falling of a roof, might have serious results. Mr. Park Benjamin, a well-known scientific man, has called attention in New York to the fact that a stream of water from a hose nozzle, striking a broken arc-light wire, might easily serve to conduct the current through the body of the fireman who held the hose, with fatal consequences; while the cutting of such a wire with an axe, particularly if the handle of the axe were wet, might have a like effect. One of our scientific contemporaries, presumably from sheer ignorance of the dangers which must attend the transmission of strong currents through over-house wires, and of the fatalities already recorded, absurdly adds, that "if one fireman were to hit another hard over the head with an axe, whether the handle was wet or dry, the man hit would receive a violent shock. Mr. Park Benjamin has curiously enough omitted to call attention to this fact. It would, perhaps, be better, under the circumstances, either to give up the use of electricity, or else to have no more conflagrations. By either expedient comparative safety would be secured for fire brigades." This may be meant for wit, but we fail to see it. The danger is a real one, and in justice to the public themselves we are constrained to again re-echo the warning.

THE fishing in Sir Joseph Hooker's park at Kew is also good—so his friends say. His enemies, and some who are neither one nor the other, speak in a different way about both the fishing and the shooting. They say it may be abundant, but it is not altogether the right thing.

THE Garden—we beg his pardon, Sir Joseph's estate—is positively open now to the public for no less than *two hours and a quarter* on Sundays, on week-days for three hours and a quarter.

THE gate which was to be blocked up is now only lumbered up, and seems likely so to remain.

THE *North Times* has suddenly become an ardent (an amazingly ardent) advocate of the most uncompromising school of vivisectionists. After quoting our remark that most of us cannot tolerate the thought of vivisectional experiments "on even the most worthless of human beings," the *North Times* remarks that it makes the blood run cold to read these lines, that they are entirely unchristian and irreligious, nay, "constructive blasphemies and appalling outrages on the very name of our common humanity." We are sorry for it; but at the risk of still further hurting our contemporary's feelings, we must repeat that to us, and we believe to most men, the very thought of experiment on human beings, however worthless they may be, and however valuable or dear the lives in whose interests such experiments might be made, is utterly intolerable. We cannot see why this should be considered a "constructive blasphemy" (not that we have the least idea what a constructive blasphemy may be). There may be some recondite reference to the sacrifice of life for life in Christian annals; but, apart from some such reference (if there is any), we find our contemporary's indignation inexplicable, astounding, almost staggering. Anything more barefaced than this advocacy of the most pronounced views of vivisectionists we have never heard of, and could hardly have believed credible in a civilised community!

AT a recent meeting of the Buda-Pesth Society of Natural Science, Professor Than (a member of the committee appointed to investigate theatre fires) spoke on the danger of ordinary gas, and the means of reducing it.

From experiments, he was of opinion that gas was not dangerous so long as it occupies less than 5 per cent. of a given space; between 5 and 12 per cent. it begins to be [illegible], and at [illegible] per cent. the danger of explosion is present in the highest degree. He has improved Anselm's apparatus, which, acting on the principle of diffusion, causes an electric bell to ring as soon as a certain quantity of gas is present, so that even ½ per cent. of escaped gas causes loud ringing. Another ingenious arrangement shows the actual percentage quantity of escaped gas, while a contact manometer, which Professor Than has used several years in his laboratory, reveals the place of escape of the gas.

The *Railroad Gazette* record of American train accidents for August shows for that month a total of 139 accidents, by which [illegible] persons were killed and 218 injured. There were 65 collisions, in which 27 persons were killed and 117 injured; 70 derailments, with 18 persons killed and 100 injured, and four other accidents, in which one person was killed and one injured. Twenty-six accidents caused the death of one or more persons each; 28 caused injury, but not death; while in 85, or 61·2 per cent. of the whole number, no serious injury to persons is recorded. These accidents may be classed as to their nature and causes as follows:—Collisions: Rear collisions, 41; butting collisions, 20; crossing collisions, 4; total, 65. Derailments: Broken rail, 2; broken switch rod, 1; broken bridge, 4; spreading of rails, 7; broken axle, 4; broken wheel, 2; broken truck, 1; wash-out, 5; accidental obstruction, 4; cattle on track, 8; misplaced switch, 7; neglect to use signals, 1; purposely misplaced switch, 2; malicious obstruction, 1; unexplained, 21; total, 70. Boiler explosion, [illegible]; broken connecting-rod, 1; broken crank-pin, 1; broken axle, not causing derailment, 1; total, 139. Derailments of the long American cars are thus the most frequent form of accident.

A new use has been discovered for potatoes. They can be converted into a substance resembling celluloid by peeling them, and after soaking in water impregnated with eight parts of sulphuric acid, drying and pressing between sheets of blotting paper. In France pipes are made of this substance, scarcely distinguishable from meerschaum. By subjecting the mass to great pressure, billiard balls can be made of it rivalling ivory in hardness.

We propose in the next two weeks to give a very much simpler account of Venus's transits than in the comparatively difficult papers now nearly completed.

Several physicists, chemists, spectroscopists, and others who chance to be not also mathematicians or astronomers, have recently advanced, advocated, or adopted the theory of an interstellar and interplanetary atmosphere, to which (being free from the restraints imposed by a knowledge of astronomical and mathematical laws) they assign various degrees of rarity according to the requirements of their own or their friends' pet theories. Astronomers have looked on with some amusement at the innocence with which [illegible] of carbonic acid gas, the vapour of water, nitrogen, oxygen, hydrogen, and so forth, have [illegible] the interstellar universe, in calm unconsciousness that if [illegible] to accept these additions, all that Galileo, Kepler and Newton have taught (and which we had supposed proved) must be abandoned. While enjoying the joke, astronomers have not been very anxious to advance the overwhelming arguments which have always been available. But as these invaders of the domain of the exact science have lately seemed to mistake this reticence for acquiescence, it seems desirable to show at least the *shape* of the rock-masses which overhang the precipitous and trackless region over which they have been for some time cheerfully adventuring. For this reason we give this week M. Faye's masterly though short demolition of these theories, which we would recommend in a special manner to the attention of Dr. Siemens, Mr. W. M. Williams, the Editor of *Nature*, and others, who appear to regard mathematics as the bane of science, because it kills wild theories.

Eight full columns of Mr. Murray's publications appeared in the *Standard* of the 14th inst.

Among the many unexpected developments of electrical science is an application in the hiving of bees when they swarm, successfully tried by German experimenters. It was thought that by utilising the electric force the bees might be stupefied for the necessary period of time without being injured, and the result proved the correctness of the idea. The first attempt was made upon bees that had gathered upon trees, the insects falling upon the ground in a kind of trance, which admitted of their being safely handled. The next stage in the experiment was to capture the bees when they were about to swarm. By introducing the ends of two connecting wires into a fully-occupied honeycomb and turning on the current, the bees were rendered inactive for about thirty minutes, while no bad results appeared to follow their awakening.

From Sydney is reported the discovery of a new building material at Suva, on one of the Fiji Islands. It is known as fossil coral, and when cut from a mass is soft, but on exposure to the air it looks and is very much like brick. During the short time it has been known it has satisfactorily stood the tests that have been applied to it. Orders have already been received for quantities of it to be used in building.

It is a remarkable fact that there are no rats in the islands of the Pacific Ocean. Repeated attempts have been made to acclimatise the rodents there, as the flesh is much esteemed by the natives as an article of food. But the attempts thus far have failed, as they [the rats] invariably die of consumption.

In the hour columns on p. 373 relating to the comet's path, there are some obvious mistakes, relating, however, only to the part of the motion still to be observed. Thus in the first table the *hours* on Nov. 25, 29, and Dec. 2, should be 2, not 3, while those in the second table, for Nov. 21, 25, 29, and Dec. 2, should be 1, not 3. Circumstances caused our time for correcting those columns to be very short indeed.

Next week we shall give some pictures of the comet, and our promised discussion of the probable effect of its destruction by the sun.

With No. 61 the Exchange and Sale Advertisement Columns will be discontinued, as we find we frequently have to defer them for want of space.

M. FAYE ON INTERPLANETARY AIR.

FEW features in recent scientific developments have a more unwholesome aspect than the reticence with which false doctrines are received by those who *know* them false—if advanced by men who have (deservedly, perhaps) attained a high position in science. It seems to be regarded as a point of courtesy to avoid all reference to obvious flaws in reasoning, and to speak only of the possibly correct experiments, well-observed facts, and charming results *if* the theory were true, leaving altogether out of sight the clear and certain disproof (often multitudinous disproofs) which yet those who thus use flattering words have perfectly recognised from the beginning. I would cite as among the worst illustrations of this weak and unmanly way of dealing with science, the tone in which men who ridiculed among themselves Professor Tait's Sea-bird Theory of Comets' Tails, spoke in public as if it were an admissible and possible theory; the silence of those who *knew* about the flaws in Professor Tyndall's Negative Shadow theory of the same phenomena (as if Professor Tyndall, of all men, were such a weakling as to need the unclean sacrifice of untruth, which some seem to love); the reticence of many respecting Professor Sir W. Thomson's meteoric theory of the origin of life on the earth; and the way in which men who are known to have expressed privately their recognition of its fallacy, have publicly written and spoken of Dr. Siemens's theory of solar energy. To my mind, apart from all worthier reasons for objecting to this lip-serving humbug, better suited to Oriental courtiers than to men, it is a very poor compliment to whose whom it is meant to please—it implies that they care more for flattery than for truth, that they are too foolish to see through all this, or fail to perceive the "claw me and I'll claw thee" tone which runs through it all.

We hail then, cheerfully, the sensible and manly, yet (in the best sense) courteous tone in which M. Faye, the eminent French astronomer, has discussed Dr. Siemens's new theory of the sun, giving one among the many complete and convincing disproofs of which the theory, being essentially wrong, necessarily admits. M. Faye is not wanting—no man of sense can be—in just appreciation of Dr. Siemens's eminent services to science, but when Dr. Siemens talks paradox, M. Faye does not hesitate (no honest man of science should hesitate) to say plainly that it is so.

"We know," he says, "that under the action of light, and with the intervention of chlorophyll in plants, the vapour of water and carbonic acid gas are decomposed at ordinary temperatures, and restored to combustible forms, carbon and hydrogen variously associated. Dr. Siemens, an English man of science, has inquired whether the action of the sun alone might not effect this decomposition, when we subject to it the vapour of water and carbonic acid gas greatly rarefied—reduced, for instance, to one 1,800th of atmospheric pressure. These experiments, which only need, in my opinion, a counter-test, easily applied, would seem to have given affirmative results. Thus, gases which had undergone combustion, having been so rarefied that the induction spark would no longer pass through them, a few hours' exposure to solar light sufficed to cause the mixture to let the induction spark pass with the well-known colouring which it takes in hydrocarbonised media.

"Regarding these five experiments as decisive, Dr. Siemens has been led to ask whether the phenomenon might not play a more important part in the universe than in vegetable life. Regarding space as filled with analogous gases which had already undergone combustion, the light of the sun would revivify the combustibles, hydrogen and carbon, which would then be ready to furnish fuel for fresh combustion.

"In drawing them back to himself and burning them afresh, the sun would recover a large part of the enormous heat, the radiation and loss of which in celestial space we are so pained to see.

"Dr. Siemens has thus been led to enunciate the following hypothesis:—Space is filled with burned gases" (gases the products of combustion, *gaz brûlés*)—the vapour of water, and carbonic acid gas, mixed with inert gases, nitrogen, &c., somewhat like those of our own atmosphere at 1-2000th pressure. These gases would be partially transformed into combustibles under the action of solar light; then, by a mechanism similar to the air-sucker of a pair of bellows, the sun would draw them back to him, burn them, and send them back into space. This immense source of heat would thus continually revivify itself; the only part of its radiation lost would be that which would not be absorbed by the cosmic medium 1-2000th in density [which, unfortunately for the theory, is nearly all that had troubled us,—the stars being our witnesses.—ED.].

"It is true enough that air at 1-2000th pressure would be to the physicist an almost absolute vacuum; so that, in such a vacuum, the electric spark would not pass. But for the astronomer, such a medium would be quite dense (*bien grossier*). When we speak in astronomy of the resistance of a medium on the æther, and with the help of most delicate observations and most profound calculations, seek the traces of this resistance, *we have something very different in view* (*il s'agit de tout autre chose*).

"Without entering into details, I note that the trajectory of a cannon-ball, travelling 500^{m} (547 yards) per second is altered at the end of even only a few seconds, in such sort that astronomers are forced to take into account the resistance of the air in their range-tables.

"Reducing the air to 1-2000th, but raising the velocity of the projectile to that of the celestial motions, 60 times greater, for instance, these coarsely obvious results would, for a host of heavenly bodies of dimensions comparable to our cannon-balls (as bolides, flights of shooting-stars, aerolites), be twice as great as in our practice ranges, not at the end of several years or several centuries, but at the end of a few seconds.*

"Secondly, it appears to me that the eminent English physicist has to some degree omitted to consider the quantity of matter he was about to add to the solar system. Under the effect of attraction, this matter would unite itself to pre-existing stars, the sun in particular, and would continually augment their mass.

M. Faye goes on to consider the mass which would thus be added to the sun, considering only such parts of the interstellar atmosphere as lie within Neptune's distance from the sun. He finds this sphere of interstellar air, even of the tenuity indicated by Dr. Siemens, would amount to about 100,000 times the present mass of the sun—a trifling addition of which astronomers might expect to find some traces in the celestial mechanism. This consideration forces us to reject absolutely and decisively an atmosphere such as Dr. Siemens and Mr. W. M. Williams have imagined—whatever opinion we form as to the existence

* There would even, in the resistance of such a medium, be a source of additional heat for the terrestrial globe, quite independent of the sun. Judging from certain experiments by Sir William Thomson on the elevation of temperature of a thermometer moving in air with a certain velocity, that of the terrestrial globe due to resistance against this medium would be several hundreds of degrees (centigrade).

[illegible] of [illegible] to planetary and stellar [illegible].

"[illegible] persuade M. Faye, "that astrono[illegible] hypotheses. Doubtless they would [illegible] that nature has in reserve for [illegible] by which his heat may be made to last [illegible] his final cooling is, in any case, a catastrophe [illegible] far off, they will be consoled by the thought that [illegible] among the things of this world not [illegible] been made to last for ever.

"As for the fundamental experiments of Dr. Siemens, these [illegible] none of their importance in the eyes of astronomers. It is a question of a conquest of one of the secrets of living nature, one of the laws of the organic world; they will earnestly desire (*de tout leur cœur*) that Dr. Siemens should pursue the path so brilliantly entered on, though they cannot expect from it any very brilliant light for their own department of research."—*From M. Faye's Address [illegible] Paris Academy of Sciences.*

EARTHQUAKES IN THE BRITISH ISLES.—III.

([illegible] from page 374.)

IN the year 1784, Loch Tay was disturbed in a very remarkable manner. The water receded from the two ends and rose in a great wave in the middle of the lake-basin; then this wave spread itself laterally over the shores, passing high above the usual limits of the lake. This was repeated every day for a week, with less and less violence. It is worthy of notice that the year 1784 was remarkable for the earthquakes which disturbed different parts of the world. One occurred on the 18th of July, in Armenia, and caused the loss of upwards of six thousand lives. The city of Ezerghan was destroyed by the same shock. But the volcanic effects observed in Iceland in the same year were yet more remarkable. In fact, Iceland had been disturbed more violently during that and the preceding year than at any former period in the history of the island. "It has been calculated," says Professor Ansted, "that a single volcano in the wild and untrodden desert lying in the south-east part of Iceland threw out that year fifty to sixty millions of cubic yards of matter. The accounts which have been handed down to us of this event present to us a picture almost too terrible for belief. With a wide-spread destruction of the land, the depths of the sea were invaded, and the fish (the Icelanders' chief means of sub[illegible]) driven from the shore. The flames broke out [illegible] through the waves in the line of movement, and the sea was covered with pumice for 150 miles. A thick [illegible] hung over the island for a year, and the winds carried the ashes over Europe, Africa, and America. The [illegible] darkened, and [illegible] only as a ball of fire: [illegible] hurricanes, hail-storms, thunder and lightning [illegible] horror."

[illegible] worthy of notice that the great earthquake of Calabria had taken place but a year before, and that [illegible] this great [illegible] of nature lasted, the barometer [illegible] of an inch of the bottom [illegible] of many of the Highland lakes [illegible]

[illegible] 17[illegible] took place near [illegible] there was suddenly shivered [illegible] earthquake on [illegible] San Sepolchro, in Italy, [illegible] were wholly swallowed up. And, lest we should seem fanciful in associating this earthquake with events which happened in Scotland, we extract the following passage from the *Scots' Magazine*, referring to the Italian earthquake. It says: "On the same day three distinct shocks of earthquake were felt at the house of Parson's Green, on the north side of the hill of Arthur's Seat, near Edinburgh." Only four days before the county of Wiltshire had been shaken by a very perceptible shock of earthquake.

A somewhat severe earthquake was felt in Edinburgh in the year 1801. Singularly enough, the shock was not felt in the Old Town. But in the New Town the sensation experienced was as though the houses had been lifted bodily upwards, and then violently shaken from north to south. Some hours afterwards a house sank so much that the magistrates condemned it. The gable of a barn near the city fell in upon some reapers and crushed two of them to death. We believe this is the only earthquake which has taken place for many centuries in the British Isles in which there has been any loss of life. At Crieff and Comrie the earthquake was felt even more distinctly than at Edinburgh; but no buildings were injured.

But perhaps the most remarkable earthquake experienced in the British Isles during the present century is that which took place on the evening of August 13, 1816. The summer had been remarkable for heavy storms of rain and hail, which caused much mischief to the crops; and a circumstance which had attracted much attention was the want of correspondence between the barometrical indications and the weather, the barometer often rising before heavy storms and falling before fair weather. The earthquake of August 13 was felt over nearly the whole of Scotland. But its action at Inverness was much more intense than at any other place. Indeed, one is reminded of the narratives of more destructive earthquakes by the account of the scene presented in Inverness on the night of the occurrence. Most of the inhabitants had gone to bed, when suddenly a violent vertical shock was experienced, followed immediately by a trembling which lasted for about half-a-minute—or longer as some thought. So violent was this earth-throe that many were flung out of bed. "All others who had gone to rest," says the narrative of the event, "instantly sprang from their place of repose, and with little ceremony as to clothing, joined the crowds who had rushed into the streets, which immediately became a scene of wild and unusual terror, no one knowing but what a second shock was immediately to bury them under the ruins of their houses. Under this apprehension many hurried, ill-prepared as they were, out of the town, and spent the greater part of the night in the fields. It was found that already great damage had been done to the buildings. Many were rent from top to bottom; great numbers of chimney-tops had been shaken down. From a stack of chimneys on the Mason Lodge, a coping-stone weighing fifty or sixty pounds was thrown to the other side of the street, a distance of not less than twenty yards." Nothing could more strikingly exhibit the energy of the lateral vibration than the fall of this great stone. It is wonderful that much more serious damage was not effected by a shock of this nature.

It was noticed that the old buildings suffered less than the new during this shock. Three gentlemen who were approaching the town from the westward heard the great bell toll twice, but the townspeople, amid the crash of falling stones and tiles, and the shrieks of terrified women, did not notice the sound.

When the morning came it was observed that a steeple which had recently been fixed to the county gaol had received a twist a few feet from the top. The spire was octagonal in shape, and was twisted through about a sixteenth of a circumference, from the east towards the north. For upwards of ten years the steeple exhibited this curious token of the energy of the earthquake of 1816, but it was afterwards repaired.

In other parts of Scotland very remarkable effects were experienced during the occurrence of this earthquake. Three arches built across an arm of the sea in Sutherland were flung down. A man who was walking amongst the mountains of Lochindorb "was first alarmed by a sudden and tremendous noise of a rushing wind, which came sweeping up the hills like a roar of water; this was instantly followed by a rumbling noise, and the ground was sensibly heaved up and down under his feet." A similar noise and motion were observed near Montrose by two excise officers who were on the watch for smugglers. They were lying down on the ground when the shock came, and one of them leaping up exclaimed, "There they are! I feel the ground shaking under their horses' feet!"

It is worthy of notice that only six days before this remarkable earthquake Mount Vesuvius had been in eruption.

HAIR EELS.

By Dr. Andrew Wilson, F.R.S.E., F.L.S., &c.

SOME time ago a correspondent of Knowledge wrote to the Editor that a large number of "hair eels" had appeared in the ponds and ditches in his neighbourhood. He remarked, in the course of his letter, that he "noticed one hair eel struggling with a black-beetle (probably a water-beetle), which was floating on the surface of the water. In a short time the hair eel, which was quite white, had freed itself, and sank to the bottom immediately. Seeing the two 'insects' struggling together, recalled to my mind that I had somewhere read of these eels being internal parasites of black-beetles and grasshoppers. It would be interesting," adds the writer of the letter, "to know if this is really the case, and if not, where the eels come from, and what becomes of them on the approach of winter." As there are doubtless many readers of Knowledge who feel curious concerning the biography of the hair eels, I will endeavour to state the few plain zoological facts in which their history may be said to be comprised.

The zoological position of the "hair eels" is perfectly well ascertained. They are, in a sense, "worms"; removed, no doubt, from the area of the ordinary earth worms, sea worms, and the like, but still related by many ties of kinship to these familiar forms. There is a group of "worms" known to naturalists as *Nematelmia*, a name literally meaning "round-bodied worms." In this group the hair eels find a home, and their rounded form separates them from the tapeworms and flukes, which are denominated "flat worms" (*Platyelmia*). Included in the round-bodied section, we find such worms as the common internal parasites of man and other animals. Such are the "thread worms" (*Oxyuris*), the "common round worms" (*Ascaris*), the *Trichina* found in diseased pork, the guinea worm, and allied species. All of these forms differ from the ordinary worms in possessing no well-marked ringing or segmentation of their bodies. Very rarely do we find in them the side-bristles and appendages we see so familiarly in the sea-worms, and also, but somewhat modified, in the earthworms and their neighbours. Again, most of the "round worms," like most of the "flat worms," are parasitic, either during the whole of their lives (*e.g.* tapeworms, flukes, thread-worms), or during a part of their existence. Under this latter category, the hair eels may be ranked, as we shall presently observe.

The "hair eels" are technically named *Gordiacea*, and the *Gordius aquaticus* is the scientific name of the common species. The well known vinegar eels, which make their appearance in vinegar, in decomposing paste, and in like fluids, resemble them in form, but, of course, differ materially in size. There are several curious points connected with the anatomy and habits of the "hair eels," which, by the way, should be properly named "hair worms," of course. Thus, in the first place, their digestive system is of imperfect nature, and no posterior aperture exists to this system, which, in fact, opens into the cavity of the body. This disposition of the intestine is not unknown in other groups of the animal series, and its occurrence would seem to indicate that the functions of the digestive apparatus are in some respects differently carried out from those of normal forms. Then, secondly, there exists in the hair worms only an imperfectly-developed system of "water-vessels," such as we find well developed in allied worms. The use of these vessels is still problematical, but their presence is highly characteristic of both round and flat "worms."

In respect of their habits, however, the hair worms are peculiar. That part of the correspondent's letter in which he speaks of the hair worm struggling with the insect, becomes highly interesting, inasmuch as it supplies a clue to the real history of these curious animals. One of their chief characteristics is that they inhabit the bodies of insects during at least part of their existence. They are thus partially "parasitic" in their habits. The life-history of a hair worm, in fact, begins with its appearance when liberated from the egg (produced by the parent form), as a minute speck, swimming freely in fresh water. This youthful worm is provided with a boring apparatus, in the form of a kind of proboscis armed with hooklets. In this respect it reminds us of the young tapeworm itself, which is provided with a crown of hooks adapted for boring. Thus armed, the young hair eel seeks an insect host, and boring its way into the insect tissues, there ensconces itself. Development now proceeds so far, that within the insect's body we find a hair worm which may far exceed its host in length. Sooner or later development is completed, and the adult stage reached by the appearance of the egg-producing or reproductive organs. The sexes in the hair eels are situated in different individuals. When the period of egg-deposition arrives, the worm seeks to leave the insect-body which has sheltered it. It was at this stage of the hair eel's career that our correspondent beheld the worm; and, passing from the insect's body, the liberated hair worm once again finds itself in the water. Here the work of laying the eggs proceeds apace. The eggs appear to be deposited in long strings in the water, and after the process of development has proceeded sufficiently far, we behold the young embryos, with their boring apparatus, ready to repeat the parental history. The swarms of hair eels which appear in our ponds and brooks in summer are the newly-liberated worms about to begin the work of egg-laying.

Such being the well-ascertained history of the "hair eels," we can readily value at its true worth the superstition, not yet extinct, which maintains that they arise from horse's hairs, which by some marvellous process of vivification assume the likeness of the worms. Over and over again, in newspapers and elsewhere, have I had to combat this absurd belief. Frequently, persons who should have known better have assured me that they have placed horse's hairs in a stream, and in a few days or hours have seen hair worms swarm therein. Such ingenuous minds do not see the *post hoc ergo propter hoc* fallacy in which they indulge.

Because they put hairs at a brook, and because there afterwards appear hair worms, therefore the hairs have begotten the worms—such, of course, is the argument. But only a worse than childish intellect will receive this reasoning as good or likely. I have never yet had my demand for an experiment with some horse's hairs and a bowl of water at home satisfied; and I need hardly remark how fatal is the facility with which the difficulties of proving that the hairs placed in a stream actually became the living worms are glossed over. The persistence of this superstition exhibits anew that belief in the marvellous which is often uninfluenced by exact science.

Laying aside this startling theory of spontaneous generation as childish folly, we may note that near relations of the hair worms are known to exist in latitudes far removed from the familiar ponds and ditches around us. A species of hair worm is known to live beneath the shells of shrimps at enormous depths in the sea. One might feel tempted to ask if this hair worm is also generated from equine appendages; for what holds true of the *Gordius* of the pond, should logically apply, of course, to all its kith and kin. Another member of the hair worm's family circle is the *Mermis*, which is found coiled up inside the bodies of butterflies and moths. Like the hair worm, *Mermis* escapes from its insect host at the time of egg-deposition, and buries itself in the soil. The young *Mermis*, armed with a boring lancet, pierces the soft bodies of caterpillars, and grows to maturity, in fact, along with the insect, as the latter becomes the chrysalis and perfect insect respectively. There is also another ally of the hair worm, which lives as a lodger and boarder in the interior of that friend of the flowers, the humble bee. This is the *Sphærularia*, with whose history Sir John Lubbock and Mr. Cole have made us acquainted. John Hunter knew *Sphærularia* well, but in 1836 it was more fully examined by Dufour. The female worm, or that which is found in the bee, is about an inch long. It is white, and possesses a body bluntly pointed at either end. It is covered by small warty projections. No mouth or digestive system exists, but a very large "fat body" occupies the interior of the parasite. The male *Sphærularia* appears to be about 28,000 times smaller than the female. In this curious group of animals the habit of leaving the insect host to propagate the species is probably represented as in the hair worms themselves. As a final remark concerning the hair worms, I may refer to the well known fact of their remarkable tenacity of life. Both young and adult hair worms can be dried and mummified, and kept in this dessicated state for lengthened periods; yet upon the addition of moisture they at once revive, and appear able to resume all the functions of life as before. Similar phenomena occur in the history of the *Rotifera*, or "wheel animalcules." In what state the animals actually remain, or on what this "potential vitality," as it is called, depends, we do not know, but their tenacity of life may well explain how their existence is perpetuated through the winter's cold and under conditions of more rigorous nature still.

Is it True? An American paper says:—"There was excitement in front of the Central Methodist Church, Market-street, Newark, N.J., on Saturday evening last. Adjoining the church is a building with iron columns, which is supplied with electric light, and somewhere in the circuit a telegraph wire had fallen upon the electric wire, thus charging the building near the church. The current extended to the iron fence outside, and four persons who had touched the fence in passing had been knocked down. They were not seriously injured."

THE TYPE-WRITER.

By Richard A. Proctor.

SEEING an advertisement of this instrument in the columns of Knowledge, I thought it would probably be the very thing for me—if I could get over the habit of associating mental work with the manipulation of a pen. I remembered that when Goldsmith tried dictating instead of writing, he failed—only when urging pen over paper could he express his ideas with his wonted freedom. I had had a somewhat similar experience myself. A day or two before I gave my first lectures in New York, four stenographers from the office of the *New York Tribune* called on me by appointment, to take down the first lecture from my own lips. I tried to imagine an audience, and to talk as if addressing one. But it was useless. After some ten or twelve sentences, I told the four reporters I could make nothing of it; I could *not* lecture without an audience. The case of the aspirant to oratorical fame and the cabbages was reversed: he practised before a set of cabbages, and could only tell a real audience that "he—he—he perceived they were not cabbages;" I had never lectured save before an audience and trusting to the inspiration of the moment to give me fit words for what I had to tell them; and, though the four reporters were very far indeed from being cabbages (on the contrary, four as bright and clever men as one would care to meet), I had to tell them I perceived they—they—they were not an audience.

It was with some doubt, therefore, that I began to try the Remington Type Writer, especially as the makers consider that some time should be given to practice before using the instrument for regular work.

I was agreeably disappointed. In a few minutes one begins to know where the letters are, and not long after one begins to find the way of knocking off the short words—*the*, *and*, *was*, *that*, *in*, *if*, *of*, *there*, *ever*, *were*, and so forth, almost at a stroke. The mind forms ideas and sentences as readily as with the pen; and though at first the rate of writing is, of course, slower than with the pen, the work is much pleasanter.

In my own case there was no time wasted over practice. I gave up a certain department of my work with Knowledge (the "Answers to Correspondents," if you *must* know, Mr. Inquisitive,) to the type-writer; and so made progress at once with practice and with my work. I only found one defect in this arrangement. It was so much pleasanter to work with the Writer than with the pen, that I was disposed to give more than due time to the Answers.* Fortunately, correspondents are so numerous, and increase so fast, that material was not wanting. To the accompaniment of our "Steinway," on which divers members of my family continued *their* practice, the work went merrily forward, and that which some readers regard as sulphuric acid, while others only just recognise in it an occasional (and then slight) acidulous flavour, trickled over the paper from the almost noiseless writer.

The use of the instrument, pleasant from the beginning, grows pleasanter with every day's practice, until there is quite a charm in manipulating these little keys. The rate

* In passing, I may note that many readers seem not to understand that the greater the space given to Answers, the more space is saved for the large-type matter which the bulk of our readers chiefly care for. Almost every answer means a letter which would otherwise have appeared in the "Correspondence," to elicit, perhaps, a dozen answers, and possibly a lengthy controversy. Putting an average of only one column for each (which is very moderate), I find that about twenty pages weekly would be required for correspondence. Thus, I am absolutely forced to adopt some such plan of dealing with most of the letters which reach me.

of writing, of course, increases with practice, and as I am a mere beginner, having only bought my instrument a few weeks back, I am as yet unable to say what rate can be obtained with it. I have not yet learned to write with it as fast as with the pen—perhaps I may never be able to do so. For I am an unusually rapid writer. Mr. J. G. Petrie, in a very interesting paper on "Reporting and Transcribing Machines" (published by Jas. Wade, London, price 6d.) says the maximum rate of writing is from thirty to forty words per minute, but that few writers can keep up that rate of writing for many minutes, and the writing would then be far from legible. I find, however, I can, at a pinch, write from forty to fifty words a minute, and keep up a rate of from thirty to forty for quite a considerable time, and as I get very clean proofs, I infer that compositors can read my writing. That does not prove my writing legible in the ordinary sense, for compositors can read almost anything.

The following sentences quoted from the above-named pamphlet were written at the rate of forty-seven words a minute (sub-editor's timing). I will faithfully record, later, how many mistakes the rather villanous writing has caused the much-tried compositor to make. [I hope the most skilful will be selected.]

"Like everything else in this world, there is a right way and a wrong way of manipulating the machine. The keyboard is composed of forty-four keys, arranged in four rows, and these would be almost equally divided between the fingers of both hands; the right hand manipulating the right half of the keyboard, while the left hand works the corresponding half. By using the three first fingers of each hand, as I have said, a good style of playing the machine can be acquired; and in order to gain facility for its working, those words which are most in use in the language, amounting to a few hundreds, and which can be taken out of any shorthand instruction book, should be practised over and over again until ease and facility in writing them are acquired. The long bar, which makes the spaces between the words, is always struck by the third finger of the right hand, and in course of practice this action becomes quite automatic."*

To the last point in the above passage I venture to demur. I find the bar much more conveniently struck with the thumb of either hand. From the beginning, the Space, which I had thought likely to be often omitted, was readily and systematically marked, except when the rate of work was pushed beyond that which practice had rendered easy.

It is claimed that with great practice fifty or sixty words a minute can be printed with the "Writer," and some thirty a minute, neatly and clearly printed, would be better work than forty scrawled, and save much time, too, in the long run. Then the work is so much pleasanter. One can sit squarely up to the instrument, and take a good full breath at each inspiration, instead of filling the merest corner of the lungs, as when busily engaged in writing—especially when trying to write very quickly.

Russia and the Telephone.—We do not hear much of any progress being made with the telephone in the Russian Empire. A facetious contemporary explains this circumstance by the fact—if it is a fact—that the exclamatory halloo! with which, as everybody knows, all telephonic conversation must begin, is, in the Russian language, rendered Tzijakanfitkrajanjanzski! which, of course, no telephone yet invented can pronounce.

* Total number of errors in author's first proof—0.—R. A. P.

THE AMATEUR ELECTRICIAN.

ELECTRICAL MEASUREMENT.—V.

The question which next presents itself is, having a certain number of cells, and a certain line-resistance to be overcome, what will be the most advantageous mode of joining the cells together so as to get the greatest possible amount of work out of them? By taking an example we shall see that the best result is obtained when the two resistances, internal and external, are nearest to equality. Suppose we have 40 ordinary Daniell cells, each having an E M F (electro-motive force) of one Volt, and each offering a resistance of 10 Ohms to work a circuit of 100 Ohms resistance. When joined up in series we get

$$\frac{E}{R+R'}=\frac{40}{400+100}=\cdot08$$

If we divide the battery into two series of 20 cells each, and then put them side by side for quantity (see Fig. 1, Knowledge, No. 51) we get

$$\frac{E}{R+R'}=\frac{20}{100+100}=\cdot1\cdot1$$

The E M F becomes 20 Volts, because there are only 20 cells in series. With a single set of 20 cells the value of R (internal resistance) would be 200 Ohms, but as we practically double the size of the cells by joining a similar set of 20 cells with it for "quantity," that value is reduced to 100 Ohms; so that whereas 40 cells in series give 400 Ohms, the same number joined up as just described give only 100 Ohms.

If now we divide the full battery into four sets of 10 cells each and join all these sets side by side, we get

$$\frac{E}{R+R'}=\frac{10}{25+100}=\cdot04$$

In this instance R becomes 25, instead of 100, because instead of one battery there are four batteries side by side, quadrupling the conductivity or quartering the resistance. It is here clearly demonstrated that, while in the first case the battery resistance exceeded the line resistance, and in the third case *vice versâ*; in the second instance the two resistances were exactly equal, and as was predicated, the greatest strength of current was then obtained. This is well worthy of thoughtful study, not so much, perhaps, for working out problems, as for firmly imprinting upon the mind the very important deduction laid down.

In deciding on the form of battery to be used for any particular kind of work, resort should always be made to the simple formula we have been explaining. It frequently happens, however, that we cannot obtain a current of given value in Volts and Ampères without having a greater or less difference between the internal and external resistances. Let us suppose, for instance, that we want to illuminate a small room with an incandescent lamp which offers a resistance of 30 Ohms, and absorbs a current of 1·2 Ampères, with an E M F of 40 Volts. Suppose we tried it with 40 Daniell cells, we should get

$$\frac{40}{400+30}=\cdot093,$$

which is a long way short of what we require. In fact, in order to procure the required current it would be necessary to place 100 sets of 40 cells each, side by side, in order to reduce R to the value most useful for our purpose. Let us next try a Bunsen battery, each cell having an E M F of 2 Volts; 20 cells joined together in succession or series will give us 40 Volts. The internal resistance is very low, 20 cells giving 3 Ohms, or ·15 per cell. We therefore get

$$\frac{E}{R+R'}=\frac{40}{3+30}=1\cdot2$$

There is here a considerable difference between the internal and external resistances, but this is unavoidable in order to satisfy the requirements of the lamp. We can only reduce the external resistance by joining a number of lamps in parallel circuit or multiple arc. This consists in joining two or more lamps together in such a way that the current coming from the battery or generator on reaching

Fig. 1.

the junction, A, Fig. 1, of the lamps L, L' will divide between them, the two currents reuniting on emerging at B. It will be apparent on a little reflection that looking at a lamp as a conductor, two lamps put side by side or in parallel circuit, double the conductivity of a circuit having only one lamp, or, in other words, halve the resistance. The equations then become

with 2 lamps $\frac{40}{3+15}=2\cdot\dot{2}=1.1\dot{1}$ per lamp

with 5 lamps $\frac{40}{3+6}=4\cdot\dot{4}=\cdot 88$ per lamp

with 10 lamps $\frac{40}{3+3}=6\cdot\dot{6}=\cdot 6\dot{6}$ per lamp

In explanation it may be pointed out that although the joint resistance of the external circuit in, say the first case, is only 15 Ohms, each lamp offers a resistance of 30 Ohms. In the same way a water-pipe offers the same individual resistance to a flow of water, when another similar pipe is placed side by side with it to increase the delivery. The pressure of water, or the E M F of the electric current, are not affected by a reduction in the respective resistances, and consequently the E M F will be the same through each lamp, but as the current will have a choice of two similar channels or circuits, the *amount* of current will be equally divided between them, so that we get only $1\cdot\dot{1}$ Ampère instead of 1·2. This may be thought to be only a slight difference, but we shall recognise its importance if we bear in mind that we lose that part of the current which is most effective in illuminating the lamp. This loss of luminosity continues as we add the lamps, until heat only is generated.

To secure sufficient current to furnish a strength of 1·2 Amperes per lamp, we must increase our battery power, adding similar sets by the "quantity" arrangement, so that

with 2 lamps, 2 sets will give $\frac{40}{1\cdot 5+15}=2\cdot\dot{4}\dot{2}=1\cdot\dot{2}\dot{1}$ per lamp.

with 5 lamps, 5 sets will give $\frac{40}{0\cdot 6+6}=6\cdot 0\dot{6}=1\cdot 212$ per lamp.

with 10 lamps, 9 sets will give $\frac{40}{\cdot 3+3}=12\cdot 0=1\cdot 2$ per lamp.

The slight excess of current in the two first instances is increased in the third instance to sufficient to enable us to use nine sets instead of ten with which number we should get $1\cdot\dot{2}\dot{1}$ per lamp.

In each of the cases above cited the E M F was the same, but it must not be forgotten that when we join the lamps in series so that the whole current passes through each lamp, then we must increase the E M F in proportion. For instance, if we wished to illuminate two lamps in this way, we should require 40 cells, when we should get $\frac{80}{6+60}=1\cdot\dot{2}\dot{1}$

Here, while we get the desired E M F, we also secure the necessary amount of current; because with a current passing through a single circuit, the strength is the same at each and every point in that circuit.

An Ampère is for ordinary purposes too large to use as a unit, and it has been found more practicable to use instead a thousandth of an Ampère, under the designation of a Milliampère (expressed frequently by the letters M A).

The next unit for consideration is the Coulomb, which is a current of one Ampère flowing for one second. There is very little to be said on this head. It will be apparent that whereas the Ampère is strength independent of time, the Coulomb is strength enduring for a stipulated time, and is therefore virtually a measure of quantity. We may call it a measure of work-power. Again, as the force necessary to raise one pound through one foot in one second is identical in amount with that necessary to perform the same work in ten seconds, so also is one Ampère lasting one second equal to a tenth of an Ampère lasting ten seconds—that is, one Coulomb.

TRANSITS OF VENUS.

By Richard A. Proctor.

(*Continued from page 356*).

We have now to consider the circumstances which render the varying position of the conjunction-lines important in connection with transits of Venus.

If Venus travelled in the same level as the earth, she would necessarily be directly between the earth and sun

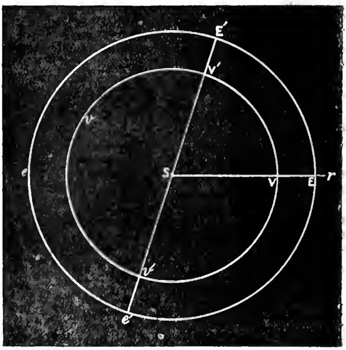


Fig. 2.

when in conjunction, as when the two bodies are at E_1, V_1, or E_2, V_2, or the like. Venus would then be visible, from the hemisphere of the earth which was at the moment turned sunwards, as a black spot centrally placed on the sun's disc at the moment of conjunction. But although the path of Venus lies *nearly*, it does not lie *exactly*, in the same level as the earth's. Thus, if EE′e (Fig. 2) represent the earth's path, while VV′v represents that of Venus (E being the place occupied by the earth at the Autumnal Equinox, so that SV is directed to the point in the heavens called the First Point of Aries), then the planes of the two orbits intersect in the line E′e′. And if we regard the earth's orbit as lying in the plane of the paper, then the orbit of Venus must be regarded as crossing the plane of the paper at V′, passing to its greatest distance above (or north of) that plane at *v* (the actual distance being represented by the short white line at *v*), passing down to the paper again, which it crosses at *v*′, and then passing to its greatest distance below, or south of the plane of the paper, where a short white line is seen near V, and so onwards to its crossing place at V′.

It is manifest, then, that only when Venus is in conjunction with the earth at or near V′ (which is called her *ascending node*), or *v*′ (which is called her *descending node*), will she be seen upon the sun's face, crossing or *transiting* it as she passes onwards from conjunction. If she is in conjunction when near *v*, she will be above, or north of the sun's disc, by her greatest possible amount; if she is in conjunction when near V (close to the short white line), she will be below or south of the sun's disc by her greatest possible amount. But when in conjunction anywhere on the arc V′ *v v*′, she will be more or less above the *centre* of the sun's disc; and when in conjunction anywhere on the arc *v*′ V V′, she will be more or less below the *centre* of the sun's disc; and she will only transit the disc when she is so near V′ or *v*′, as to be *not more than the sun's semi-diameter* above or below his centre.

Let us then inquire within what distance from V or *v*′ Venus must be, so that, if in conjunction at the moment, she would be seen upon *some* part of the solar disc. The inquiry is a very simple one, in any case; but to reduce it to its simplest form, we will make the following assumptions:—First, the earth and Venus shall be assumed to be at their mean distances; next, we shall consider only the centres of the two planets, inquiring under what circumstances Venus's centre would be on the sun's face, as seen from the earth's centre at the moment of conjunction.

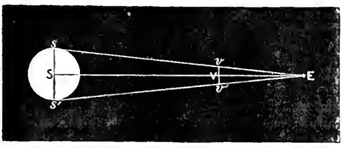


Fig. 3.

We have, then, the following relations:—Let E (Fig. 3) be the earth's centre, S the sun's, V the centre of Venus, when in absolute conjunction, that is on the line E S. Let lines E *s* and E *s*′ be drawn from E, to touch the solar globe; then, owing to the sun's enormous distance, *s* S *s*′ may be regarded as a straight line, square to E S. Draw another line *v* V *v*′, also square to E S. Then if, when in conjunction, the centre of Venus is anywhere between *v* and *v*′, the centre of the disc of Venus will be on the sun's face.

Now *s* S *s*′, the sun's diameter, contains 852,908 miles, if E S be assumed equal to 91,430,000 miles, as throughout this paper*; and on the same assumption the distance, E V, is 25,296,000 miles. But manifestly *v* V bears to E V the same proportion that *s* S bears to E S. Hence we have the simple rule-of-three statement:—

91,430,000 : 25,296,000 : : S *s*, or 426,454 : V *v*.

Whence V *v* or V *v*′ is equal to 117,987 miles.

It follows that if Venus, when in conjunction, has her centre not more than 117,987 miles above or below the line joining the centres of the earth and sun, then Venus's centre, as supposed to be seen from the earth's centre, will be on the sun's face.

Now it is easy to find how near Venus must be to her node in order just to have this limiting distance 117,987 miles from the level of the earth's track. Venus's orbit plane is inclined 3° 23′ 30·8″ to the plane in which the earth travels. Let us suppose that the orbits are looked at from a point in the prolongation of their common line of intersection, so that they appear like two lines, as VSV′ and ESE′, in Fig. 4. Then the points V and V′, where

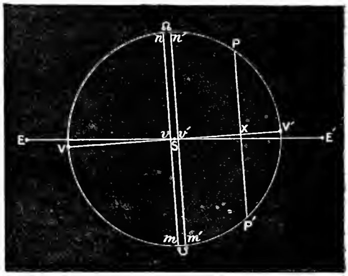


Fig. 4.

Venus has her greatest distance from the plane of the earth's orbit, are easily shown† to be 3,912,807 miles above and below that plane. And when Venus is at any other point of her orbit, as X—corresponding to either P or P′ if the orbit be supposed opened out to the circle VPV′—then her distance from the plane of the earth's orbit is less than 3,912,807 miles in precisely the same proportion that SX is less than SV or SV′. But what we want is to determine where Venus must be so that this distance may be 117,987 miles, neither more nor less. If *v* and *v*′ on either side of S be the required points (corresponding to the four points *n*, *n*′, and *m*, *m*′ in the orbit, where ☊ and ☋ are the nodes) we manifestly have the following rule-of-three sums for determining S *v* or S *v*′:—

3,912,807 : 117,987 :: S V or 66,134,000 : S*v* or S*v*′ whence we find that S *v* or S *v*′ is equal to 1,994,212 miles. Thus *v v*′ is about 4,000,000 miles. And it is clear that each of the arcs *n n*′ and *m m*′ is very nearly the same in length as *v v*′; for where the arc is small it differs very little from the chord. Hence we have this simple result: If Venus is within 2,000,000 of miles of either node when in conjunction, there is a transit; otherwise not.

* The result is not at all affected by this assumption, which is only introduced in order to make Venus's displacement a question of miles, instead of heliocentric latitude.

† Of course, this distance is equal to Venus's mean distance × sine of her inclination—on our assumption of mean distances. Owing to the small eccentricity of Venus's orbit, this assumption is not far from absolute correctness.

H[illegible] to know how many degrees, [illegible] each of the arcs [illegible] and [illegible]. This [illegible] calculated, since we know the radius of the circle [illegible]. We find, then, that each arc [illegible] 27 2[illegible]. Thus if Venus, when in conjunction, is within [illegible] 7 of either node (always, be it [illegible] assumption of mean distances) there will be a transit[illegible] not.

Again, adding together the two arcs [illegible] and [illegible], we get [illegible] as the total amount of arc of Venus's orbit, [illegible] must be for a transit to occur when she is [illegible]. Now the complete orbit contains 360°, and [illegible] is contained in 360°, 52·08117 times. So that on the average of many conjunctions one transit occurs for 52·08117 conjunctions. As each synodical period contains 583·9201 days, it follows that on the average of long periods of time, one conjunction occurs in 83·26182 years. But this would only correspond to the case where a very large number of conjunctions was considered.*

(*To be continued.*)

LEAF-COPYING.

BY TARANAKI, No. I.

I USED Mr. Roberts' process (p. 312) years ago, but never with good results. The following plan is much better:—Take a piece of thin muslin and wrap it tightly round a ball of cotton-wool as big as an orange. This forms a *dabber*, and should have something to hold it by. Then squeeze on to the corner of a half-sheet of foolscap a little colour from a tube of oil paint. Take up a very little colour on the dabber and work it about on the centre of the paper for some time, till the dabber is evenly covered with a thin coating. A little oil can be used to dilute or moisten the colour if necessary. Then put your leaf down on the paper and dab some colour [illegible]. Place it then between the pages of a folded sheet of paper (unglazed is best), and rub the paper above it well all over with the finger. Open the sheet, remove the leaf, and you will have an impression of [illegible] of the leaf. Any colour may be used. Burnt or [illegible] works the most satisfactorily.

ELECTRIC LIGHT ACCIDENT.—Much disappointment, says the *Standard's* Vienna correspondent, was created by an accident at Brünn on Sunday night last, where a new theatre was to have been opened, illuminated with the electric incandescent light. It was found that the lead connected with the conducting wires had mostly been melted by the current. A large and fashionable crowd had assembled at the doors of the new building, whom the Burgomaster had to inform that the performance could not take place in consequence of the failure of the electric lights.

* [illegible] resulting [illegible] intervals of [illegible] 105[illegible], 8, 121[illegible], [illegible] 60, [illegible] average [illegible] period of [illegible] more [illegible] there will [illegible] This [illegible]

"MUCH ADO ABOUT NOTHING."

(*Concluded from page 389.*)

WE have but a few words to add to that which want of space compelled us last week to leave unfinished. It will be noticed that in these pages, which do not aim at dramatic criticism generally, only those performances can be noticed which are important not solely because of the subject illustrated, but because their reception by the public tells us something about the culture of our theatre-going public—a matter of some sociological significance. As Herbert Spencer has recently well remarked in America, we hear a good deal of the Gospel of Labour, but the Gospel of Relaxation should also at times be heard of.

And speaking of America, it will be interesting in the light of what we hear respecting the reception given to Mrs. Langtry, to note how an actor and actress like Mr. Irving and Miss Terry are received by trans-Atlantic audiences. If it should appear that crowds rush to see and applaud a lady socially interesting, to minds of a certain order, but unquestionably not a great actress now, nor likely ever to be one (though in scenes where her natural self suffices she retains more of her natural self than most amateurs, being more self-possessed), while they are not interested in anything like the same degree in real dramatic power, then we shall have to admit that our cousins over the water, whatever excellent qualities they may possess, have *as a people* little taste or judgment in matters theatrical; though indeed their dramatic critics have thus far expressed views sufficiently correct.

We referred in our last to the scene between Benedick and Beatrice in the church, because we believe this scene to afford a crucial test of the actors' reading of their several parts. One who considers this scene superficially might consider (as we find many do) that Mr. Irving is right in regarding it as intended to excite laughter. If Benedick and Beatrice are in truth so shallow they should little interest us. Rightly read, there can, we take it, be no doubt whatever that the quaint love-making of Benedick in this scene, the half-sobbing confession of love by Beatrice, should be in no sense suggestive of laughter. He rightly takes her affliction as a motive to speak his love and to proffer his sympathy. She as rightly understands his kindly words. Neither falls entirely out of the old tones. It would have been scarce natural that either should. But there is only so much of that tone left as shows how truthful they both are. Anyone who fails to feel how the thoughts of each are occupied—his with sympathy and hers with sorrow—can never be made to feel as much by explanation or by reasoning.

One other fault (as it seems to us) in the rendering of these parts, and we have done—noting always that the good points far outweigh the errors. We cannot quite approve of the way in which both Benedick and Beatrice applaud their own wit. Beatrice laughs aloud at her own jests. Approved wits do not thus; only those whose jests must be illuminated with laughter or they would pass unnoticed. Even if Beatrice had had this excuse, her laughter would have seemed a little unladylike.

In passing, we would invite attention to the significance of the names Benedick and Beatrice.

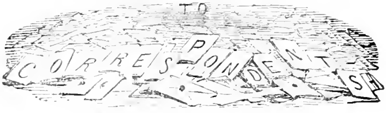
A seeming pertness, which is neither Beatrice's nor Ellen Terry's, arises from a change in the acting version. Shakespeare wisely interposed a good deal of conversation in the first scene, between the first words of the Messenger, and Beatrice's "I pray you, is Signior Montanto returned from the wars or no?" she waits to ask her question till all in whom her uncle is specially interested have been spoken of. In Mr. Irving's acting version she breaks in very rudely much earlier. It is impossible for the best actress in the world to correct the bad effect of this ill-advised change. We notice some other departures from the text which seem ill-considered. The parts of Dogberry and Verges are so cut down that the actors have no fair chance in them. The quaint ejaculation of Benedick's, "How now! Interjections? Why, then, some be of laughing, as, ha! ha! he!" is cut down to simply, "How now! Interjections?" which is quite out of character, the quotation from the old grammar rules being just as markedly in character. To have left out the whole sentence would have done well enough; leaving out all that marks the words as Benedick's, reminds one of the change made by an illiterate manager, who, having to abridge an acting version of "Rob Roy," altered Frank Osbaldistone's "My cousin Rashleigh, but for what reason I cannot conceive, my bitterest foe," into simply, "My cousin Rashleigh, but for what reason I cannot conceive!"*

Dr. Jule has been experimenting, with a view to counteracting the bad effects produced by the sulphuric acid, which the combustion of ordinary illuminating gas causes in sufficient quantities to destroy the binding of books and to tarnish the lettering on their backs, besides, of course, vitiating the atmosphere so much that the health of the person breathing it is injured. He suspended two plates of finely perforated zinc, one three and the other twelve inches above the burner. At the end of three months the lower plate showed an accumulation of the ordinary brownish-black deposit and a furring of sulphate of zinc, but the upper plate was only slightly affected. The inference from this examination is that a single plate of perforated zinc, about a foot square, placed over a gas jet is sufficient to retain most of the noxious emanations.

Electric Lighting of Canterbury Cathedral.—A contract has been entered into by the South-Eastern Brush Electric Light Company with the Dean and Chapter of Canterbury to illuminate the Cathedral by the electric light for a period of three months.

A Curious Tree.—Lieutenant Houghton, who has recently visited New Guinea and several other groups of islands in the Pacific, reports the existence of a prehensile tree. It appears to be a species of ficus, allied to the well-known banyan tree, which throws out from its branches air-roots, that eventually reach the ground, and take root there, and in their turn become new stems, which perform the same function; so that a single tree will eventually extend so far as to form a complete forest, in which the stems are united by the branches to each other. The prehensile tree in question similarly throws out from its branches long, flexible tendrils, which, touching the ground, do not take root there, but twine around any article that may lie within their reach. After a time these *quasi* branches contract, so that they fail to reach the ground; but the finger-like processes continue to closely gripe the article round which they have twined themselves, and which are consequently suspended in mid-air. In this way articles of considerable weight may be literally picked up from the ground and held in suspension.

* We may note here a curious blunder in the account given in the *Illustrated London News* of the play as acted by Charles and Mrs. Kean at the Princess's. Referring to a picture obviously describing the masked scene, the writer of the critique, who manifestly had neither seen nor read the play, refers to it as picturing the part of the final scene where Beatrice and Benedick read their "own hands against their hearts." In the folio edition, by the way, Benedick's "Peace, I will stop your mouth," is given to Leonato!



Letters to the Editor.

[*The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.*]

All Editorial communications should be addressed to the Editor of Knowledge*; all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs Wyman & Sons.

⁂ All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

ADVANCE OF SCIENCE.

[622]—In your "Answers to Correspondents" in a recent issue of Knowledge, I see that some one requires a book treating on the advance of science.

Let them try "A Short History of Natural Science." This is a capital book by Miss Buckley, and treats on the subject from the time of the Greeks to the present day. A. Carus Wilson.

COLD BATH AT NIGHT.—LUMINOUS SEA.

[623]—I am not in the medical profession, but can inform A. E. Oram (605, p. 364) that a doctor, who many years ago advised me to take a cold bath every morning, recommended me under no circumstances to do so at night, the body not being then fit to resist the shock. He would himself omit his morning's cold bath if he had been attending a patient during the night. To the cold bath I feel that the preservation of my health and even life is owing.

When in Dunkerque harbour last year, my son amused himself on board while the steamer was waiting to leave by throwing pebbles, &c., overboard, to watch the luminosity, not observable unless the water was disturbed. This corroborates "Florian's" last paragraph (609, p. 364). A. Gaubert.

LUMINOUS SEAS.

[624]—I have seen, when conger-fishing at night off the coast of Finisterre, France, the water phosphorescent to the depth of over a fathom. The arrival of "fish" was announced at that depth by bright flashes of light, caused by the struggling eel disturbing the water. At the depth of three or four feet the fish was coated with the organisms, enabling us to distinguish size and species.

I believe that the amount of light displayed by the phosphorescent organisms depends a good deal on the state of the weather. In foggy weather, it is almost nil and superficial; if the day has been hot and calm, the phosphorescence is very vivid, sometimes covering the "cord" with a coating of fire to the depth of six or eight feet. G. D. Home.

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[625]—It is not the case that they became phosphorescent on the surface alone. I was told by the sailors of the ship that they were believed to extend to a depth of 50 ft. or so, and also to spread over certain parts of the sea in large shoals, covering several miles of sea. They always became phosphorescent on being disturbed, as in the case of a ship passing through, or the instance of the luminous shark, where the sensibility of these organisms must have been great. E. R. Nevill.

THE MILKY SEA AND JOSHUA.

[626]—Mention was made in a back number of the white waters sometimes seen in the Indian ocean.

Any one wishing to read an interesting account of this singular phenomenon should read a book entitled "The Green Land;" and, beyond that account, he will find some most wonderfully graphic descriptions of tropical storms and African coast scenery, which, if [illegible] he came to him [illegible]

[illegible] into the common error [illegible] the sun's *setting*, whereas [illegible] rather that clouds should [illegible] the slaughter of the [illegible]

PERCIVAL A. FORTHERGILL.

[illegible] however.—ED.

UNIVERSITY OF LONDON.

[627]—[illegible] strongly recommend "Matriculating Student" [illegible] the subjects (to the extent required) thoroughly. [illegible] the policy of study is to make the probable [illegible] the examination-day the measure of necessary [illegible] For books of study, Geddes' "Greek Grammar," [illegible] "Analecta Græca Minora," Newth's "First Book of Natural Philosophy," and Roscoe's "Elementary Chemistry," if [illegible] mastered, prove more than sufficient. King's College, [illegible] is one of the best teaching institutions for the examination.

FRANK P. MONTH.

628—There is a very good Matriculation Examination Class [illegible] at St. Bartholomew's Hospital.

MEDICUS.

BRAIN TROUBLES.

[629]—May I add my quota to singular experiences of this kind. When tired, or not feeling "fresh" at my work, I find myself [illegible] writing "b" for "p," "d" for "t," "v" for "f," and [illegible] Thus I look over a page and find "derifed" for "derived," "fenture" for "venture," "abart" for "apart." Has this confusion been experienced by any of your readers?

G. R. W.

INTELLIGENCE IN FISH.

630—The following, which I have just received from a relative, will, I think, show that minnows, small though they be, are not utterly devoid of reasoning powers. A minnow was put into a bowl which was usually only inhabited by another minnow smaller than itself. Shortly after the larger minnow was observed driving the smaller one furiously and unceasingly round the bowl, and was, in consequence, taken out and put into a cup of water. Soon after this it was found that it had jumped out of the cup and was lying on the floor in an almost dying condition. It was however replaced in the cup and afterwards again transferred to the bowl with the other fish, where it has now become as lively as ever, with this difference that it now always backs away from the little fish as if afraid of it. Perhaps its fishy brain connects its frights and adventures with the little one, and imagines it to be its victor.

E. T. C. W.

A QUERY.

631—[illegible] of your correspondents give the formula used [illegible] for the reduction of barometric observations [illegible] level and to 32° F.?

JAS. WATSON, JUN.

LEAF COPYING.

[632]—[illegible] "Leaf Copying," by J. F. Roberts, in your [illegible] interested me very much. There is only [illegible] a little in doubt, and about which I [illegible] What is meant by copying-[illegible] to the paper upon which we take press [illegible] so far as I am aware, ruled. [illegible] in a future number of KNOW-LEDGE [illegible]

R. F.

[illegible]

[illegible] you or any of [illegible] the hosts of flies which [illegible] disappear sometimes in a [illegible] Many of these insects, we [illegible] during the [illegible] forth with the return of [illegible] These, however, [illegible] for our midsummer [illegible]

[illegible] is pro-[illegible] within the body of the [illegible] the long battle?

M. D.

Answers to Correspondents.

*** *All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded, nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

T. A. The effect of condensation is measurable, and greatly falls short of that necessary to produce the intense light. On the other hand, the heat required to effect dissociation and given out when chemical combination takes place is also measurable, and is found to be equivalent to that necessary to produce the light. This being so, can we doubt which is the true theory? S. M. A very singular coincidence. AN ADMIRER OF KNOWLEDGE. We wished to insert your letter. But it is not quite fair. You speak of Z wishing to torture prisoners that his own corns or toothaches may be cured, and apply the same sarcasm to Tyndall and Huxley. I doubt if any advocate of vivisection has ever thought of getting cures for his own pains. J. W. WILLIAMS. I suppose there would be a slight difference in favour of the stronger-haired teazels. This would tell in the long run, though many even of these would doubtless be consumed.—P. O. DODD. Please address the publishers on such matters.—M. H. C. "Gradatim" was asking about the actual glacial periods, not about relative glaciation. The quotation is given as a line, not as a hexameter; if it had been given as in Horace, the passage would have been absurd. It would have read thus:—British earthquakes remind us of the old line, "the mountains are in labour, a ridiculous mouse *will* be born," where we meant "*is* born." That would have been absurd if you will. It was actually to show that the original was not quoted from that the order of the first two words was changed.—EDM. P. TOY. The calculation is given in my "Saturn and its System." But I may shortly give it again here.—TRESILIAN. I am somewhat of your opinion, but originally the papers were to have been fewer. J. M. S. That quotation appeared in our first number. It sounds a little too assuming for a quotation at the head of our correspondence.—TH. D. Many thanks. We had cut out that passage for quotation, but had not room. There is more to the same effect in this month's "G. MAG." May quote some of that.—GRUB. What a charming *nom de plume!* The invisible vapour of water turns into visible cloud under both conditions. In my article on Fog in Rodwell's "Cyclopædia of the Physical Sciences," I wrote, "Thus a river flowing from a warm to a cold region, will often be covered with fog, because it is colder than the surrounding air, which, becoming cooled below the dew-point, discharges its moisture in the form of fog; but again, a river flowing from a warm to a cold region will also often be covered with fog, because it pours more vapour into the air than can be retained in the invisible form." This last corresponds with the case in your experiment. J. M. I wish you had repeated your signature; had to search for former answer. The *locus* is the envelope of a series of circles of equal radius, all having their centres on the ellipse. To obtain the equation to this envelope would not be a very simple matter, simply because the equation is one of a rather high order. You get a biquadratic equation, involving the X-coordinate of the original ellipse; and eliminating this (as, of course, also the Y-coordinate) you get the equation required; but what you can do with it when you have it I do not know. REV. URB. S. You mistake; our omission of religious matter means only that controversial matter is excluded, not that "God cannot be introduced into his works." You will find no such omission either in KNOWLEDGE, or in the works of the writers attacked in the paper we censured. We did not ridicule this last, the case being too serious for ridicule.—C. W. BOURNE. We hope that Col. Keyser may be led to give the true account of what he did, and so correct the absurd statements which have been going the rounds of the papers. Fear we cannot find space for the simple geometrical proof that the circumference of the circle is less than $3\frac{1}{7}$. Whewell gave a similar proof that the circumference exceeds $3\frac{1}{8}$; see De Morgan's "Budget of Paradoxes," p. 417.—A. B. You have gotten a little mixed. Our formula connects r and a, the actual and the mean distance; from it and a known perihelion velocity, you seek to obtain the earth's perihelion distance—a most illegitimate proceeding! The ratio 207 : 208 which comes out is really the ratio between the estimates of the sun's distance used by me and you respectively.—A. F. OSBORNE. I know of no good text-book of astronomy for beginners—those by astronomers who *know* are so unintelligibly written, and those well written are so obviously written by those who do *not* know. We speak, be it noted, of text-books only. In Lardner's Handbook you will find a pleasing mixture of the two sorts.—O. W. P. Pardon me; I have not put the growth of the oak from the acorn as a proof of the doctrine of evolution. Both are illustrations of the wonderful operation of those laws which the Creator has assigned to his works. You say the acorn is the product of a perfect form. How do you know that? By the result only; for no man can recognise a perfect oak in an acorn. In like manner I find the forms you speak of as immature (though, by the way, the acorn is scarcely a mature article) must be perfect, for they develop to perfect forms.—G. N. Lt.-Col. Sorry for the delay, but between the comet and the transit astronomical matters rather crowd us.—A. F. O. Two comets travelling along precisely the same orbit near the sun would, of course, pursue also the same orbit far from him. But an orbit of great eccentricity, and with perihelion very near the sun, would be changed to one *appreciably* the same near the sun, but very different at a distance from him. Mr. Neison's remark must have been misunderstood by the *Athenæum* writer. It is perfectly correct, of course, but my friend Mr. Neison is not in the habit of announcing that two and two make four.—Jos. Clark. See letter about Rainband Spectroscope in No. 53.—H. W. C. K. (1.) See advertisements as to star maps for November and December. (2.) There is no mistake, either of engraver's or of mine. The signs of the zodiac were all right in their proper constellations two thousand years ago, at about which time, having for two thousand previous years been travelling athwart their constellations, they began to leave them. The cause was and is the precession of the equinoxes. (3.) That method of copying drawings is not suitable for drawings on thick paper.—Dens. I think I can answer that tooth question myself, for, sixteen years ago, I consulted a dentist about just such tiny black marks on a tooth. He scraped them out a little, and filled with gold, and I have had no more trouble with them. It is rather strange, by the way, that all the trouble I have ever had with my teeth began and ended (so far, I mean, as actual mischief was concerned) when I was at Cambridge, whence you write.—P. D. Glad of your kindly words. (1.) It would be difficult to say which pictures in ordinary galleries are "improper." There are paintings from which some turn away as if they were ashamed to look at them which are full of grace and beauty, and perfectly wholesome to healthy minds. I agree with you if you mean the coarse pictures of Bacchanals (hideous beasts!) by N. Poussin, and the like. (2.) Yes, "'allegiance,' 'loyalty,' and 'faith,' have been most nobly exhibited as between man and man, not between corporations, boards, and societies." Allegiance to the state, as the highest form of patriotism, is a worthy quality all the same. But if one sees a Fijian (for example) devotedly loyal (save the mark) to his chief, *because* that person is descended from X., a pirate warrior of some other race, and from Y., another pirate chief of yet another race (who perhaps conquered X.'s descendants, but married with a female representative), each descent being traceable through twenty generations along a line including nine or ten murderers, ten or twelve imbeciles, a few bastards, and some casual lunatics by intermarriages with neighbouring Polynesian races of more savage origin still, *then* science recognises a most interesting problem in tracing the growth and development of this most preposterous Fijian superstition. Yet a Fijian of twenty generations back, fighting for his chief and cheerfully giving up his life to save that of the leader of his people, showed true loyalty, and deserved to be held in loving remembrance by all his tribe—so greatly do circumstances alter cases.—R. H. A. Those lottery schemes are as honest as such schemes can be; that is, they are quite rascally. You know your chances and take them, and the company pockets assured profits, having not benefited but injured their kind.—H. Comberg. The effect of repeated doublings is indeed great; but I think it is pretty well known.—R. Waugh. My lecture has not been published.—Alfd. Dray. Better observe when the pole-star is just above or just below the pole; or else just to right or left, correcting for the star's distance from the pole. In my "Easy Star Lessons" the times when the pole-star is in these positions are given.—W. J. Palethorpe. Do not know the weight of the large mirror of the Rosse telescope, or of the Princeton lens. The diameter of the great mirror of the former instrument is 8 feet.—M. C. S., will be obliged to any correspondent giving information respecting the so-called caterpillar-tree of New Zealand. We have seen it, and been told much about it; but our informant was not scientific.—E. S. Purcell. Thanks.—Enitor ut Vincam, H. W. L. (?), A. A., Grisel. I believe you can always get Hamiltonian translations of Latin works at secondhand book-stalls. They explain themselves. You read on till you find yourself falling into the swing of the language and catching its idioms—it is just as if you heard the language spoken, and were told its meaning—just, in fact, as you pick up a foreign language when you live among those who speak it. Then you begin to combine this process with the study of the grammar—such simple books as Arnold has written, not the ridiculous books devised to perplex unhappy beginners. You gradually extend your vocabulary; but by reading, not by wearing out dictionaries. You will be told that this easy way of learning is not so good for you as the old-fashioned way, which reverses the usual order, and sets you learning rules before you know what they are about. It is not what a boy is told, said a learned idiot, but what he teaches himself, that is of use to him; whereunto the Rev. Sydney Smith rightly made answer, that one might as well say it is not the clothes a boy puts on that covers his nakedness, but those he makes for himself. I can only say, that having occasion thirteen years ago to review a German book, and knowing practically nothing of German, I bought four or five Hamiltonian books of German in Holywell-street, reviewed that work in less than a fortnight, after reading and enjoying it (the review appeared in *Nature*, and was republished in my "Light Science for Leisure Hours,") and that ever since I have been able to read any German prose I have yet come across, with such occasional aid from a dictionary as is rendered necessary by defects in my German vocabulary. A German grammar I found exceedingly interesting *after* I had thus got the swing of the language.—F. Chapman. If x = number of bullocks, y = number of sheep, and z = number of pigs, you have (using the half-sovereign as coin unit)

$$20x + 6y + z = 200$$
$$x + y + z = 100.$$

whence $19x + 5y = 100$, an indeterminate equation as it stands, but determinate if combined with the condition that x and y are both positive whole numbers, neither being zero. For it is obvious that x *must* be a multiple of 5, and cannot be a greater multiple than 5 itself, for if x were 10, y would be negative. Therefore, $x=5$, whence $y=1$, and $z=94$; making the total price paid for the bullocks £50; for the sheep, £3; and for the pigs, £47.

ELECTRICAL.

H'sett. — Very ingenious. Terrestrial magnetism is to all appearance the result of electric currents. Magnetism can scarcely be substituted for gravitation, because—if for no other reason—gravitation is an attractive force, exerted by all forms of matter in proportion to the bulk, but irrespective of chemical or physical constitution.—A. W. L. The slope is of no importance, and is only made for the sake of appearance, etc.—G. McIntosh. 1. Anent lead filings, try the experiment and see how it answers, but lead is the ultimate condition of the peroxide. Might not the heavy filings tear the spongy lead away? 2. Better use felt or asbestos, not cardboard. 3. Quantity and intensity are terms which have served a good purpose, but are now dying out. The fourth article on "Measurement" should help you to understand them, but another article is to follow, which, as it may remove your difficulty, please see. 4. The intensity or E.M.F. of secondary batteries is dependent on their constituents and independent of the charging current. A current of low E.M.F. may be transformed into one of high E.M.F. by charging the accumulators in parallel circuit or quantity, and discharging them in series. 5. You were right in connections, as the discharging current is opposite in direction to the charging current. 6. The E.M.F. of a dynamo varies as the number of revolutions made by the armature, and the intensity of the magnetic field affects the amount or strength of the current. 7. Don't quite see what you mean. 8. A motor, generally speaking, requires a current of low E.M.F. The little Griscom takes 12 volts. 9. I should not, under any circumstances, recommend Bennett's battery. Its E.M.F. is 1·5 to 1·8. It polarises like the Leclanché, and the recovery is slower than in that battery. Try Higgin's Bichromate battery.—H. W. H. Use white wax instead of the varnish.—Errol (?). Let me know the resistance of your battery.—R. O. The sounds may have resulted from indifferent insulation, considering the relatively high E.M.F., the "cracking" probably being caused by the passage of minute sparks between the wire and the frame of the instrument. The variations of the current were evidently too rapid to affect the galvanometer.

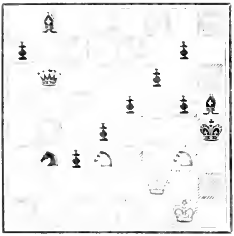
Our Chess Column.

By Mephisto.

REJECTED PROBLEM.

[illegible]

Black.



White.

White to play and mate in three moves.

1. K to KB5 (ch)
 K Kt5 best.

This is the problem which contains an idea similar to that [illegible] in the fine composition by John Simpson (Problem No. 54). We present it to our readers as a three-mover.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

[illegible] P. Rees.—The problem you sent has already been in type [illegible] time. We do not think it advisable to invite solvers to [illegible] problems; such a course is bound to create bad feeling.

[illegible] It is our intention to have a problem every week, but [illegible] proposes and [illegible] disposes.

[illegible] Problem [illegible] without solution. All problems [illegible] for publication [illegible] have the solution and the name and address of the composer written on the back of the diagram.

[illegible] Hancock, John W. Lower.—Problem received, will be examined in due course.

Correct solutions of Problem No. 53 received from Schmucke, [illegible] Watson, C. W. Croskey, H. Y. T., W. C. Thomas, John Alex. [illegible], G. Woodcock, Geo. H. Bonner, W. J. Reynolds, T. T. Dor[illegible], R. J. P., J. K. Milne, E. C. H., Berrow, Rev. C. C., W. Powell, T. S. L., C. S. Bright.

[illegible] correspondence games: G. Woodcock v. G. H. T., Alfred [illegible] Palmer v. R. Pilkington.

Our Whist Column.

By "Five of Clubs."

ILLUSTRATIVE GAME.

[illegible]

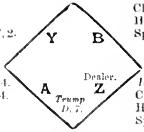
DEAR FIVE,—The [illegible] query answered by you, [illegible] 387, and in the [illegible] of our correspondence last [illegible] I was [illegible] in the evening than the [illegible] p. 387; [illegible] in your reply, my [illegible] have made five by [illegible] correctly [illegible] overlooking his indication [illegible] of trumps [illegible]. But the game will be instructive, [illegible] faithfully,

Editor.

THE HANDS.

Y.
Diamonds—Q, Kn.
Clubs—10, 5.
Hearts—8, 7, 5, 3.
Spades—K, Kn, 10, 7, 2.

B.
Diamonds—A, 10, 8, 2.
Clubs—A, Q, 9.
Hearts—Q, Kn, 10, 9, 6.
Spades—A.



A.
Diamonds—K, 9, 6, 4.
Clubs—Kn, 8, 7, 6, 4.
Hearts—A.
Spades—6, 4, 3.

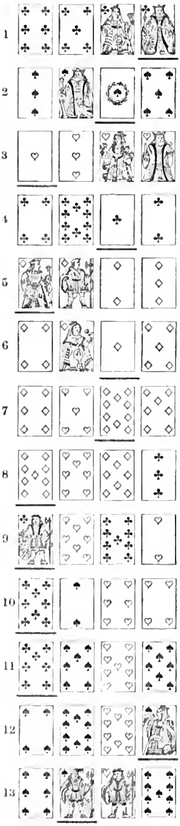
Z.
Diamonds—7, 5, 3.
Clubs—K, 3, 2.
Hearts—K, 4, 2.
Spades—Q, 9, 8, 5.

Score: Love all.

THE PLAY.

Note.—The card underlined wins the trick, and card below leads next round.

A	*Y*	*B*	*Z*
Mr. M—s.	Mr. W.	Ed. K.	Mr. F—r.



REMARKS, INFERENCES, &c.

1. *A* rightly opens his long suit, leading the penultimate. Unless some one is signalling, *B* perceives that *Z* must hold either two out of the three cards below the Six, or all three if *A* has not led from a five-card suit. He finesses the Queen as a matter of course.

2. *Z*'s suit is shown.

3. *B* properly opens his long suit, and is fortunate enough to see it established in the first round.

4. *A* completes the penultimate signal. *Z* must hold the Three; *Y* has no more; therefore, *A*'s Clubs are established.

5. *B* properly leads Trumps his own suit and his partner's being both established.

6. *A* rightly returns the lowest.

7. *B* should now be certain that the enemy's trumps are exhausted; but whether they were exhausted or not, his proper lead would now have been from his established Heart suit. This would have forced out the last hostile trump, however the Hearts lay: and then, the long trumps bringing in the lead again, *A* would have made all the remaining tricks with his Clubs. Putting aside *A*'s showing, in tricks six and seven, that he held originally four trumps (or he would have returned the Six) the case illustrates well the use of the force. For we see that even if the best trump had remained with *Z*, it could have been forced out, and the game won by cards. The only explanation of his bad play is that the triumphant aspect of matters, after trick five, caused our Editor's attention to nod for a moment, and so he suffered a won game to slip from him.* The rest of the game plays itself.—Five of Clubs.

* It is ever thus! The spur of difficulty is needed by most of us, to keep us on the alert. Kaiser, of Leyden, counting nearly 90,000 rotations of Mars to determine the Martian day, easily sets right all the really difficult parts of his problem, correcting even at last for the aberration of light, the effect of which, lost among so many rotations, is as nothing; and then, nodding, forgets that the years 1700 and 1800 were not leap years, and counts two whole days too many. Take care of things easy: things difficult take care of themselves (the proverb is to be patented).—Ed.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, NOVEMBER 24, 1882.

CONTENTS OF No. 56.

Science and Art Gossip.

We hear with extreme regret of the death of Dr. Henry Draper, Professor of Physiology at the University of New York. It has followed very soon after the death of his father. In Dr. H. Draper science loses an honest and zealous worker; one who has devoted time without promise of reward to his scientific work, nay, has expended more money in his free gift of labour to science than some advocates of the Endowment of Research have begged for. The discovery that oxygen, and probably nitrogen, exist in the atmosphere of the sun, is due to Dr. Draper, and would of itself suffice to keep his memory green. Scarcely less important, however, was his success in photographing the spectra of stars and planets, of Wells's Comet, and the great Orion nebula. The zeal and devotion with which he discussed the photographic methods available for observing the transit of Venus in 1874 were fully recognised by his fellow-workers in science, and even, wonderful to relate, by the Government.

The Poet Laureate seems to find it difficult to believe he is not a dramatist. Perhaps this is because some unwise critics described his first play as equal, *at least*, to Shakespeare's "Henry VIII." (so much of that play as may be Shakespeare's). "Queen Mary," where every character comes in with his label, saying at the outset in effect, "I am a clever person," or "Here you have a hypocrite," or "Behold in me the chief villain," should have shown every one of any critical judgment that our deservedly eminent poet has no dramatic power whatever. From bad to worse and worst, has brought us the "Promise of May," where the poet's idea of what a freethinker ought to be (but what no freethinker ever was or will be) is brought out in company with an utterly impossible plot, the climax of the unnatural being reached when a wretched girl, who returns to ask for pardon from her father, seems to jest (though the poet, no doubt, meant otherwise) at the words which show his mind is wandering:—"Take me out, little maid," he says, "this is one of my bad days:" there is a touch of true pathos here, though rather poetic than dramatic,—and she says, as he retires, "This is like to be the *last* of *my* bad days."

The Postmaster-General, in reply to a question in the House of Commons on the 9th inst., said that, taking a radius of one mile from the Post-office, the proportion, of underground to overhead telegraph wires was 1,822 miles underground, as compared with 58 miles overhead. By far the greater number of overhead wires belonged to telephone and other companies, and not to the Post-office. In one thoroughfare there were 97 overhead wires, only three of which belonged to the Post-office.

Among the proofs of the development of civilised races from savage tribes are the fighting instincts, which the reason rejects as unworthy, but which most of us feel none the less. We suspect even Mr. Herbert Spencer, who speaks with such contempt of these instincts, if he once began a fight, would hold out while he could see or stand. Many who hold (as we do) that all save defensive wars degrade the nation that begins them, have in them fighting instincts altogether independent of any question of right or wrong; instincts that once roused transform the whole nature, or rather show our nature as we had not before known it. So, too, "the pomp and circumstance of glorious war," which reason holds in supreme contempt, affect the calmest and the wisest. The fact is we are none of us so wise as we think in these matters. "We must pay soldiers to defend us," said a "white-bearded fellow" at the march past last Saturday; "but it is not a noble employment," *und so weiter*. A little later the band struck up, the martial pageant began, and lo! our wise man was cheering with the loudest. And why not? If we must (and we *must*) have fighting, those who do it for us deserve our heartiest thanks, even though they are paid so many pence a day for the work. And though military pomp no longer moves the more reasoning among us, one does not much envy the man who can see a torn war-stained flag, and, thinking what those rags and tatters *mean*, feels no thrill as it is borne past him.

A correspondent who approves of our objections to the publication of a private letter by Darwin's correspondent, expresses further the opinion that while Darwin's views about matters scientific must necessarily be of weight, his views about religious matters cannot be equal in value to those of men who have given their whole life to the study of revelation. We doubt if this would apply to his opinion whether there *has* been a revelation. By parity of reasoning the opinion of a Christian theologian should be regarded as of no weight against the views of a learned Buddhist respecting the validity of what *he* held to be revelation. All that any theologian can do is to acquire intimate and perfect knowledge of what those books teach which are sacred to *him*. Against the whole life of a Christian, Mahommedan, or Buddhist theologian devoted to the study of what he regards as a revelation (and two out of the three *must* be mistaken), may very fairly be set the whole life of another man devoted to study on a line consistent, perhaps he may have thought with only a material revelation.

After a heavy storm of wind and rain, which terminated yesterday week, there was experienced the most severe "magnetic storm" ever recorded. It commenced early last Friday morning, and continued at irregular intervals until Monday. The aurora was distinctly visible, and earth-currents traversed the telegraph wires throughout the country. The currents varied considerably in strength and alternated in direction very rapidly, although the general direction appears to have been south-west to north-east. At one time the current measured 59 milliampères, and as most of the telegraphic apparatus now employed responds to a current of 3·5 milliampères, the effect can be readily imagined. "Looping" was resorted to in almost every possible instance (by looping is meant dispensing with earth-connections and using a return wire instead.) This method, while it prevents earth-currents reaching the wires, necessarily reduces the number of lines by half, besides doubling the resistance of the circuit in each case.

The value of the American signal service to the commerce of the country was strikingly illustrated during the violent equinoctial storm in September. As soon as its approach was heralded from the South Atlantic coast, cautionary signals were displayed at all the ports, and hundreds of vessels, whose commanders had learned by experience the value of such warnings, waited in harbour until the storm was over. The observers at a number of ports report that the value of the vessels and their cargoes which were prevented from sailing by these signals was $6,460,586, and as no trustworthy statistics could be obtained from New York, Philadelphia, or Boston, the estimate that $13,000,000 of property in all was thus kept safely in harbour does not appear unreasonable. As the storm was very severe, there is no doubt that a considerable percentage of this great sum, to say nothing of many lives, would have been lost if the vessels had put to sea, and the saving thus effected is of itself a sufficient vindication of the value and efficiency of the signal service.

Overhead Wires again.—The daily papers report a fire in a Manchester warehouse last Friday, with a loss of £100,000. It is asserted that fully 300 telegraph and telephone wires converged on or passed over the building. They were in the midst of the flames. "A few of the wires broke soon after the fire had heated them, and fell into the street, but the main portion held out until the roof of the warehouse gave way, and they were then broken by hundreds, and the ends of most of them fell in a state of white heat into the street or on the roofs of adjoining buildings." We leave our readers to imagine the amount and duration of the inconvenience likely to result from such a catastrophe.

In the *Evening Times* some capital star maps have been commenced, which promise to be of great use in spreading a knowledge of the heavens. It is worthy of notice that these maps are printed with the ordinary machinery of the *Evening Times*, which prints 25,000 impressions in an hour.

The following statistics may interest those readers (very few) who seem to think Sir J. Hooker may after all be using the public fairly in the matter of Kew Gardens :—

[illegible] upwards of £20,000 per annum, [illegible] to sunset, at this time of the year [illegible] Edinburgh Botanic Garden, [illegible] from 6 a.m. to 6 p.m. in [illegible] from 6 a.m. to 8 p.m. in June, [illegible] are held daily. (Extracts [illegible] support of the Garden £200 [illegible] The funds at present granted [illegible] Garden are only £1,466, [illegible] by the utmost economy [illegible] The class last session [illegible] can only accommodate [illegible] Garden is open from 10 a.m. to 6 p.m. Madrid [illegible] open from morning until dusk. Chris[illegible] Hamburg Botanical Gardens are open from sunrise to sunset. Geneva Jardin Botanique and Jardin Anglais, open from sunrise to 10 p.m. Amsterdam "Hortus Botanicus" of the University, open from sunrise to sunset.

A rather amusing mistake was made in our Gossip columns last week ; a mistake for which our readers have not, we think, to thank ourselves, but the printers. We meant, at any rate, to say that Elihu was spoken of as approved of Yahveh (or Jehovah) ; but he is described as "approving of Yahveh," which would rather have suited the three friends Bildad, Eliphaz, and Zophar, and some teachers even in our own times. I recall here a case showing rather amusingly that many of the more ranting religionists are very ignorant of the book they intend to revere. At the close of a lecture in Sydney we had quoted as a sentiment, of which every student of science still sees the truth, the saying of Elihu that as touching the Almighty we cannot find Him out. On this it was announced the next Sunday by a popular preacher that he would show the foolishness in God's eyes of "Job's three friends and Mr. Proctor," who failed to find out God. It was a new light to him that Elihu was not one of the three friends of Job, but condemned them as fully and as justly as he reproved Job.

As a proof of the advantage of using the type-writer, I note that, owing doubtless to our bad writing, the Rosse telescope has been magnified from a real diameter of six feet to one of eight feet. We usually answer correspondents on the type-writer, but this time were away on a lecturing tour.

A meeting was held in the Royal Exchange, Middlesbrough, on Friday, the 10th inst., to consider the proposal of Mr. B. Samuelson, M.P., to establish a school of science at Middlesbrough. A letter from Mr. Samuelson was read, giving his views on the matter. He suggests, first, that the school should give theoretical and practical instruction in inorganic chemistry and in certain departments of physics, more especially heat. Secondly, that there should also be taught elementary mathematics, including mechanics and drawing. Thirdly, that the earlier courses should be followed by others in metallurgy, more particularly in the technology of iron and steel. Fourthly, that organic chemistry should be taught, and pupils should be instructed in the technology of the chemical manufactures in the district. Mr. Samuelson thinks the school could be built for £5,000, exclusive of land, and recommends that not less than £10,000 should be raised. He says he is willing to subscribe £2,000 and £120 per annum. A committee was appointed to take the matter up.

The star maps for November and December are to be published, price 2d. each, for the benefit of those who wish to complete sets.

The editor requests that in future letters intended for the authors of articles in Knowledge, should be addressed to them, care of the publishers, as it has become quite impossible for him to deal with half the letters which reach him. In any case, there can be no quick replies to most letters, for already there are dozens in arrear. If any reader can suggest a way out of the difficulty, short of random shots at the waste paper-basket, he will oblige ; but not if he has no practical suggestion to make, for that would only add to the difficulty.

THE GREAT COMET.

By T. W. Webb.

I HAD been hitherto very unfortunate with respect to this noble object. Presuming, after what I had read on the subject, that with so efficient an instrument as my excellent 9⅓-inch "With" mirror I should have little difficulty in detecting the nucleus by day, and being anxious to ascertain its aspect, as to which no definite information had up to that time reached me, I spent much time on September 22, and again on October 2, in sweeping for it, but all in vain; my very hot and uncomfortable search on the former day being enlivened by the occasional passage of small white nebulosities across the field, which I at once recognised, according to Dawes's former experience, as thistle-down or winged seeds of some kind. One of these for a second or two revived my hope as to the attainment of my object, being, no doubt, entangled in some temporary aerial eddy, from which it soon escaped and sailed away speedily after its congeners. October 3, in the early morning, I obtained my first view of the end of the tail, the rest being hidden by trees. It was of a distinct though very pale brownish yellow hue. From that time bad weather or other hindrances prevented my getting a sight of it till after I had left home, October 25, when, as on the following morning, notwithstanding a full moon, it was a conspicuous object. The nucleus appeared in a small binocular like a third magnitude star, with a coma of perhaps 15′ in diameter; the tail, to the naked eye, may have reached about 15°, of a slightly yellowish tinge, of considerable apparent density, not much degraded towards the end where it was a good deal expanded, curving very slightly upwards, and rather better defined on the under side. On the 25th my wife's keen sight detected a darker space in the interior of the tail, for a considerable distance from the end, which was bifurcated, the uppermost apparent portion being the longer and the most curved upwards, presenting a slight resemblance to some of Schröter's figures of the comet of 1807, in which, however, this unequal division was so strongly marked as to lead that observer to the idea of a double, not hollow, tail. The approaching though decreasing moon subsequently interfered with its visibility, but on Oct. 9, that impediment being removed, it was a very striking object about 5 h., and not inferior to its earlier appearance. Bad weather again intervened till Nov. 14, when, as there was a fair prospect over-night, I left the shutters of the telescope-house open, and the ocular (a beautiful low-power Kellner, by Parkes, of Birmingham) in its place, and everything prepared for an attempt before the dawn. Nov. 15, at 3 h. 30 m., the end of the tail was visible in the south, and before 5 h. the whole comet was a striking object from the house; and though we both thought that it was a hopeless case, as being below the range of the "great gun," yet I decided on a hasty dressing, and sallied out, in a temperature of 25°, to be fully repaid for my venture. Though shortly about to pass behind trees, the head was completely visible, and the sharpness of the surrounding stars proved that its definition suffered little from its small altitude. But great was my astonishment to find that the nucleus, which had just before been seen with the binocular as a misty third magnitude star, was entirely dissolved into haze. It was very considerably elongated, at least three times longer than broad, by an independent estimate, agreeing remarkably with that of Dr. Erck, on Oct. 16; and though eminently luminous, entirely destitute of definite outline, melting away into the surrounding feeble coma, and forming the uninterrupted base of a dense tail. These appearances were fully confirmed by a very fine positive ocular, power about 200. A rough guess from memory might allow it about 0′·75 by at least 3′. Its aspect was that of a brilliant and abrupt condensation of the surrounding mist, without the slightest indication of jet or envelope or more luminous centre. I did not on this occasion notice the harder definition of the lower side of the tail, but we both remarked a kind of tuft at the end of the upper side, as though some of the luminous material were left behind and scattered in its progress. The subsequent change of weather has made me still more pleased with my success; as possibly this may have been the last opportunity of efficient observation, before increasing distance has rendered it a more difficult and less interesting object.

In a neighbourhood so remote from the ordinary opportunities of scientific observation, I have perhaps no right to complain; but I have been much struck with the absence of easily-accessible information as to the aspect of the head of the comet in its earlier stages. We have heard much of its having been seen, but little of what it was like. Even in that "unique" observation which records its visibility even up to the sun's limb, no mention was made, as far as I have seen, of its aspect or apparent magnitude. Let me express the hope that, at some future time, when its visible course has been more nearly run, and suitable materials can be collected, our Editor will favour us with what he is so peculiarly qualified to give [thanks, but I doubt this much.—R. A. P.]—an exhaustive monograph of this confessedly most wonderful object; and if it should swell to the magnitude of a treatise, I am sure none of his readers will complain.

THE REVIEW.

By the Editor.

BY the merest accident, I saw much more of the march of the troops, &c., last Saturday—having been trapped in St. James's Park by a clever manœuvre of the park-keepers, on my way from St. James's-station to Piccadilly—than I wanted to see. Let me record something of what I saw and of what I thought on the occasion. It had its sociological, and therefore its scientific aspect. The people have had an opportunity of expressing their sense of the business-like way in which a difficult and trying campaign has been carried out, and their recognition of the bravery which our troops displayed, as far as the cowardice and inefficiency of the troops opposed to them would permit. There was something very satisfactory in the sensible way in which those assembled to witness the march of the troops welcomed those who had done their work well, and who would certainly have shown the old fighting qualities of our well-welded race if they had had the chance. There was a kindly warmth about the reception of the soldiers, no very undue air of glorification over a small triumph, and good temper with the rather blundering police. The soldiery looked as if they had no end of fighting in them, if wanted—not so stalwart, all of them, as we could have wished, but with looks suggestive of stubborn pluck, such as the British bull-dog is expected to possess, and as (Herbert Spencer notes) the Tasmanian Devil possesses in higher degree than any animal on the face of the earth. Many of the officers rode ill, but perhaps their horses suffered in Egypt. The police were good-tempered, and though some of them acted rather stupidly, they stood the chaff of the people pleasantly enough. The way in which they imprisoned many hundreds of British citizens in St. James's Park was ingeniously blundering, [illegible] the gates on the north side at the same [illegible] the south. When a little common sense [illegible] that egress should in such cases [illegible] egress is prevented. Thus, many [illegible] had intended to see the march from their club windows, [illegible] windows along Piccadilly, St. James's [illegible] and (a more serious wrong) several work [illegible] way to execute orders, found themselves im[prisoned] in St. James's park at half past eleven, through a [illegible] stupidity on the part of the park-keepers and [illegible]. Viewing the conduct of these prisoners as a [illegible] of character, I was struck by their patience while they thought their imprisonment due to official zeal, and [illegible] their marked change of tone when, after the return of the royal folk to Buckingham Palace, the gates were still kept locked. What happened elsewhere I do not know; but where I was, the strength of those gates was [very] quickly subjected to a scientific test, and the result—which I have much pleasure in submitting to the park-keepers—showed that the gates must be made very much stronger if they are to imprison people who are resolute to get out. Far the warmest cheering heard throughout the day followed the capture of that Tel-el-Kebir gate, in the face of policemen who had a few moments before forbidden a working man to climb over it. But those who had been imprisoned had really had, at first, small reason to complain, for they had far the best and most varied view of the whole affair. Those who wished could see the [illegible] from Buckingham Palace and back, as well as the march of the soldiery to and also from the Horse Guards, and the Mall was really the only place where a tolerably large array of soldiers could be seen at one view. After continental reviews, where from fifty to a hundred thousand men are brought together, the affair was, of course, somewhat insignificant as a military display; but a view commanding the Mall at one time on the 18th was rather fine for this country. Our people, by the way, are not often favoured [illegible] with great military displays—when they have them they seem willing to make the most of them,—and so do our newspapers.

Of the royal [illegible] I can say little, my attention having [been] chiefly occupied with the soldiery and the people. Besides I was so unfortunate as not to know any of the royal family by sight. A genial and kindly-looking gentleman in a cocked hat—the Prince of Wales, people said—left a pleasant impression; and of all the ladies I saw throughout the day, none seemed more perfectly lady-like and charming than the Princess, his wife. It seems [illegible] the way, that so much bowing should be expected, [illegible] intended to correct the impression that princes [illegible] generation—quite the contrary, I should [illegible]. A rather dull-looking Scotsman seemed from the [illegible] given him not only by those in the same carriage but by the people, several of whom cheered as he [illegible] important personage; yet, oddly enough, he was not riding inside a carriage, but at the back. I [illegible] he was the representative of some ancient Scottish [illegible] Bradwardine tells of—"the [illegible] of the great tenant of the crown"—a sort of [illegible] he may not be as dull a man [illegible]. Later in the day, two well-mounted officers [illegible] Prince of Wales and the Duke of Connaught, I think [illegible] great [illegible] and patience under trying [illegible] for, as they rode through the crowd, they [illegible] cheered, but some of the more ill-[illegible] of the crowd [illegible] grasped the hand of the [illegible] with a [illegible] that he seemed likely to [illegible] his horse. But he bore it all like a prince [illegible] fellows. The mere staring of the people was enough to have taxed any man's patience (scarce one in the crowd seemed to think that manners required that they should leave off staring when a Prince or a General was close by!), but pulling a man nearly off his horse is *un peu trop fort*.

A student of human nature may pass a few hours worse than in observing the ways of a British crowd. Our people are not brilliant on such occasions. The nearest approach to a joke which I heard, was the comparison of a trooper to a Dutch oven, and I suspect even this was a jest of hoar antiquity. But they are good humoured and tolerably patient. So too are our police. Americans, who think they have more real liberty than Englishmen, may do well to note that many things which our police accepted with good-humour last Saturday, would have brought into unpleasant action the truncheons of the police of New York.

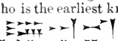
THE LIBRARIES OF BABYLONIA AND ASSYRIA.—I.

IT is now more than thirty years since Sir Henry Layard, passing through one of the doorways of the partially explored palace in the mound of Kouyunjik, guarded by sculptured fish gods, stood for the first time in the double chambers containing a large portion of the remains of the immense library collected by Assurbannipal, King of Nineveh. The floors, to a depth of a foot or more, were covered with thousands of tablets, all engraved with cuneiform writing; many in perfect condition, but the majority broken into several fragments, frequently widely separated and portions apparently sometimes missing altogether. These tablets were of various sizes, ranging from one inch square to about nine by six inches, by far the larger portion alike in shape, something similar to a pin-cushion, or dog biscuit, but occasionally resembling a cylinder or small barrel. The lesser ones contained, perhaps, only two or three lines of characters; the larger sometimes nearly one hundred. From the manner in which they were heaped together and broken, and the fact that many have been found buried in neighbouring parts of the *débris*, it is evident that these chambers were not the original depository of the tablets, but that the library must have been placed in some upper story of the edifice of which they formed a part. Then, upon the destruction of the building, they were precipitated into the position in which the explorer found them. Some, however, owing to this violent change of site—and others because of the whole ruin at some period having been searched over, doubtless for treasure—were scattered to other parts of the mound, which consequently has to be carefully examined all over in order to restore to us the library as far as possible complete. Since that time, with but slight intermissions, this treasure house of a forgotten past has been turned over again and again, notably in the expeditions of the late Mr. George Smith, and still the supply of its cuneiform literature is not exhausted.

Until last year this discovery remained unique; but the perseverance of the British Museum authorities and the patient labour of Mr. Rassam were then rewarded by the exhumation of what is apparently the library chamber of the temple or palace at Sippara, with all its 10,000 tablets, resting undisturbed arranged in their position on the shelves, just as placed in order by the librarian twenty-five centuries ago. In hope of both gratifying and increasing the interest awakened by this wonderful discovery, it is intended to give a short and simple account of what is known as to Babylonian and Assyrian libraries, their sites, founders, librarians, and the language, writing, and subjects of their contents, embodying the most recent acquisitions to the history of the subject; but carefully adhering to the ascertained facts, and avoiding inferences, however attractive, that may still be matters of dispute.

It cannot yet be determined with certainty where was the seat of the first public library of the Accadian inhabitants of Babylonia; and even if it were, that would not inform us whether the contents of its clay tablets or books were written there for the first time, or copied from texts brought on papyri by the Accadians when they came into the country. This, however, is a question which will receive much incidental illustration when discussing the original writing materials of this people.

From what Berosus* tells us with regard to Sippara, or Pantibiblon (the town of books), the very city, one of whose libraries has just been brought to light, which, if we may judge from the first half of its contents that has arrived, was devoted to documents relating to mercantile transactions almost exclusively, having been the spot where Sisuthrus buried his literary treasures before the Deluge, it may be inferred that this was certainly one of the first towns that collected a library. It was from the site of this city, now the mound of Aboo-Habba, that Mr. Rassam sent the ancient engraved stone which he found, together with two cylinders of Nabonidus in an earthenware coffer. This stone is dated in the reign of Nabupaliddina, that is, in the ninth century B.C., and tells us that the place of its deposit is the famous temple of the sun-god E Barra, speaks of its destruction by invaders called the Sutu, mentions that Simas Sigu commenced its restoration, that the work was carried on by another monarch, but it remained for Nabupaliddina to finally destroy the Sutu and complete the temple. This King Simas Sigu is about the fortieth name in the list of early sovereigns after the Deluge discovered by Mr. Pinches, and the second monarch E Ulbargarmu occurs in the ancient list of kings, a fragment of which was found by Mr. Smith, as separated by two reigns only from Simas Sigu.

It is possible that the mound at Mugheir enshrines the oldest library of all, for here are the remains of the city of Ur (probably the Biblical Ur of the Chaldees). From this spot came the earliest known royal brick inscription, as follows:—"Urukh, King of Ur, who Bit Nannur built."† Although there are several texts from Mugheir, such as that of Dungi, son of Urukh,‡ yet, unless by means of copies made for later libraries in Assyria, we cannot be said to know much of its library. Strange to say, however, the British Museum possesses the signet cylinder of one of the librarians of Ur, who is the earliest known person holding such an office, named  (Amil-anu), who lived in the reign of  (Emuq-sin), King of Babylonia. Its inscription is given thus by Smith:—"Emuq-sin, the powerful hero, the King of Ur, King of the four regions; Amil Anu, the tablet-keeper, son of Gantu his servant." An inscription of Sin Iddinna, from Ur, relating to the excavation of a canal, and another of a monarch named Nur-vul, and also a contract tablet of his reign, are given by Smith,§ who also found a mutilated memorial tablet in the mound of Kouyunjik, which had probably been carried away from Ur by the Assyrians in some victorious campaign. It refers to "Rim-agu, the powerful hero, governor of Ur, king of Larsa, king of Sumir and Accad," a sovereign who we know, from Hammurabi's inscriptions, was defeated by him. It was Hammurabi who transferred the capital from Ur to Babylon, and, no doubt, from that time its library was surpassed by that at the latter city.

A Member of the Society of Biblical Archæology.

* A priest of the Temple of Bel, at Babylon, who wrote in Greek a history of Babylonia and Assyria derived from the archives written upon tablets preserved in libraries of Babylonia.—See Cory "Antient Fragments," and Lenormant "Essai de Commentaire des Fragments Cosmogoniques de Bérose."

† "Bit Nannur." The house of Nannur (the Moon God).

‡ Smith's "Assyrian Discoveries," 232. Some scholars pronounce the characters of Urukh's name differently as Lik Bagas.

§ Early history of Babylonia.

ANTI-CORSET PHILOSOPHY AND HISTORY.

The letters of the Rational Dress Reformers (I should put the hyphen in one place and they in the other) provoke me to trouble you once more. I thought Dr. Chadwick's sensible and moderate answer to that highly imaginative epistle, signed F. W. Harberton, of Sept. 29, sufficient; but Mr. Leigh's, of Nov. 10, shows again that these regenerators of mankind equally despise history and personal experience and the results of daily observation; for every one now can see for himself the truth of what several other doctors wrote a dozen years ago, that in spite of all theory, "tight lacers are generally active and healthy people," and the best riders and walkers, and are evidently not the least entitled to the glory of martyrs, as is commonly assumed, and as the victims of tight boots and enormously high heels cannot conceal that they are; which are very ugly besides.

You remarked on my letter of July 21 that you knew some one who had tried tight-lacing, as recommended in several letters in the *English Mechanic* for indigestion, &c., and had found it caused a sensation of fulness in the hand. Certainly he ought not to persist in it then, nor should any one beyond the point at which internal sensations give warning to stop. One poison is no rule for another in such matters. The letters in the *English Mechanic*, and a little book full of others, selected from a now extinct periodical which I met with about ten years ago, called *Figure Training*, and others subsequently in the same magazine amply prove that. The great majority of the writers—I may say all who wrote from their own experience—said they had found the tightest lacing they could bear, especially in stays quite stiff in front, both pleasant and beneficial, and among them was a surgeon. Some, however, find it expedient to remain under contraction only a few hours in the morning, and the surgeon discarded his stays when taking strong exercise, which seems natural; but others lace tightest for riding, and ladies mostly in the evening, and some enjoy and recommend confinement in stays all night also—an old practice which used to be enforced in some families and schools. Men generally prefer belts, but not a few wrote that they found regular long and stiff stays much nicer and better for their health. Two or three said they could stand and walk much longer in them than without, and that their health relapsed whenever they gave it up. Many had begun it under some kind of compulsion, but had soon come to like it, even after severe treatment at first. As I said before, the philosophers got much the worst of it in those discussions.

My philosophy about it is that all those statements of personal experience, with their variations in detail, are worth infinitely more for practical purposes than all the talk about lungs and diaphragms and capacity of chests which vary a great deal naturally), nature, and anatomy, Greek women in flesh and marble, and the unquestioned bad effects of [illegible] tight lacing, which proves nothing but itself. Such a multitude of persons of all ages and kinds cannot possibly be either mistaken or lying about the fact of their own good health, or that of their children, pupils, schoolfellows, sisters, mothers, and friends, notwithstanding, or in consequence of, their having been contracted into the smallest circumference they could bear for many years of their lives. It is very easy to be mistaken in attributing either good or bad health to a particular cause, but the fact of it cannot be doubtful. And that, with sundry medical letters such as I have alluded to, is the summary of all those letters containing any personal experience. There were one or two about ladies who had obstinately persisted, in the face of manifest warnings that they were injuring their health, and of course did so.

I remember reading years ago, in an extract from some medical newspaper, I think, that the Empress of Austria was killing herself with tight lacing, for she happened to be ill, and was famous for the smallness of her waist which seems to be specially cultivated there, and is even enforced on boys as well as girls, according to a gentleman who was at school in Vienna, and learnt there to enjoy being laced as tight as possible in long and stiff stays, though he was very angry at it at first, as was the case with many others of the above mentioned writers. Well, she is now a grandmother, and we are told every year that she is still conspicuous in our hunting-fields for her riding and her figure. In one of those letters an old lady of 85 said that she used to be contracted into 15 inches when she was young, and, indeed, the compass of their own span, or from 11 to 15 inches, was often spoken of, up to about 40 years ago from very early times, as the standard to be aimed at by ladies, and frequently reached, and occasionally even 13; but more in foreign countries than this, though there was one confession of it in the book on figure-training. Of course, I am not advocating those extreme and foolish and dangerous reductions, but only using the fact that ladies lived long and in good health under them, to prove the monstrous exaggerations about the danger of waists which contain twice as much as those. You, at any rate, will see at once that a waist of 20 inches contains twice as much as one of 14, and 1s nearly half as much again as 15.

I cannot imagine what books Lady F. Harberton has been reading or not reading to write such amazing things as that 28 in. is the proper size for a young woman's waist, when it is a full size for a well made young man; and still more, that "it is only in the last twenty years that stays have been cheap enough for all classes to wear them from the age of ten years." When did maid servants not visibly wear stays, and sometimes very tight ones? And to go down very low indeed, the "female 'prentice that Mrs. Brownrigg whipped to death and hid her in the coal-hole (as the "Rejected Addresses" puts it), was found with scanty enough clothing on, but with leather stays next her skin, which the most fashionable ladies wore in the last century, introduced from Germany, as capable of the most powerful compression; and the same material, only thinner and stiffened with steels, has been recommended again as the [illegible] to wear next the skin, as keeping clean and sweet longer than anything, and only needing washing with cold water occasionally. Another old lady wrote that she was educated at a charity school, managed by [illegible] other ladies, and that the girls all wore [illegible] leather stays, "and no mercy was shown in the matter of lacing." George Cruikshank's pictures of women [illegible] exceptionally ugly and fat ones, give them [illegible] waists, and so do the books of costume of all nations in Europe for many centuries; and frequently the gentlemen too, whose slender waists and tight-lacing used to be the subject of satire and denunciation from very old down to very modern times, and, I suppose, of admiration none the less. If Lady Harberton is right, the higher classes ought to have perished long ago all over Europe, without waiting for this era of "cheap corsets."

It is just worth notice, on the reiterated assertions about Greek laxity, that the term "wasp-waisted," in several forms, is as old as Aristophanes. And it is certain that the Romans severely laced and shoulder-strapped their girls, and even starved them, if necessary, to make them slender and upright. *Juvencæ et graciles et sic amantur*, Terence says: and Macaulay, who had read everything, said that the Roman ladies did still worse things to preserve their figures. Whatever are the reasons for it, it is quite clear from history that corsets and tight lacing in one form or another have been the windmills of dress-reforming Quixotes for 1,000 years at least. The wind has sometimes lulled, and they have flattered themselves that they had stopped the sails; but it has always risen again and knocked over the philosophers, "clerical, medical, and general," and probably always will; so they may as well save their preaching for something more amenable, or at any rate preach more rationally than they do.

An Observer.

THE FUEL OF THE SUN.

By W. Mattieu Williams.

BEFORE discussing the points raised by Mr. Proctor in his original criticism, there are two in his note to my last letter that demand some explanation.

First, as regards the relative gravitation reaction of Venus, Jupiter, Saturn, and the earth upon the sun. If Mr. Proctor will turn to section 81 of "The Fuel of the Sun," he will find that I specify the "*mean* gravitation" of these planets upon the sun. I did this with express and deliberate intent, in order that I might not be understood as describing the "tide-raising action" of these planets. The difference between these is just all the difference between my figures and those of Mr. Proctor's, one varying with the cube, the other with the square of the distance of the gravitating body. Perhaps I should have been better understood had I said the "*total*," rather than the "*mean*"; but in sections 75 and 81 I had been describing the varying gravitation of Venus and the other planets on different parts of the sun, in order to show that "the nucleus of the sun, and all the different parts of the solar atmosphere, are subject to sensibly variable degrees of attraction from the same planet."

Mr. Proctor says that the disturbance of the solar action which I describe "must be akin" to tide-raising action. In the sense of common parentage it is akin, as they are both due to the reaction of gravitation upon the primary, but of themselves they are materially different. The tide-raising is a deformation, the action which I describe as "the reeling of the solar nucleus" is a motion of translation of the whole mass bodily, and this I still "maintain" varies inversely with the square of the distance of the gravitating body, and not, as Mr. Proctor's figures imply, with the cube.

Anybody who will read attentively what I have said will see *why* I make this distinction. A mere tidal deformation of a *complete* and profound fluid envelope (whether liquid or gaseous) would not produce the vortices and instirring of solar fuel which I have described. In section

68, I say "The gaseous matter would be lifted, or bulged, or undulated, as a tide-wave, and dropped again, but the solid (or more probably viscous nucleus) would be dragged bodily about with an irregular reeling motion inside this profound undulating gaseous ocean, which it would thus stir into eddies, as the stroke of a fish's tail makes eddies in a pool."

On comparing this with our own water-tides, we must remember that the depth of our ocean in relation to the whole earth is but as the thickness of the paper pasted on a 12-in. globe to the whole of that globe. I have endeavoured to show reasons for concluding that the solar nucleus within its fluid envelopes is comparable to a peach-stone within its envelope of pulp.

As regards the quotation of Carrington's figures, this is simply a blundering transposition of figures on my part, which I failed to observe until now that Mr. Proctor has detected it. The 30·86 should have been on the upper line, and the 28·36 on the lower. The error was copied mechanically in the parenthesis in my letter. All my reasoning and thinking on this part of the subject are based on the conception of greater equatorial angular velocity of the solar envelope, which I regard as produced mainly, if not entirely, by the inner reeling of the nucleus. This explanation appears to me better than any of the other theories that have hitherto been attempted, though it is not altogether free from difficulties. I prefer my own expression "reeling" to Mr. Proctor's "swaying," for reasons that I must not just now step aside to state.

Mr. Proctor says that he halted at the threshold of my argument on account of the awful stumbling-block of the "perpetual motion fallacy" which I have placed there.

I perfectly understand this difficulty, and am well aware that my theory was originally weak at this point. In 1868, when writing this chapter, I was unable to see how the retardation of stellar orbital motion or "star drift" is compensated, and booked the problem for further consideration; but I differed, and still differ diametrically from Mr. Proctor in finding any "stumbling-block" in the demand for perpetual motion. This was no bugbear to me, but the contrary. I looked to the operation of this universal principle for the solution of the problem.

In my estimation, the greatest achievement of modern physical philosophy is the demonstration that motion is absolutely, necessarily, and universally perpetual; that the total quantity of motion, or force, or matter (which are really convertible terms) in the universe, is precisely the same now as it was at the beginning, and will be the same evermore.

My conviction of the fundamental necessity of this principle convinced me that the mechanical motion thus converted into heat-motion must be somehow or somewhere restored. Broadly speaking, or briefly summarising my theory, it amounts to stating that the motion produced by gravitation or attractive force is converted into heat motion or repulsive force, nothing added, nothing taken away; simply action and reaction, equal and contrary, operating throughout the universe. How the reaction should obtain the form of bodily repulsion of masses of matter of solar magnitude I then had no idea, saw no clue to the solution of this mighty problem. Subsequently, however, it has been revealed by a series of researches, to the vast importance of which our present-moment astronomers are strangely blinded by the superstitions of transcendental molecular mathematicians.

The subject is too large for exposition here, but I have treated it in a preliminary essay on "The Philosophy of the Radiometer and its Cosmical Revelations," contributed to the "Quarterly Journal of Science," of October, 1876, and reprinted lately in "Science in Short Chapters."

I should add, however, that subsequent reflection has induced me to make a very great reduction of my estimate of the *quantity* of this atmospheric bombardment, and to regard it as a comparatively trivial factor in the maintenance of solar heat. I am, in fact, inclined to withdraw the term "bombardment" altogether. It was only used as an expression quoted from the then prevailing theory of meteoric bombardment, and does not fairly express my meaning. The term "impact," used in other parts of the book, where there is no comparison made with the meteoric "bombardment" theory, is better.

On page 378, Mr. Proctor says that there is no evidence of a lateral explosion of prominence matter with a velocity of more than 240 miles per second, that "nothing of this sort, or approaching anywhere near this, has ever been seen." I have before me the third edition of his own book, "The Sun Ruler of the Planetary System." I find there a description and pictures of the lateral explosion of a prominence 50,000 miles high flung out to a breadth exceeding its height in a few minutes. On page 80 is a picture of its appearance when first seen, and on page 81, of its lateral ejections as they were seen twenty-five minutes later. These, with the quoted description of Professor Young, and also the observations and conclusions discussed on pages 300, 301, and 302, supply abundant evidence of lateral projections hugely exceeding "the lateral expansion of cumulus clouds." Mr. Proctor evidently supposes that an enclosing case, like our bomb rockets, is necessary for the exertion of projectile results by explosion. Let him try the experiment on the very gases to which I ascribe this projection, *i.e.*, dissociated water elements, enclosed in a soap bubble. Having suffered bodily translation and overthrow by the recombination of about a quart of these gases only confined by the membrane of a bladder, I make a different estimate of their lateral projective power. In section 196, I quoted a well-known instance of the direct observation of a lateral ejection across the solar surface at the rate of 116 miles per second. This occurred in 1859, before the spectroscope came to our aid. Since that period a multitude of observations of far greater velocity have been made—too many even to name. I will, therefore, quote only one from the last report of the Astronomer Royal at the annual visitation of 1882. After referring to several observations of prominences "indicating very rapid motions of approach and recession," one example is given of a prominence examined on May 13, 1882. It "was observed to rise through a space of 30′ in less than two minutes, being at the rate of about 110 miles a second, whilst the C line showed a displacement towards the red, gradually increasing from $1\frac{1}{4}$ to 11·4 tenth mètres, corresponding to a motion of recession, increasing in two minutes from 36 to 330 miles per second."

This motion of recession seen on the limb of the sun is the lateral motion which, if I am right, must occur when the dissociated gases are flung up beyond the vaporous jacket which prevented their recombination below; and this observed acceleration is precisely what I stated should occur, as a result of progressive explosion, though at the time of writing no such acceleration had been observed.

(*Editor's Rejoinder next week.*)

The Bell Telephone Patent.—An American paper says:—"The Bell patent would, it is considered by those competent to form an opinion, be cheap at 10,000,000 dols. The consolidated telephone interests of the United States are estimated at from 100,000,000 dols. to 150,000,000 dols."

TRANSITS OF VENUS.

By Richard A. Proctor.

For some inscrutable reasons, any statement in which Venus, the sun, and the earth are introduced seems by many to be regarded as, of its very nature, too perplexing for any one but the astronomer even to attempt to understand. My talk in the next few paragraphs shall be about a dove, a dovecot, and a window, whereby, perhaps, some may be tempted to master the essential points of the astronominal question who would be driven out of hearing if I spoke about planets and orbits, ascending nodes and descending nodes, ingress and egress, and contacts internal and external.

Fig. 1.

Suppose D, Fig. 1, to be a dove flying between the window, A B, and the dovecot, C *c*, and let us suppose that a person looking at the dove just over the bar, A, sees her apparently cross the cot at the level, *a*, at the foot of one row of openings, while another person, looking at the dove just over the bar B, sees her cross the cot apparently at the level, *b*, at the foot of the row of openings next above the row *a*. Now suppose that the observer does not know the distance or size of the cot, but that he does know in some way that the dove flies *just* midway between the window and the cot; then it is perfectly clear that the distance, *a b*, between the two rows of openings, is exactly the same as the distance, A B, between the two window-bars; so that our observers need only measure A B with a foot-rule to know the scale on which the dovecot is made. If A B is one foot, for instance, then *a b* is also one foot; and if the dovecot has three equal divisions, as shown at the side, then C *c* is exactly one yard in height.

Thus we have here a case where two observers, without leaving their window, can tell the size of a distant object.

And it is quite clear that wherever the dove may pass between the window and the house, the observers will be equally able to determine the size of the cot, if only they know the relative distances of the dove and dovecot.

Fig. 2.

Thus, if D *a* is twice as great as D A, as in Fig. 2, then *a b* is twice as great as A B, the length which the observers know; and if D *a* is only equal to half D A, as in Fig. 3, then *a b* is only equal to half the known length, A B. In every possible case the length of *a b* is known. Take one other case in which the proportion is not quite so simple. Suppose that D *a* is greater than D A in the proportion of 18 to 7, as in Fig. 4: then *b a* is greater than A B in the same proportion; so that, for instance, if A B is a length of 7 in., *b a* is a length of 18 in.

Fig. 3.

We see from these simple cases how the actual size of a distant object can be learned by two observers who do not leave the room, so long only as they know the relative distances of that object and of another which comes between it and them. We need not specially concern ourselves by inquiring *how* they could determine this last point; it is enough that it might become known to them in many ways. To mention only one. Suppose the sun was shining so as to throw the shadow of the dove on a uniformly-paved court between the house and the dovecote, then it is easy to conceive how the position of the shadow on the uniform paving would enable the observers to determine (by counting rows) the relative distances of dove and dovecot.

Fig. 4.

Now, Venus comes between the earth and sun precisely as the dove in Fig. 4 comes between the window, A B, and the dovecot, *b a*. The relative distances are known exactly, and have been known for hundreds of years. They were first learned by direct observation; afterwards by the application of the laws of Kepler as interpreted and corrected by Newtonian astronomy. The distance of the earth from the sun has been found to bear to that of Venus very nearly that of 100 to 72; so that, when Venus is on a line between the earth and sun, her distances from these two bodies are as 28 to 72, or as 7 to 18.

These distances are proportioned, then, as D A to D *a* in Fig. 4; and the very same reasoning which was true in the case of dove and dovecot is true when for the dove and dovecot we substitute Venus and the sun respectively, while for the two observers looking out from a window we substitute two observers stationed at two different parts of the earth. It makes no difference in the essential principles of the problem that in one case we have to deal with inches, and in the other with thousands of miles; just as in speaking of Fig. 4 we reasoned that if A B, the distance between the eye-level of the two observers, is 7 in., then

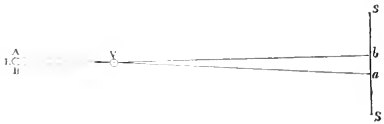


Fig. 5.

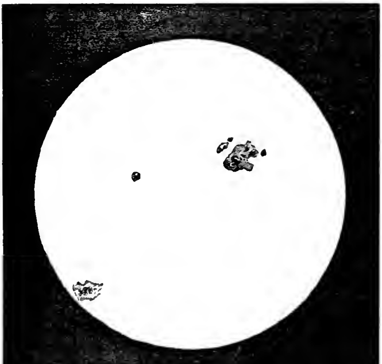
b a is 18 in., so we say that if two stations, A and B, Fig. 5, on the earth, E, are 7,000 miles apart (measuring the distance in a straight line), and an observer at A sees Venus' centre on the sun's disc at *a*, while an observer at B sees her centre on the sun's disc at *b*, then *b a* (measured in a straight line, and regarded as part of the upright diameter of the sun) is equal to 18,000 miles. So that if two observers, so placed, could observe Venus at the same instant, and note exactly where her centre seemed to fall, then since they would thus have learned what proportion *b a* is of the whole diameter S S′ of the sun, they would know how many miles there are in that diameter. Suppose, for instance, they found, on comparing notes, that *b a* is about the forty-seventh part of the whole diameter, they would know that the diameter of the sun is about 47 times 18,000 miles, or about 846,000 miles.

Now, finding the real size of an object like the sun, whose apparent size we can so easily measure, is the same thing as finding his distance. Any one can tell how many times its own diameter the sun is removed from us. Take a circular disc an inch in diameter—a halfpenny, for instance—and see how far away it must be placed to exactly hide the sun. The distance will be found to be rather more than 107 in., so that the sun, like the halfpenny which hides his face, must be rather more than 107 times his own diameter from us. But 107 times 846,000 miles amounts to 90,522,000 miles. This, therefore, if the imagined observations were correctly made, would be the sun's distance.

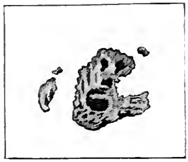
(To be continued.)

THE GREAT SUN-SPOT.

WE have endeavoured (but, as we write, we are by no means sure we are in time) to give a telescopic view of the aspect of the sun with the great spot on it, which has been visible to the naked eye during the last



week, whenever the sun's disc has been somewhat dimmed by fog or mist. The actual area of disturbance is almost as large as any single area ever recorded; though no actual umbra of any very extraordinary size is now visible on the sun's face. As will be seen from our picture, the spot—regarding as one the whole penumbral region—has four large umbræ and many smaller ones. We show the spot as it appeared on Monday, seen under very unfavourable atmospheric conditions, our rough sketch being only just finished before the sky clouded over, and the opportunity for further observation was lost. The evidence of disturbance around the spot region was marked. But the faculæ around the triple spot which has recently come into view near the eastern edge are even more conspicuous than those around the great region of disturbance, though, within the large penumbral region of disturbance, facular streaks of great splendour can be seen.



We are inclined to believe that the great spot is a phenomenon by no means so independent of the great comet as some of the daily papers have confidently asserted it to be. Professor Kirkwood's theory of the association of a great solar disturbance with meteoric matter following in the train of the great comet of 1843 will here occur to many readers. We shall touch on this later.

THE AURORA.

ON Friday evening, at about the time of sunset, if not earlier, a magnificent aurora was visible. When it began, the sky was partly clouded, and the appearance presented was as though behind the darker cumulus clouds there was a bank of cirrus clouds still illuminated by the setting sun. But the position of the region of greatest splendour, in the magnetic meridian, or some seventeen degrees west of north, indicated the real character of the phenomenon. As the clouds broke up and thinned they presented a singular appearance, looking almost green by contrast with the crimson red of the auroral clouds. When they had entirely cleared away, the crimson effulgence remained, though by this time it seemed somewhat less intense; it reached in streamers to a great distance from the arch of greatest splendour, and for a long time the crimson light could be seen extending to, and even beyond, the zenith. The aurora remained, with varying brilliancy, till near 5 a.m. Saturday.

At about five minutes past six a singular phenomenon was observed. A cloud of whitish light, shaped like torpedo, passed from the south-eastern to the north-western horizon (some accounts say from east to west, but the true direction was from a little east of south-east to a little north of north-west). It was of nearly uniform brightness. Its length was nearly ninety degrees. (One observer says that its size, compared with that of the moon (which was shining brightly at the time), was as a herring compared with a sixpenny-piece; but as he does not name the price of his illustrative herring, the illustration is not so satisfactory as could be wished: does he mean a penny herring, or one of those which may be obtained, we understand, at two a penny?) It passed across the heavens in about two minutes. It is described as a cometary body; but as it moved almost exactly at right-angles to the magnetic meridian, there can be very little doubt it was an electrical phenomenon. The appearance is akin to that sometimes seen in high latitudes, as the auroral streamers vary in position, aggregation, and length, seeming to throw folds of brightness, shaped like the folds of a curtain, athwart the auroral arch.

An electrical storm of great violence prevailed from

Friday and Sunday. Strong earth currents disturbed the action of the telegraph and telephone lines. In Canada and the United States, as far west as Utah, the electrical disturbance was felt. Electricians say that the disturbance was unlike any heretofore known, acting on the wires in strong waves, which produced constant changes in the polarity of the current. A magnificent aurora was visible throughout Canada and the United States.

The phenomena were akin in many respects to those described in the editor's treatise on The Sun, as accompanying and following the great solar disturbance of September, 1859.

SATURN'S RINGS.

MR. LYNN explains that his remark in the *Athenæum* referred, not, as I supposed, to the passage in which I thanked Captain Noble for calling attention to this subject in KNOWLEDGE, but to my remark in KNOWLEDGE for Oct. 13 to the effect that a writer in the *Athenæum* had "followed Captain Noble's lead"—a remark founded, as he correctly supposes, upon an article in the *Athenæum* for Oct. 7th, quoting a letter of Mr. Lynn's as its authority. He adds:—"Perhaps you will kindly explain how ascribing the lead to Captain Noble, whose letter, as Mr. Maunder informed you, was written after mine, differs from ascribing the first notice to him." Since I referred to the writer in the *Athenæum*, not to Mr. Lynn, as following Captain Noble's lead, there is nothing, I apprehend, to explain.

I may take this opportunity of noting that I attach the least possible importance to the question, Who first saw with the telescope any feature which the telescope was bound, earlier or later, to reveal. There is something to my mind altogether inconsistent with the dignity of science, in the childish logogriphs under which men really great in science have hidden their discoveries, lest they should lose claim to the credit of having been the first to see something. There are many, however, who speak of a first view of some astronomical object as if it deserved no less credit than the discovery of Neptune or the labours of the Herschels among stars and nebulæ.

R. A. PROCTOR.

HAS THE MOON AN ATMOSPHERE?

BY W. MATTIEU WILLIAMS.

THE letter of Mr. B. J. Hopkins, p. 379, reminded me of Mr. Ranyard's paper on this subject, which I had carelessly read when it appeared.

It appears that he and others investigating this subject have overlooked the consideration of a condition which I pointed out in Chapter XV. of "The Fuel of the Sun," as follows:—"In the determination of the pressure of the atmosphere upon the earth we take our barometers to the sea-level, or the lowest portion of the earth's general surface. We must in like manner take our imaginary barometer to the lowest general surface of the moon to obtain the calculated column of mercury of six-tenths of an inch (calculated on the assumption that the moon has its gravitating proportion of general atmospheric matter). From the great irregularity of the lunar surface it would be very difficult to define clearly where this lowest general surface is. It must be at the bottom of the average depressions of the lunar surface, probably about the bottoms of the *Oceanus Procellarum* and the other dark regions called the 'Maria' by selenographists.

"The observations of occultations are generally stated to indicate no atmosphere, though some doubts as to the absolute truth of this have been expressed. Now, the edge of the lunar disc, by which the boundary of the moon's diameter is measured, and which determines the beginning and end of an occultation, is formed by the summits of the lunar peaks and ranges, levelled by the effect of perspective; for we look upon them horizontally, as though from their own summit level. The only portion of the lunar atmosphere remaining for the purposes of horizontal refraction, visible from the earth, must be that which rises above these lofty summits."

The passage that confirms my supposition of the omission of this consideration is that commencing Mr. Ranyard's last paragraph, on page 215, where he says:—"It will be seen that the light which enters the slit close to the moon's limb must, if there be a solar atmosphere, have passed through the densest portions of it."

We must remember that in comparing the rarefaction of the lunar atmosphere on the mountains of the moon with that on our terrestrial mountains, we have an ocean of water filling the deepest depressions of the earth, and our atmosphere starts from the surface level of this ocean, while in the moon the corresponding depressions would operate as atmospheric basins, into which an excessive proportion of the general atmosphere would be compressed and concentrated.

The difference between the results obtained by M. Thollon and M. Trépied may, I think, be explained by the possibility of the radial slit of M. Trépied catching the rays coming through a notch or depression between the lunar mountains, while the tangential slit of M. Thollon swept across the summits and ridges.

If I am right in this, the atmospheric lines seen in the first case should be displayed of full length; in the second only as fragments, occurring where the length of the slit visually crossed a notch caused by a lunar valley running transversely to the line of the visible lunar horizon or limb. This result would have the puzzling and contradictory character described.

[We may conveniently consider what the difference would be in a valley, say two miles below the mean level (though such valleys must be too few and small to form any appreciable part of the moon's limb), and at a height of two miles above that level (though parts at that height can in like manner form but a very small part of the moon's apparent edge). On our earth the atmosphere doubles in pressure for each three-and-a-half miles of descent; on the moon, where gravity is one-sixth, for each twenty-one miles. Hence, if $\rho : 1$ is the ratio between the densities at lower and higher of these levels, we have the relation:—

$$\log. \rho = \frac{4}{21} \log. 2$$

(the logarithms being hyperbolic.)

Now, Neperian log. 2 = 0·6931472
$\qquad\qquad\qquad\qquad\qquad\qquad 4$

21)2·7725888

·1320280 = log. 1·14.

Hence the variation of density to which Mr. Williams attaches so much importance is in the ratio of 114 to 100, or (very nearly) of 8 to 7. All that we know of the conformation of the moon's surface, however, assures us that nothing like a difference of 4 miles could exist between any appreciable parts of the moon's edge. A difference of 21 miles in level would be required to produce a ratio of

2 to 1 between the densities, where the lines of vision touch the moon's edge. But except in occultations of stars we cannot really use such tangent visual lines, though we may seem to do so.—Ed.]

BUTTERFLIES AND MOTHS.

By W. J. H. Clark.

THERE are many other methods employed in pupa hunting besides digging, and at this period of the year, all will prove more or less productive, and though a very large proportion of the captures will probably consist of very common species, yet now and then a rarity will be obtained which will amply repay all the trouble which may have been taken with the others.

Among the best localities for pupa hunting, besides those noticed in last paper, we may mention woods where clearings have been made, open heaths and commons, coasts, sand-hills, fields, &c.

An open light soil will be the most productive, while hard, wet clay will yield nothing for our pains. Dead foliage lying on the ground will also give good results if very carefully examined and raked over, but it must be well shaken about for any pupæ which might have attached themselves to the leaves. The best way is to take a large sack and fill it with leaves, and, after having brought it home, to subject them to a thorough examination at leisure.

Next, the leaves of trees must be examined for the pupæ of those moths which spin the leaves together when undergoing their change from the larval to the pupal state. When a leaf is found rolled up, it may be nearly always suspected to contain a pupa of some kind or other, and should not be unfolded, but brought home intact on spec. However, if we wish to make perfectly sure as to whether there is any inhabitant or not, hold it up to the light, when the outline of the contained pupa will be clearly seen through the semi-transparent leaf. A large number of the *Tortrices* and various others will be obtained in this way.

In the cracks and other irregularities on the bark of trees will often be found the chrysalides of several of the *Bombyces* and others, and the tree should be thoroughly searched all round. If anything be found, do not attempt to detach it by force, but cut away the piece of bark or wood to which it is joined as well. If there be any pieces of loose bark on the tree, endeavour to tear them off, as very often large numbers of pupæ will be found sheltering underneath.

Some larvæ burrow right into the wood itself, and for these a very particular search must be made, as their haunts are not so easily found out. We have all seen the large tunnels made by the Goat moth (*Cossus ligniperda*) in our apple-trees, and other smaller tunnels constructed by various *Sesiadæ*, &c., and the question is how to get at the inhabitants. The best way is to cut off the branch or branches and take them home, and there wait patiently until the imago emerges.

All small bushes should be carefully examined, both on the branches and among the leaves; the roots, &c., should also be looked over, as several species of larvæ go amidst the network of shoots for a resting-place.

The grass and other low plants should be thoroughly searched, and all rubbish of any kind turned over and examined; sheltered walls, underneath the ledges of walls and outbuildings, old fences, &c., will also yield good results; in fact, there is no outdoor situation which does not often form a home for some larva or other.

The pupæ of *Hydrocampidæ* and other water-inhabiting species can only be obtained by dragging among the aquatic plants with a small meshed water-net.

When we have obtained our pupæ, the great thing is to keep them so that as large a number as possible may develope into the perfect insect. This requires careful treatment, which, for different species, must be of different natures.

In all cases the source from which the pupa was obtained must guide us in keeping it, and we should always endeavour to follow nature as nearly as possible if we wish to succeed in anything connected with the rearing of either larvæ or pupæ.

Pupæ which have been obtained from under the surface of the earth must be treated as follows:—They should be kept in an earthenware pan containing some light, friable soil, which is not too dry, and a layer of moss put on top, which must occasionally be sprinkled with water in order to keep up the moisture of the soil; be very careful not to make the soil *wet*, but only *naturally moist*, as if it be kept too damp, most of the pupæ will be lost from mould, or will rot away.

For those chrysalides which have been obtained from twigs or walls and places exposed to the air, we must make a frame consisting of four pieces of wood joined together at right angles thus □, with a piece of muslin or gauze stretched over them, so as to form a sort of tray, on which the pupæ are to be laid, and hung up in an outhouse, or where a current of fresh air is continually passing, as this prevents the ravages of disease and mould.

The pupæ captured by water-dragging must be kept in jars or globes, filled with water, and covered over with muslin or gauze.

Some one of the above-mentioned methods of rearing will do for nearly every species which can be found in this country, but exotic and other foreign pupæ require special treatment, varying according to the climate and surroundings of the country in which they are found.

Substance for Casts.—A prize of £500 was offered in 1877 by the German Government for the invention of a material as suitable as gypsum for taking casts of works of art, and yet capable of repeated cleaning. Forty-one candidates have sent in specimen casts, but none have been judged so absolutely satisfactory as to gain the prize.—*Mechanical World.*

In Lowell, Mass., there is a telephone for every 62 inhabitants, although the population numbers some 20,000 mill-hands. In Portland, Maine, there is a telephone for every 50 inhabitants. The telephones do as much business as the telegraph lines between those cities, and yet the telegraph company does 50 per cent. more business than it did two years ago.

Wire Fencing in Thunderstorms.—During a thunderstorm recently, five sheep were killed on the farm of Cotland, Tinwald parish, in Scotland. In one field there was a wire fence for a distance of 300 yards. The current had travelled along this, breaking the wooden posts at various distances, and at the end of the fence two sheep were struck and killed. In an adjoining field, separated from the other by a farm road, the fence was a stone wall, with a single wire on the top. This wire was broken, and touched the ground about forty yards from the road. A number of sheep were crouching near the broken wire, and three of them were killed.

Letters to the Editor.

The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.

All Editorial communications should be addressed to the Editor of KNOWLEDGE; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

⁂ All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

SELF-INOCULATION OF HYDROPHOBIA.

[634]—In asking the question, "Can a dog inoculate itself with hydrophobia?" "H. A." evidently overlooks the fact that the affection is not a *local*, but a *general* disease, and that the development of a specific virus in the region of the mouth, capable of propagating the disorder, is only a local symptom. Therefore, none but an animal already hydrophobic, manifestly or latently, could communicate the malady to one creature; though at how early a stage this may be possible is as yet uncertain. The fever known as small-pox is communicable from one person to another by inoculation of the matter contained in the pustules; but a man would not give himself small-pox by taking the secretion from a pustule on his arm [illegible], because he has the fever already [illegible] "system," and the pustules are [illegible] of its presence. But he might infect his left [illegible] right, a proceeding no more concerning the [illegible] than tossing a ball from one hand to the other.

"[illegible] a venomous snake poison itself by its own bite?" would be a [illegible] greater pathological interest, since there is much [illegible] on the point.

[illegible] road, Watford. ARTHUR STRADLING, C.M.Z.S., &c.

ENGLISH SNAKE.

[6[illegible]]—In reply to the query of "C. E. S." (610), I beg to inform [illegible] English snake, termed the *Coronella Lævis*, differing [illegible] from the common ringed snake and the adder or viper. A specimen was brought to my father as long ago as the year 1858, and is still in possession of the family. I believe it was not [illegible] or described by naturalists until three or four years [illegible] when it was thought to be a new species. I have [illegible] several specimens in the neighbourhood of [illegible]. It is smaller than the common snake, of a [illegible] particular markings, and can be readily [illegible] adder by the absence of the black lozenge-[illegible] back.

[illegible] treated, and I believe (I have not the [illegible] the keel or ridge which is [illegible] along the middle of each scale of [illegible] might be mistaken for the [illegible] true snake, having extensile jaws and a row of [illegible] poison fangs, and is perfectly harmless [illegible] the finger or any other object [illegible]. R. LEWIS WILCOX.

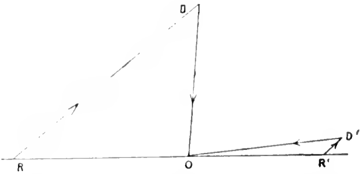
COLD BATH AT NIGHT.

[illegible] p. 364, perhaps you [illegible] I have arrived at after many [illegible] summer and winter. To [illegible] when the body is more or less exhausted [illegible] whatever, and would [illegible] quite necessary that [illegible] at the time of plunging [illegible] are most generally confined [illegible] the bed in the morning, but seldom at night, and [illegible] going to bed would not have the effect that "I. S.," No. 583, p. 314, thinks it would, viz., to induce sleep. I, too, suffer at times from sleeplessness, and on two or three occasions have jumped out of bed and taken a cold bath in sheer desperation; but the effect has been to drive away all chance of sleep for the remainder of the night. On the other hand, a hot bath at night is both healthful and soothing. It should be taken immediately before going to bed, at a temperature of from 95 to 98 degrees, and it will generally induce sleep whether after a day's physical labour or not. A hot bath frequently at night and cold bath every morning summer and winter, would be highly beneficial, but I have found it best in winter to make the cold bath a mere dip, as a prolonged immersion takes too much heat from the body.

G. HANN.

SINGULAR RAINBOW.

[637]—Referring to primary bow only, and taking deviation through a rain-drop = 10°, the above figure will represent the case of sun's altitude = 5°. Sun's rays reflected at R *behind* observer, deviated 40° by drop at D to observer O. I cannot see how when sun is *low* (lower than 40°), a bow can be seen by rays reflected *in front* of observer. On the other hand when the sun is between 40° and 50°, say 45°, an observer on a bridge may see two sets of reflected bows, one by reflexion in front, the other by reflexion behind, thus:—



Rays reflected at R behind observer form a high bow at D. Rays reflected at R′ in front of observer form a low bow at D′. In this case the usual direct bow is not formed. If I am correct, it is curious that the phenomenon is not more often noticed.

A. LE SUEUR.

IRON PYRITES.

[638]—Can any of your readers inform me if it is possible to melt up and make any use of the nodules of iron pyrites (popularly called thunderbolts) which so thickly strew the beach at Eastbourne, St. Margaret's, and other places on our southern coast? If they are good soluble metal, many tons of valuable material seem to be wasted. I shall be glad to know if there is anything in their chemical composition which prevents their being treated as useful metal, either melted and cast alone, or mixed with other metal.

D. & M.

BREWING AND MALTING.

[639]—I have been consulted by the head of a family in California, U.S., as to the best method of brewing and malting, and the most suitable practical works on the subject. The object is simply to supply home wants; not sale. If you could or would give me any information on these points I should be much obliged. It appears that almost all drinks in the State are largely adulterated.

CALIFORNIA.

Answers to Correspondents.

Hints to Correspondents.—1. No questions asking for scientific information can be answered through the post. 2. Letters sent to the Editor for correspondents cannot be forwarded, nor can the names or addresses of correspondents be given in answer to private inquiries. 3. Correspondents should write on one side only of the paper, and put drawings on a separate leaf. 4. Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.

E. S. Thorne. I quite agree with you. No man who has ever walked past that Kew wall should fail to do all that in him lies to get it replaced by a railing. I do not live in a house overlooking the grounds, but if a subscription is opened to raise the necessary sum, I will gladly put down my name for £10. But Sir J. Hooker would infallibly resign if Government agreed to such a change, and what would old England do then, poor thing?—F. S. L. The question related to a garden-walk, and though a circle is, as you say, one of the limiting forms of the ellipse, a circular walk would not therefore be regarded as an elliptical one.—W. H. Taylor. Thanks; but medals are apter rewards for prize pigs than for men.—J. Spiers. I should only be too glad to have an excuse for visiting old Ayr, where I passed a very happy half-year.—Poor Student should note what sort of work he wants the spectroscope to do. For some very simple work, a slit and a prism, with a blackened tube or so, would serve very well; for other work something more elaborate must be made.—W. S. Pavitt. That light theory of comet's tails is not only foiled by multiple tails, but by curved tails, thwart streaks, and other phenomena. But it will not do anyhow. It has been tried many times, and never would fit a single case.—Gradatim. I write away from my books (lecturing at Newcastle), but you will find in De Morgan's "Budget of Paradoxes," $\sqrt{2}$ to 110 digits. There are two digits which appear only 8 times, and digit 7 appears no less than 18 times. But you can try this experiment: Take out a list of digits at random, by opening a book of logarithms and bringing down a pencil point at random in the open page, marking down in your list the digit nearest to the point marked. You will find nearly always among the digits thus taken out, one or two which get the lead in numbers and keep it, one or two which fall behind and keep behind. It is because there are so many digits that the chances are one or other will be, as it were, lucky in the drawing, and one or other unlucky. Of course, the mathematical question is dealt with by comparing, for n trials, the sum of all the co-efficients in the expansion of

$$(x_0+x_1+x_2+x_3+x_4+x_5+x_6+x_7+x_8+x_9)^n$$

in which the power of *any* one of the terms falls short of $n \div 10$ in a given degree *at least*, with the sum of all the remaining co-efficients.—W. S. Bradley. About the comet, shortly; but we (students of science generally, I mean, not "we" editorially) know much less about comets than we should like to. On the other point —the bet was an idle one; but he might have safely wagered his £50 that no one could convince *him* the moon was not "perfectly stationary, and never moves from place to place."—"Taranaki." The evolute of a circle is a point—the circle's centre. The evolute of a straight line is either of the points at infinity in direction perpendicular to the line.—H. Dennys. I must ask "Mephisto." —An Invalid. We should certainly recommend you to have a fire; but we are not medical.—Inquisitive. I forget what particular defeat of the Spaniards is referred to by Browning in the poem you mention.—K. L. McGrath. Let us consider the point logically, if your wrath, which really seems blinding, will permit you. You say, "Kerdic was a pirate," and "Rollo was a pirate;" you count me out your ten murderers and eleven imbeciles, cite Richard Sans-peur and William the Conqueror himself as of illegitimate birth, and William of Luneberg, George III., and a third, as subject during parts of their lives to attacks of mental aberration. Then you ask me if I "dare to deny that the parable related to them." I dare say not, if you dare say so much. But either you are right in all your statements, or you are not. If you are *not* right, you should hold your peace; and if you *are* right, I cannot be far wrong. As to your strongly-expressed wrath, I can only say, God keep you in your present mind, for you treat your friends ill. "Call you *that* backing of your friends?" If so, I would rather not be one of them.—F. Foot. It is quite true that the obliquity of the Ecliptic has changed since the days of the first astronomers. This is due to the disturbing actions of the planets by which the path of the earth has been changed; in other words, the position of the Ecliptic itself has been changed, not the axial pose of the earth in space.—D. Maxwell. Is not that rather what one would expect, than the reverse? The result in Tyndall's experiment is what one would not expect; but where the close packing of the particles is done away with, as in your experiment, one would expect its effects to be corrected too. S. D. I use Chauvenet's "Astronomy" for the purposes you name. S. Standring. Oh! give us a rest: or write about matters less difficult. Metaphysics is not in our line. Besides, you spell so erratically, it is hard to know what you mean.—M. D. Uranus goes the right way round; it presumably rotates the same way as its satellites, but its rotation has never been properly observed.—G. T. Ryves. I quite agree with you about the comet; it is very difficult to get engravers to attend to such points closely. It is now not likely that the comet will return anything like so soon as had been thought. The poem is capital, all but the too complimentary adjectives applied to Mr. Proctor.—R. J. H. Those figures on p. 344? Which figures? If you refer to my figures about the Egyptian signalling, they are nearly correct. The depression for a mile is rather less than 6 in. when correction is made for refraction. Sidereal time is measured from the time when the first point of Aries crosses the meridian. Now, on March 21, if sun at first point of Aries at noon, the sidereal time at *apparent* noon will be 0 h. 0 m. 0s.; but at *mean* noon, which is six or seven minutes earlier, sidereal time is some six or seven minutes earlier too, or 23 h. 53 m. or 54 m. Debate. Do not know where you can find any account of the failure of justice through the incorrect findings of juries.—E. Gerrish. The quotation will be found at the end of my "Universe of Stars."—J. wants the solution of the following problem: To describe three circles in a triangle, each circle touching two sides of the triangle and the other two circles.—A. Shepherd. The reflected bow in such pictures is manifestly wrong, but if you draw the angles correctly you will find your smaller reflected bow could not be given.—A. C. It is of little use to look at Neptune with a 3-in. telescope, though you can see it. The "Nautical Almanack" gives the place, which you can mark down in any good map.—R. C. Taylor. A sovereign contains 113·001 grains of gold and 10·273 grains of alloy.—E. R. Cowley. Those questions, to be properly dealt with, would require all the space in a volume of Knowledge, and much very profound reasoning and calculation.—W. B. Phillips. Jupiter has been in Gemini lately. Certainly Venus visible as an evening star, and rather a bright one.—G. Garratt. Do not know where the results of the observations of Mars in 1877 have been collected.—C. W. G. Thanks.—E. Gschwind. A very noteworthy observation: we should be glad to learn whether any other noticed the passage of a meteor apparently from tail to head of comet at 5.17 on the morning of Nov. 8.—F. H. M. wishes to know whether trapped animals are unfit for food, owing to blood-poisoning, resulting from their death agonies.—Nil Desperandum. Want of practice prevents some from winking without blinking. Try again; only not when ladies are passing.—J. F. You should get Mr. Pearson's book on the tides.—Unit. Consider the equation $v^2 = 2gh$, and I think you will see why kinetic energy $= \frac{1}{2}mv^2$.—X. Y. Yes; we do think it impertinent curiosity to inquire into a man's religious belief, while we consider it only just and proper to inquire how he discharges duties for which he is paid (by you and me, among the rest). If men thus paid are hardened against deserved censure, they must be punished in any way by which they can be reached—by ridicule, if that serves. As for courtesy, a man of sense who had found reason fail, would as soon think of extending courtesy to—well, to any other wilful wrongdoer.

Our Whist Column.

By "Five of Clubs."

PLAY FOURTH HAND.

The fourth player's duty is usually but to win the trick if he can, and as cheaply as he can. The exceptions usually belong to the cases in which the general conduct of the hand involves considerations overruling such rules of detail as we are for the present considering. Thus, the player fourth in hand may be unable to win a trick except by ruffing, and ruffing may mean giving up all chance of commanding the run of trumps and bringing in a long suit: in that case, he would pass the trick. Or it may happen that the card of the suit with which he could alone take the trick would obviously be likely to serve as a re-entering card, after trumps were exhausted: in such a case, if the chances were clearly in favour of that power of re-entry being obtainable in no other way, fourth hand should pass the trick. The consideration of such points belongs to a later stage of our discussion of Whist principles. We may simply note here that in all such cases a good general rule to bear in mind is that a certain trick ought not to be passed, unless there is a great probability of making two by so doing, always remembering, however, that if the game can only be [illegible] trick should always be passed, [illegible] trick saves or makes the game, it should [illegible]

A [illegible] often spoken of as if fourth hand alone [illegible] to second hand equally) where it is [illegible] should be passed or taken. King is [illegible] hold Ace, Knave, and others. Here [illegible] if the suit is continued, as it usually [illegible] apart from ruffing, make two tricks [illegible] Holding up the Ace second hand in such [illegible] good, is occasionally advisable. But it [illegible] trick when you hold Ace, Knave, and [illegible] There is a considerable chance that either [illegible] and adversary may have held originally [illegible] if so, either would trump. Your partner [illegible] because he would believe the Ace to be [illegible] hand would, of course, trump if he [illegible] been led. Where you hold up the [illegible] have a much better chance, for you [illegible] trumped by your partner. Clay adds [illegible] that you give up for one round, at [illegible] the advantage of getting the lead; that, however, may be an [illegible] according to the nature of your hand. He adds [illegible] either from suspecting your tenace, or because he has [illegible] strong suit to show his partner, changes his [illegible] next led it is probably by your right-hand [illegible] through your tenace, instead of to it." These [illegible] less important, however, than the others; for [illegible] would be suspected, covering with ace being the [illegible] very seldom happens that a player finds it [illegible] suit to his partner. The fall of the cards in [illegible] of course, lead him to do so; but ordinarily he [illegible] The case is rather different, when his partner [illegible] For then, the possibility of a held-up [illegible] may lead him to prefer returning his [illegible] afterwards lead the Ace if he has it, and [illegible] to the Queen.

That playing a small card in such a case gives your partner a wrong idea of the contents of your hand is a valid argument against passing the trick, unless the indications are such that you are [illegible] in attaching less importance to informing him than to strengthening your own position. If you are strong in trumps, there is a further reason for disregarding this point. For should [illegible] to suspect that a tenace is held up, he will be apt [illegible] which can hardly fail to suit your hand.

Cases of [illegible] have specially to be noticed in playing fourth [illegible] in which it is necessary to take a trick already [illegible] secondly, those in which it is necessary to pass a [illegible] We are not going to consider all [illegible] depend on the previous fall of cards, and [illegible] of the hand as a whole. But two simple general [illegible] must be considered here.

(To be continued.)

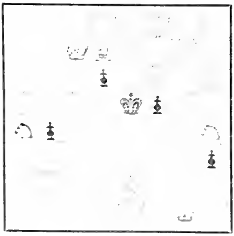
Our Chess Column.

By Mephisto.

PROBLEM No. 60.

By [illegible] Simpson, Edinburgh.

Black.



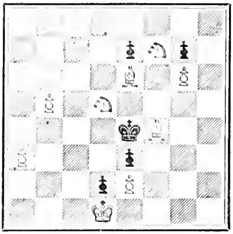
White.

White [illegible] to play and mate in [illegible]

PROBLEM No. 61.

By Leonard P. Rees.

Black.



White.

White to play and mate in three moves.

SOLUTION.

Problem No. 59, by Herbert Jacobs, p. 396

1. B to Kt2	1. Anything.
2. Kt to B6 mate.	

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Problems received with thanks from John O'Keeffe, Francis J. Drake: will be examined.

Brimstone. In questions of that kind it is usual to give name and address, besides the *nom de plume.*

G. W. Barrow.—We agree with you that the idea in Problem 54 was far better worked out than in Eichstadt's composition; there are several unnecessary pieces on the Queen's side in the latter problem.

Correct solution of Problem 59 received from F. W. Cooper, E. A. F., T. Steele, Sheldon, (Old Meldrum, wrongly addressed to Chief Editor.)

Reprint Problem.—Berrow, S. Jordan, J. K. Milne, S. Bassan, Lello, W. J. Reynolds, G. W., John Watson, G. H. Bonner, John O'Keeffe.

NOTICES.

The Star Maps for November and December, 1882, can now be had, price 2d. each, post-free, 2½d.

The Back Numbers of Knowledge, with the exception of Nos. 2 to 8, 10, 11, 12, are in print, and can be obtained from all booksellers and newsagents, or direct from the Publishers. Should any difficulty arise in obtaining the paper, an application to the Publishers is respectfully requested.

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Just published, Part XIII. (Nov., 1882), price 10d., post-free, 1s. 1d.

Subscribers wishing to complete their Sets are advised to make early application to the Publishers, as no further reprints will be ordered.

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MAGAZINE OF SCIENCE
PLAINLY WORDED - EXACTLY DESCRIBED

LONDON: FRIDAY, DECEMBER 1, 1882.

CONTENTS OF No. 57.

Science and Art Gossip.

THE comet seems to be a fruitful subject of error—or, at least, of change of opinion. Prof. Chandler, who out-Heroded the sensation-mongers by saying the comet had actually gone through the sun, now sits in judgment on Prof. Smyth and the rest, with a new orbit, showing no coincidence with the orbits of the comets of 1843 and 1880. He seems nearer the truth this time, and we give the deduced path of the comet, with Hind's estimate for November for comparison.

DR. SIEMENS' theory is getting rather roughly used. M. Faye has given one of the many proofs of its incorrectness. M. Hirn follows with three, one being that which the Editor gave in these columns immediately after the theory was published (we shall translate his paper for next week). Dr. Tommasi gives yet another disproof, ending with the remark that the hypothesis "would lead to perpetual motion, and therefore to absurdity." Those who recognised this at the outset should have spoken as plainly as we did. It would have saved much wasted time, and much misapprehension among the inexperienced.

THE ELECTRIC STORM.—One of the most remarkable features attending the electrical disturbances to which we made reference last week, was that in two wires running side by side, one going about two miles further than the other, currents were travelling in opposite directions simultaneously.

AMERICA appears to have had a stronger visitation than was observed at home. The effect upon electrical apparatus in various parts of the States was very great. A supreme joke appears, however, to have been played upon the New York correspondent of one of our daily contemporaries, who wired that "Bangor worked a message a distance of 700 miles without a battery. At Milwaukee, by means of the storm alone, an electric light, requiring eight horse-power, was kept burning for some time." This is very rich. What will the gas folk say to it?

IT is a noteworthy fact that every electric storm noticed recently has occurred at a time when spots of a greater or less magnitude are observed on the sun.

AT a meeting of the City (London) Commissioners of Sewers, held on Tuesday week, a prolonged discussion took place on a report by Mr. W. H. Preece on the subject of electric lighting, and it was ultimately resolved by 22 to 21, "That while the Commission was in favour of electric lighting in the abstract, it was advisable to allow all further experiments to be conducted at the risk of the lighting companies, and not at the expense of the ratepayers."

ARTIFICIAL turquoise are made in Paris and Vienna that cannot be distinguished by external appearances from the natural product, and when artistically made can only be distinguished by means of the file, being usually softer. The *Scientific American* says they are made from phosphate of alumina and phosphate of copper mixed together, and subjected to hydraulic pressure. Even in chemical composition it resembles the natural mineral, which is a hydrated phosphate of alumina with 2 per cent. of oxide of copper.

A CORRESPONDENT sends us the following letter from Mr. Darwin, in 1873, to N. D. Doedes, a Dutch gentleman, who wrote to ask him his opinion on the existence of a God. Mr. Darwin wrote:—It is impossible to answer your question briefly; I am not sure that I could do so, even if I wrote at some length. But I may say that the impossibility of conceiving that this grand and wondrous universe, with our conscious selves, arose through chance, seems to me our chief argument for the existence of God; but whether this is an argument of real value, I have never been able to decide. I am aware that if we admit a first cause, the mind still craves to know whence it came and how it arose. Nor can I overlook the difficulty from the immense amount of suffering through the world. I am also induced to defer to a certain extent to the judgment of the many able men who have fully believed in God; but here, again, I see how poor an argument this is. The safest conclusion seems to be, that the whole subject is beyond the scope of man's intellect; but man can do his duty." This interesting letter was published first in *De Dageraad*, a Dutch Freethought paper, and has just been sent to Dr. Aveling by a Dutch Freethinker.

WITH the six large Edison dynamo-machines in the New York central installation, each driven by engines indicating from 120 to 150 horse-power, it has been found, says the *Engineer*, that if one machine falls in speed, the currents from the other machines short-circuit themselves through the machine which has dropped in speed, and thus overpower the engine driving it.

AT a meeting of the Royal Dublin Society, Dr. G. Johnstone Stoney made a communication "On the energy expended in propelling a bicycle." Dr. Stoney referred to a bicycle match of twenty-six competitors between London and Bath, in which the winner did 211 miles in twenty-four hours, and fourteen others travelled over 150 miles a-day each. A bicyclist travelled from London to John o' Groat's House in thirteen days, being at the rate of 76 miles a-day. These were the performances of athletes, but an ordinary young person could travel 60 miles a day, and a man between 50 and 60 years of age, 30 miles a day. The result of his experiments showed [illegible] energy was [illegible] in propelling [illegible] of applying human [illegible] circumstances that the [illegible] that it could adjust with [illegible] to the best possible [illegible] and also the extent [illegible] and scenery, it [illegible] Dr. Stoney that the ultimate comparison [illegible] the energy expended and the feats accom[illegible] the fatigue [illegible], which was small, [illegible] Dr. Stoney, in reply to [illegible] the riding of a tricycle was just above, and [illegible] just below, the perspiring point. It had [illegible] the energy expended in labour on a tread[illegible] the hours of labour were eight hours a day, was [illegible] per minute, while the average energy [illegible] riding a bicycle was about 5,000 foot pound [illegible]

The town clerk of Stranraer has been in correspondence with the town clerk of Chesterfield in reference to the advantages of electric lighting, so far as experience has been gained in that town, and the letter sent to him by Mr. [illegible] (town clerk, Chesterfield) says:—"The majority of the Corporation of Chesterfield are satisfied with the lighting of the town by electricity on the ground of [illegible] and economy. We have twenty-two Brush arc [illegible] and ninety-six Lane Fox incandescent lamps at a [illegible], for the present year, of £885, in place of 200 gas-lamps [illegible] £950 per annum. The contractors are Hammond & Co. It is well to have on record such [illegible] statements as to cost, efficiency, &c., whether they [illegible] borne out in general electric lighting practice or not. Such a statement in reference to the Chesterfield electric lighting experiment has not been previously published.

At the last meeting of the Central Board of the Miners' National Union, held at Durham, Mr. Thomas Burt, M.P., the chairman, called the attention of those present to a scheme put forward by Mr. Ellis Lever, of Manchester, to give a premium of £500 to any person who could invent the best portable electric lamp for use in mines. A letter was read from Mr. Lever, jun., stating that in his opinion a portable electric lamp to be used in mines was quite a probable thing. The meeting, looking upon the offer as important, passed the following resolution: "That this meeting [illegible] to tender to Mr. Ellis Lever its best thanks for his kind and generous offer to pay a premium of £500 to the person [illegible] the most useful portable electric lamp to [illegible] used in mines. That should Mr. Lever still kindly consent to give the premium of £500 for this purpose, the president and secretary be empowered to correspond with him, and, if necessary, see him on the subject." It was further agreed that the president (Mr. Burt), the vice-president (Mr. [illegible]), and the secretary (Mr. Crawford), [illegible] committee to [illegible] the praiseworthy [illegible] Mr. Lever wishes to bring about. The question of the amount of [illegible] which miners may place [illegible] safety [illegible] long been debated, so that the offer [illegible] create a great interest in mining circles.

[illegible] present proprietor [illegible] for twenty hours per [illegible] Kew Botanic Gardens [illegible] more zealous in [illegible] He [illegible] yielded [illegible] the work of closing up the [illegible] there the woodwork is which [illegible] him [illegible] the proverbial rope.

Civilisation in the Time of Abraham.—Among the Chaldean cylinders recently discovered by Mr. Rassam in the course of his excavations in Babylonia, and upon which Mr. Theophilus G. Pinches read a most interesting paper at the last meeting of the Society of Biblical Archæology, is one of the most remarkable yet found, by reason of the light it throws upon the ancient chronology of the Chaldean Empire. It dates from the time of Nabonides, and records, among other things, that this sovereign, digging under the foundations of the Sun God Temple at Sipara, forty-five years after the death of King Nebuchadnezzar, came upon a cylinder of Naramsin, the son of Sargon, which no one had seen for "3,200 years." This gives as the date of the ancient sovereign named 3,750 B.C. This, and the fact pointed out by Professor Oppert, who was present, that there was in those early days already "lively intercourse between Chaldea and Egypt," will have to be taken into account by future Bible critics. It is certain (says the *Jewish World*) somewhat to modify the vulgar conception—due in the first place to Dean Stanley—of Abraham, the founder of the Jews, as a wandering Arab Sheikh, a kind of nomad Bedouin as he exists in our day. The existence more than 5,500 years ago of two highly-civilised and highly-cultured Empires in Egypt and Chaldea; the fact that constant intercourse was going on between the two; again, that the high road between them led direct through Southern Palestine, and that Abraham was a native of the one great Empire and an honoured visitor in the other, cannot but serve to modify in no slight degree our notions of the wandering sheikh to whom we owe our origin. That he would have been unaffected by the culture in which he was born, and the rival civilisations between which he lived, is hardly likely. Altogether, the discovery to which Mr. Pinches has called attention may open up a new field for investigation in the matter of Akkad and Akkadian civilisation.

American common-sense, as we anticipated, is rising superior to the Langtry delusion, which crowded theatres here, to see a passable amateur in parts utterly beyond her strength, for no other reason than——than *what?* Does any one know? Or, rather, is any one ignorant?

Professor Wilson has promised a series of papers on "Our Bodies;" to begin next week with "Our Bones," and to be continued systematically on alternate weeks.

Mr. W. Mattieu Williams, leaving for awhile (in these columns) the fuel of the great centre of the universe, is going to discuss on alternate weeks the "Chemistry of Cooking," a subject about which too many are lamentably ignorant.

The author of the series "How to Get Strong" has left the chest and begun on the waist. We keep back his first paper for a week, as it would clash with this week's discussion of the corset-wearing question. He writes somewhat emphatically that his papers are *not* meant for any who would seek to obtain or restore waist strength by wearing corsets; he shows, rather, he says, how a natural corset may be formed—that is, a good waist-enclosure of muscle instead of whale-bone or steel.

Our Mathematical Column was displaced last week owing to an accession of advertisement matter. We were not at the office to decide what must give way, and this column was selected, we suppose, as considered likely to interest fewest readers. We should have made another choice; hereafter the Mathematical Column shall not be omitted two weeks running.

LEARNING LANGUAGES.

By Richard A. Proctor.

I HAVE had a rather varied experience in learning languages, for which acquisition, let me note, I have no exceptional aptitude, as some people have, so that my experience may, perhaps, be of use to many. As I have received also a great number of letters (more than eighty) relating to the Hamiltonian method, I may combine what I have to say on the general subject, with a short sketch of the advantages of that system.

All the languages of which I have any knowledge I learned for the purposes solely of reading books written in those languages. At school and college, indeed, I was taught Latin and Greek according to the system in vogue at our schools and colleges, the object of which appears to my apprehension (possibly dull) to make the use of either language, in the way of book-reading, appear to the learner the last and most remote of all the purposes for which a language can be learned. Somehow, so far from appreciating, I could never, even as a boy, read without ridicule the preposterous things which our Latin and Greek grammars set forth to teach beginners. Nor do I envy my own boys, taught from the public school grammar, such useful things as that, "B. Any finite part of the verb *sum* (*esse*), *to be*, is usually a copula or link; and a word linked by it to the subject, and completing the sense, is called a complement, both together forming the predicate, as—

	Predicate.	
Subject.	*Copula.*	*Complement.*
Præceptores	*sunt*	*inepti.*
The authors of this grammar	*are* (*surely*)	*quite too awfully profound.*

Yet I must admire the elaborate ingenuity—if I ought not rather to say the fiendish, boy-devouring malignity—with which new difficulties are created. It is bad enough to tell your boy that "the impersonal gerundive construction implies necessity, principally in intransitive verbs, as *Corrigendum est: one would think such elaborate nonsense ought to be corrected:*" but when new and various pronunciations and modes of spelling are devised, when even our girls at Queen's College and Girton may at one time be taught to pronounce *vicissim* "viegissim," and at another to say "We kiss 'im, *in turn*," while the familiar, but even then perplexing, *cujus* and *jusjurandum* of our boyhood assume the unfamiliar forms *cuius* and *iusiurandum*, one begins to ask, What are the commissioners in mental aberration about that they overlook their work thus? Either the schoolmaster is very much abroad, or one wishes that he were, and some sensible folk at home would undertake the work of teaching boys Latin and Greek.

It so chances that I learned to speak French as readily as English when as yet I was in about that stage of Latin in which the urchin Page is represented to have been. I learned French by being sent hap-hazard, as it were, at seven years old or so, to a French college. I remember some boys kindlier than the rest telling me as much about the French equivalents for English words as their limited knowledge of the latter language permitted. Other French was rather told me than taught me at home. I suppose I worked in some way or other, for on alternate Fridays I was marched home in triumph, decorated with a brilliantly-coloured medal (an honour to which an elder brother who went there with me failed to attain). I particularly remember the march home, because as I was grasped on either side by the bigger boys, who walked on the *trottoir*, I trotted in the central gutter, and reached home a spectacle for gods and men! But the work for which I was thus doubly decorated I do not remember. My impression is I simply picked up French as in babyhood's happy but unconscious hours I picked up my mother-tongue. I could jabber French and a good deal of Bas Bréton when the simplest book in French and many simple books in English were sealed to me. Thus when, at nine or ten years old, in England, I was rebuked by my language teacher, at an English school, for imperfect translation, I could defend myself in good French, which he, having only the French of "Stratford-atte-Bowe," could by no means understand. Like Becky Sharp, under rather similar conditions, I rather enjoyed these encounters.

But the point to be noticed is that, having thus merely picked up French by being spoken to in the language, with occasional explanation, and having subsequently studied by myself, and enjoyably, the grammar of the language, I now read French as readily, within a very little, as my own language.

Next comes Latin. Here my experience, compared with what I have since obtained in other languages, which, though not dead, have been learned as dead languages by me, assures me that the most perfect way to ensure failure in learning a language, is to begin with the careful, systematic, and purely logical study of its parts of speech. The ridiculously slow progress which all boys make with Latin in the usual hammer-and-tongs grammar-and-dictionary style of work, contrasts strangely with the ready way in which I, who had been as dull as any with Latin, picked up German without aid from any master. I am certain I have given enough time to Latin to have learned more that is useful of at least six languages than I ever *so* learned of Latin. I *have* learned the kind of Latin which I want—not critical, construction-balancing, word-weighing, sentence-analysing mastery (which is useful enough for those who want it), but the power to catch readily the meaning of an author—but I have learned this outside of school and college, and by the pleasant process of reading Latin works, instead of studying the learned twaddle of the Eton Latin grammar. And I could read Greek with enjoyment when I was utterly ignorant about the really interesting, but (for the *language*) useless knowledge in such books as Buttman's "Lexilogus" and the like.

My method of learning Latin and Greek was an imperfect anticipation of the Hamiltonian method, and must be described before the true system.

(*To be continued.*)

OUR CHEMISTRY COLUMN.

By William Jago, F.C.S.

THE interest attached to the study of almost every subject begins only after certain rudiments have been mastered. These are, however, necessary to a proper understanding and appreciation of the subject itself. Notwithstanding a desire to write chemistry as unconventionally as possible, there are yet a few preliminaries in the way of definitions to be got over. Among the first series of terms that must continually be used by the chemist there are Element, Compound, Mixture. These words have each distinct and exact meanings; the elements are those bodies which have never been separated into two or more substances by any means known. Among the [illegible] included [illegible] potash, soda, and [illegible] electrical experiments, [illegible] obtaining from it the [illegible] then relegated from the [illegible] to [illegible] of compounds. Since that time [illegible] has been sustained with [illegible] the last [illegible] or two the researches of M[illegible] have indicated a possibility of decomposi[illegible] should such decomposition be [illegible] would have to be considered a a compound [illegible] element. At this point an experiment may [illegible] that, simple though it may seem, will considerably [illegible] in detailing the further terms. Procure [illegible] in the form of very fine turnings, or better, as filings [illegible] with about three times their weight of powdered sulphur; notice that, however well mixed, the particles of copper and sulphur are still plainly visible. Put the mixture in the bottom of a 6 in. test-tube, which it should fill about two inches; heat it over a Bunsen lamp very carefully: it shortly commences to glow at the bottom: and then, without the assistance of the flame, [illegible] red hot throughout the whole mass. Heat now strongly, and [illegible] considerable quantity of sulphur boils off, and [illegible] in the upper part of the tube. Allow it to cool, and [illegible] blackish substance, very unlike both the sulphur and the copper, may be taken out. This substance [illegible] of sulphur and copper. Its ap[illegible] properties are very different from those of the [illegible] and further, the exact quantity of [illegible] definite: if [illegible] in the experiment [illegible] of sulphur is used, that excess simply [illegible] away. This should make [illegible] and a com[illegible] what is simply a m[illegible] in any proportion; a [illegible] combination of elements in [illegible] proportions. The terms, when used in chemical t[illegible] attached to them.

[illegible] properties [illegible] one which, the more [illegible] to underlie all the [illegible]. On weighing the copper, &c., in the [illegible] found that 63 of copper [illegible] with 32 of sulphur to form 95 of [illegible]. When copper combines with oxygen, [illegible] proportion of 63 to 16 [illegible] and if the whole [illegible] compound [illegible] they will be found [illegible] multiple of that weight of copper. For [illegible] there is also a number which repre[illegible] of it entering into a compound. In some [illegible] there are two compounds of the same [illegible] water consists of 2 by weight of hydrogen, [illegible] of oxygen, while hydroxyl, or hydrogen peroxide, [illegible] hydrogen and 32 of oxygen. Not only, then, [illegible] combination occur in definite proportions, [illegible] this instance, two elements combine in [illegible] proportion, they do so in multiple propor[illegible] and other considerations have led chemists [illegible] to adopt John Dalton's atomic theory. H[illegible] matter as consisting of extremely small [illegible] particles, called atoms, concluded that they [illegible] between which chemical action took place. A[illegible] theory, when copper and sulphur unite, [illegible] the atom of each, one to one; the [illegible] produced is termed a molecule, the weights [illegible] are [illegible] considered the respective weights of the at[illegible]. We have in this theory one which, though not ad[illegible] of absolute proof, yet affords a simple explanat[illegible] of [illegible] of chemical combination. There is a[illegible] reason for supposing that, with the elementary bodies, the atoms unite together, and hence there are elementary as well as compound molecules.

Another point requires some little explanation, and that is the use of symbols. Chemists usually write the initial letter, or a combination of letters, instead of the full name of the element; thus, H is written for hydrogen, O for oxygen, &c. The letter not merely represents the element, but also exactly one atom of it. In writing compounds, the symbols of the two or more elements are written side by side; thus, CuS means a compound of one atom each of copper and sulphur: H_2O a compound of two atoms of hydrogen with one of oxygen. When chemical changes take place, they are generally represented by an equation—$Cu+S=CuS$. This means that one atom of copper and one of sulphur produce one molecule of the compound, copper sulphide.

Readers wishing a fuller explanation of the terms discussed in this paper, will find such given in a text-book on chemistry recently prepared by the writer, and published by Messrs. Longmans & Co.

Having now removed some slight difficulties from our way, we shall be able to proceed in the future with more descriptive papers, taking as our first subject the chemistry of sea-salt.

American Brass Cleaning.—Our American cousins have marvellous powers of *reinvention.* An example is given in your Science and Art Gossip of November 3rd, where is repeated the claims made by the United States arsenals to be the possessors [not *possessors,—users* only—Ed.] of the best method in all the world for cleaning brass. It is neither more nor less than the Birmingham process of "pickling," that has been practised beyond the memory of the oldest inhabitant by all the brass-founders and brass-workers there. The acid is sold retail in all the oilshops under the workshop name of "pickleacky" ("acky" is the pet name for aquafortis or nitric acid). Not only is the "acky" borrowed from Birmingham, but also the "pail of fresh water and box of sawdust," these being always used. The article, after cleaning as described, is dipped in the "acky" and held there a second or two, then rapidly plunged into the fresh water and dried in sawdust box sawdust preferred. I may add that the proportions of nitric and sulphuric acid of the United States arsenal are not the best possible. I have had some experience in practical pickling, and have found that, except for cheapness, a much smaller proportion of sulphuric acid is better. In pickling electro deposits of copper, preliminary to bronzing, I prefer unmixed commercial nitric acid, *used smartly.* This is dearer than the crude impure stuff sold as "pickleacky," and, therefore, not commonly used.—W. Mattieu Williams.

Western Union Telegraph Company.—Like most other great undertakings, this company had very small beginnings, but it has steadily added line upon line to its network, has brought up competitor after competitor, and has now a business of extraordinary magnitude. In 1871-72 the company had 62,033 miles of line, 137,190 miles of wire, and 5,237 offices. The number of messages despatched during the year was 12,414,499, and the receipts were 8,157,695 dols., of which 2,790,232 dols. remained in the company's treasury as so much net income. In 1881-82, the company owned 131,060 miles of line, 374,368 miles of wire, and 12,068 offices. The number of telegrams despatched was 38,812,347; the rough receipts of the year were 17,114,165 dols., and the net receipts of the twelve months were 7,118,070 dols. The most satisfactory feature in the progress made by the company during the last ten years is the growth of the net revenue.

CORSET - WEARING.

By R. A. Proctor.

I MUST confess that I have seen with some surprise "An Observer's" advocacy of tight-lacing, and with even more surprise, knowing his great acumen and power in argument, the inadequacy (or what seems to me the inadequacy) of the arguments by which he supports his case. If we consider what the arguments employed by "An Observer" and Dr. Chadwick really establish, we shall find that they have in reality scarcely any bearing on the only points which can be regarded as actually at issue.

Dr. Chadwick maintains that in the case of women, wearing corsets, from girlhood, which produce moderate pressure and gradually modify the form, may do no harm to the health—may even in some cases give much-needed support, and will improve the figure, according to his own idea of what constitutes a good figure. "An Observer" shows that in past times the Romans (and even, perhaps, the Greeks) admired small-waisted women, that in the middle ages and in our own time they have been admired, that even men have endeavoured to become small-waisted, that many women have preserved good health with moderate or even great waist-pinching, and that even many men have not only been uninjured by tight-lacing, but have found their health improved by the practice, and have noticed a marked falling off in their health when they have for a time given it up.

All this may be admitted—may even be regarded as requiring no demonstration—and yet the reasonableness of the views of the dress-reformers may be admitted, except in so far as they may very well be attempting (as "An Observer" opines) an utterly hopeless task.

It can be proved very readily that for many centuries a crushed foot has been greatly admired among ladies in China. It can even be shown that Chinese ladies with crushed feet often retain fairly good health to a very advanced age, notwithstanding the seemingly most mischievous character of the artificial deformity. So with the long-headed deformity of which Miss Buckland told us not long ago. The folks with crushed heads, like the ladies with crushed feet, survive, as a matter of fact, what, theoretically, should bring them to an early grave.

But more. It may be admitted—and is, indeed, the case—that a small waist, like a small foot or a small hand, is pleasing to the artistic eye (so it be natural), and is moreover an evidence of what is commonly called good blood—which really means several generations free from hard bodily toil such as labourers in the field have to undergo, by which hands and feet and loins are unduly and as it were coarsely exercised, with the natural result, abnormal development.

Yet more, it may be admitted—because it chances to be true—that even as regards well-balanced strength in man, a large waist is a defect, though for some forms of exercise (and markedly for rowing) a small waist always involves weakness. I happen to have special reasons for remembering this. I had, as a young man, the waist-measurement mentioned by "An Observer," viz., 28 in., though, as I was short (5 ft. 6 in. only was, I think, my stocking-foot record as a volunteer), this did not correspond to quite the same tenuity as "An Observer" seems to consider suitable for well - made young men. My chest measurement was 42 in., my arms long (extending nearly 6 ft. horizontal), and my shoulder and upper-arm muscles exceptionally well developed. Yet though thus well supplied with most of the rowing muscles, I suffered—and very seriously at first—from the weakness of the abdominal and loin muscles. At the beginning of each term three or four weeks would pass before these muscles took kindly to their work. For the rest of the term they seemed as hard as wood; but they were in reality too small for their share of hard rowing in the old-fashioned Cambridge style. For the long races men of strong and large loins and fully-developed abdominal muscles were then, and have always been, the best fitted, though that does not prove the large-waisted men best in all-round development.

But even if we granted that small waists were good (instead of moderate waists and small hips, as in Thorwaldsen's "Jason"), and again, if we admitted that small waists were artistically pleasing (instead of being hideous in men, if the hips are wide), how would that help to show the advantage of tight-lacing? It is good to have a good biceps muscle, but sticking a good-sized padding inside your jersey, to simulate a good biceps, is of very little use. That does not illustrate tight-lacing, "An Observer" may say. No, it does not; it is not sufficiently unreasonable. Take this, then. It is good to have strong wrist muscles, which will not yield under great strain; and tying a ribbon tight round the wrist may save the ligaments of the wrist from the effects of undue efforts, besides, perhaps making the wrist look small and neat; moreover, a person who has been in the constant habit of wearing such a bandage would be apt "to suffer whenever he gave it up." Does this prove that it is well to wear tight bandages round the wrists? Nay; but it proves the reverse. It shows that their use so weakens the natural muscles by saving them their proper work, that (as Sir Edmund Beckett notes in his "Origin of the Laws of Nature") being "not exercised and less worked for the time," they decline both in size and strength.

In like manner, a waist of moderate size, enclosed by small and well-hardened muscles, is good; it shows that there is no lumber of fat either about the abdominal or lumbar muscles, or about the abdomen itself; that these muscles are fit to bear any strain likely to come upon them: that, in fine, the abdominal region is in good condition. If it is not in good condition, and a man is unwilling or unable to get it into good condition, tying it up in bandages or enclosing it within stays may be a very desirable or even a most necessary precaution. It will make the waist look more like the waist of a stalwart man, and may perhaps prevent pain, or fatigue, or even serious injury from the weakness of the abdominal and lumbar muscles. Doubtless when a discussion arises about the use of stays, hundreds of weaklings who have had this experience come forward, and laud their corsets; while the hundreds of thousands who have never felt the want of corsets (or have preferred steady exercise to keep their abdominal regions in good condition) can say nothing on the subject.

But I take it that we might get quite as overwhelming a weight of evidence in the same way to show the use of wearing a truss as we have for the wearing of a corset—by men, at any rate. Two or three or more might "say they could stand and walk much longer" with a truss on

* What does "An Observer" do if he finds any muscle show signs of weakness? Does he bandage it up for ever after? I doubt the wisdom of such a course. In a railway accident in America, I had the knee-cap muscle of my left leg badly injured, and it was for a long time weak. *Instead*, I gave it steady exercise, cold water streams, and so forth. If I had tied up my knee, I should doubtless have prevented further injury, but I should have kept the muscle worthless, and kept a worthless muscle. So if the loins and abdominal muscles are weak, you may save them from mischief by tying them up; but it is far better to make them strong—as, unless very lazy, you readily can.

[illegible] without, and not a few would tell us "that their [illegible] relapsed whenever they gave it up." Those who [illegible] never worn a truss could give no opinion from experience; and if any philosophers had argued from theoretical [illegible] that [illegible] men were better without a truss, those philosophers would get much the worst of it *in* [illegible]. The "statements of personal experience, [illegible] in detail," would be all on one side, [illegible] of Touchstone's illustration, and [illegible] the better for being one-sided. Nor [illegible] by such arguments to begin the [illegible] "An Observer," and the letter-writer [illegible] and "Figure Training," "may as well [illegible] as to men wearing corsets [illegible], or at any rate"—no, let the [illegible] stop there.

As to women, the case is not altogether the same—nor is it quite the same as regards the artistic question. Narrower flanks than exercise will give to well-built men, and wasp-waists for women may be pretty to look at, and the wooden busts of Cruikshank's women * may be lovely instead of hideous, for anything I have yet shown. That part of the subject is not quite so amenable to argument, because [illegible] *non est disputandum*. But I shall try to show that, so far as the artistic question can be judged by the most celebrated examples, the argument is all against the straightly laced, and all in favour of the curve of beauty. For this, however, illustrations are needed, and they cannot be ready for this week. Next week some Greek and Roman persons in marble shall be introduced, to show what the sculptors of old, at least, thought and taught, whom also our modern artists still follow, and our shapeliest men and women too.

(To be continued.)

Time by Telephone.—At Ann Arbor, Mich., astronomical time is furnished by the observatory to subscribers daily at 9 o'clock a.m. by telephone. The telephone transmitter at the observatory is placed close to a Morse sounder, which is operated automatically by the observatory clock. From 8.58 to 8.59 the sounder clicks once for each second, and from 8.59 to 9 o'clock twice for each second. At 9 o'clock it ceases. The click of the sounder is heard distinctly in the receiving telephones of the subscribers.—*Operator.*

The Pennsylvania Railroad Company has purchased [illegible] tin boxes containing a few simple surgical materials likely to be wanted in cases of accident. Some of these boxes are kept on each locomotive, and they each contain [illegible] rubber [illegible], one package of absorbent cotton, [illegible] roll of bandage, one pyramid of pins. With the box are the following simple directions:—When an arm or leg is crushed, causing hemorrhage, pass compress [illegible] immediately below the injured part. In case of rupture of a vein [illegible] tightly until arrival of the surgeon. The rupture of an artery can be distinguished by the colour of the blood, which is red, and spurts out, while a vein [illegible], and flow continuously. For wounds on the head or face apply absorbent cotton, and bind with a bandage. The company has set a good example.

* [illegible] to "An Observer" for the circumstance [illegible] corrected. The following changes [illegible] Line 23 of article, for "[illegible]," read "one [illegible]." Page [illegible] 1 line 2 from bottom, for "exceptionally," read "except [illegible]." Line 13 from end of article, for "[illegible]," read "[illegible]."

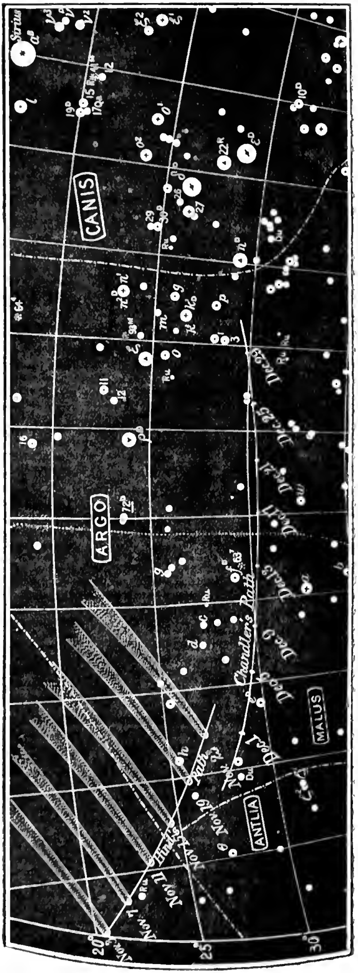


Fig. 1. Course of the Comet during December.

THE COMET'S PATH IN DECEMBER.

We give the comet's path in December as deduced from Prof. Chandler's elements of the orbit. Our figure shows the path for November, deduced from Mr.

40° above Horizon.

Fig. 2.

Hind's elements. It will be seen that there is considerable discrepancy. The second figure shows the position of the comet's path on

December 2, at 4·15 a.m.
December 6, at 4 a.m.
December 10, at 3·45 a.m.

For later dates we can refer our readers to "The Stars in their Seasons," now ready for issue, from which the course can be traced for any hour on any night (or in this case morning). We shall, however, give in due time a map like Fig. 2, for the morning hours in the latter half of December.

The comet still continues a conspicuous object on moonless mornings. It will probably be visible with the telescope till the end of March, 1883.

There is now no reason to believe that this comet will soon return. It is travelling along steadily enough in an orbit of great extent, though, as will be inferred from the varying estimates as time proceeds, the exact extent of the orbit is not yet known. The Vienna observation, on which our estimate of the period was (provisionally) based, turns out to have been quite incorrect.

THE AURORA.

A MOST brilliant display of the aurora was observed on Friday evening, the 17th ult. It commenced about 4·30 with a band of beautiful yellow, almost due west, which lasted about ten minutes. A glare of rosy crimson then began to appear in the north, which soon developed into a brilliant arc, with a decidedly greater lustre and size west, where rays of the most brilliant colour were constantly shooting upwards to the zenith. At 5.30 an arc of pale lemon colour appeared under the arc of rose colour, which was greatly augmented in the east, precisely as the rose-coloured one was in the west, and like it, sending rays up to the zenith, though, of course, of a pale yellow colour. The sky due north below the second arc had a very dark appearance. This was, in fact, noticed the whole time, and seems to me to indicate that the aurora was of great extent. The two arcs at 5.45 seemed to have blended together and to be dying out; but a few minutes later the rose colour increased with great rapidity, seeming to rise in the east and pass to the west, where it was brightest. At 6.10 an arc of pale lemon colour appeared for the second time under the arc of rose colour, with the same increase of light in the east. Two minutes later occurred the most interesting sight of the whole display; a brilliant point of light appeared in the eastern horizon, a little south of the patch of light which had just appeared there; this gradually rose with almost visible motion until it had attained the length of about thirty degrees and five degrees in breadth, tapering to a blunt point at either end. Passing a degree south of Saturn, it described an arc so as to just pass over the moon and disappear in the western horizon, close to the patch of rose colour which had been almost stationary in the west during the whole display. It was visible just a minute and a half. The aurora, after this, gradually toned down into an arc of soft white light, which lasted over an hour. By 9.30 there was nothing but a faint light, like that of the rising moon. [A. G. describing the aurora as seen by himself and four others.—Ed.]

THE GREAT SUN SPOT.

MR. SYDNEY HODGES has kindly forwarded to us a picture of the sun spot, as drawn by him on Nov. 19, at 8 a.m. We have inverted his picture to show the spot as it would have been seen with an erecting eyepiece, so that it may be more readily compared with our

At 8 a.m., Nov. 19.

At 11 a.m., Nov. 20.

own drawing. We give both for comparison. It is singular that Mr. Hodges should have made his drawing, in our hands before last number appeared, to almost exactly the same scale as ours.

A Powder Magazine Struck by Lightning.—A despatch from Scutari, in Albania, dated Nov. 17, stated that the powder magazine of the fortress at that place had been exploded by lightning. There was no loss of life.

THE FUEL OF THE SUN.

(Continued.)

(1.) Not knowing what Mr. Williams meant by "mean gravitation," I paid no special attention to the word; but, of course, it was obvious he meant what he says (though he miscalculated for Venus), and that is just where he is mistaken. If the mean gravitation of Jupiter were fifty times what it is, it could not cause the body of the sun to reel or sway inside the profound fluid envelope. Only a difference of influence on one and the other could cause any difference of motion, though not a hundred times the sun's own mass, outside of him, could make his body reel in the lively way Mr. Williams imagines. He may say this is mere assertion; if so, it is assertion for assertion: but it is assertion based on some knowledge of the conditions of the problem; and whenever Mr. Williams endeavours to maintain his proposition he will find this counter assertion can be maintained effectively. But I will venture to say that when he begins to reason out the details of his assertion he will withdraw it.

(2.) The total quantity of motion or force in the universe is invariable for evermore. Certainly. But Mr. Williams wants it to be ever increasing. The sun, according to his theory, as originally propounded, was to go careering through space, getting bombarded through its own motion (or, more precisely, communicating to billions of tons of matter per second the motion it possessed itself), and yet this motion was to remain unvarying. However, as subsequent reflection has given a new form to this part of the theory, we need not perhaps consider it further.

(3.) Mr. Williams will find, in Fig. 74 of my "Sun," spectroscopic evidence of motions of recession and approach quite as remarkable as that described in the Greenwich Reports. But these are movements of a cyclonic sort in the hydrogen atmosphere after disturbance by the outrush of prominence matter. Into the partial vacuum left after the passage of the ejected matter, the surrounding gas rushes with continually increasing velocity, as shown by the Greenwich observations, which indicated continual inrush towards the region of disturbance. So the rush of luminous matter athwart the sun's surface in 1859 gave no evidence of lateral ejection such as Mr. Williams' theory requires. Mere thwart motion arising at, or from below, the surface would not (he now admits, though he did not originally) do what is wanted. There must be a rush of matter from a point high above the surface in such a direction as to give the matter a free orbit round the sun, which orbit might be changed (Mr. Williams thinks, though as a matter of fact it could not be changed), by perturbations, into an orbit like that of a planet. But Mr. Williams speaks of explosions, as if the dissociated gases, rising up from the sun's interior, after passing through the flaming photosphere, and being thus suddenly combined, exploded by hundreds of masses, like our own earth for size, "combining their propulsive efforts like the contiguous grains of powder in a gun." *Like!* Very like, if the most complete contrast means resemblance. The grains of gunpowder are suddenly converted into many times their own volume of gaseous matter; the gaseous matter in the other case, as also in the cheerful soap-bubble experiment suggested for my translation, are suddenly converted into liquid matter, occupying but a minute portion of their volume. If a globe as large as this earth of hydrogen and oxygen duly combined, were suddenly exploded, there would be an awful disturbance, but very little expulsion of matter, for the globe would be suddenly changed into much less than the thousandth part of its volume of water. The enclosing shell would be crushed *in* were there a surrounding atmosphere, not scattered in fragments outwards. But even if there *were* an outburst such as Mr. Williams imagines, is he not aware that in the case of such an explosion high above the sun's surface, the centre of gravity of the exploding matter would remain absolutely unaffected by the explosion; and as much matter as might be sent in the direction of planetary motion, just so much would be sent in the opposite direction. This would not be very easily reconciled with the movements of the asteroidal family, if Mr. Williams' theory of the origin of this family were correct. Now if a number of loaded cannon of monstrous size were flung from the sun's surface in such sort as to be fired when several hundred thousand miles from him, expelling the ball always in the direction of planetary motion, at a velocity of not less than 250 miles or so per second, we might get something like Mr. Williams's genesis of asteroid rings; for the cannons themselves, though driven backwards in such sort that the motion of the centre of gravity of cannon and ball would not be affected at all by the explosion, would not in this way have orbits clear of the sun's globe, while the expelled ball *would* have such orbits. Thus the cannon-balls would thenceforth circulate round the sun, while the cannons would be gathered up again by him,—for future use, perhaps, in the same way. In some such way might matter be expelled from the sun, so as to form free planetary attendants going the right way round. But though this explanation is "my own ownest," I am not so enamoured of it as I suppose I ought to be.—RICHARD A. PROCTOR

LIFE OF A MAXIM LAMP.—At the New York Post-office it has been found that the average life of a Maxim incandescent lamp (the ordinary 50 candle-power type) is nearly 1,900 hours. About 25 per cent. of the lamps in this office have burnt between 3,000 and 4,000 hours.

ELECTRIC INTERCOMMUNICATION ON TRAINS.—A good illustration of the need of this mode of intercommunication between passengers and guards was afforded on a German railway the other day while travelling between Lottringhausen and Horde stations, near Dortmund, in Westphalia. A fire broke out in a carriage of the train, the fire increased as the train progressed, and it was only by dint of much shouting that the unfortunate passengers at length attracted the attention of the guard, and were released from their perilous position.

BURYING-PLACE OF INDIANS NEAR ATURES.—A strange place of interment exists at Atures, in the neighbourhood of San Fernando, New Granada, held in much veneration by the Indians. In order to reach it, a lonely savanna has to be traversed, then a river has to be crossed and an island reached bearing the name of Cucurital. Behind a thin curtain of trees and bushes is a natural grotto, formed by the overhanging of an enormous rock. Underneath this rock are hundreds of large earthen pots, each pot containing the remains of an Indian, surmounted by the skull. Some of the remains were simply wrapped in mats formed from the leaves of the Guahibos palm. There is a sacred burying place in a cave high up the side of an almost precipitous wall of rock, to reach which requires a skilled climber endowed with a powerful grip of foot and hand, and with a head that will not be affected with vertigo. Here are found the same class of coffins, if such a term is permissible, the ghastly skulls grinning at the profaning intruder.

HAS THE MOON AN ATMOSPHERE?

I AM aware of the logical weakness of all merely negative evidence, cumulative though it may be; but I may, perhaps, be permitted to adduce my own very extensive experience in the observation of occultations of stars and planets by the moon, as tending to show that no lunar atmosphere of any appreciable density exists. If physicists are content to dignify with the name of atmosphere a condition of things cognate with that which we call a "vacuum" in a good air-pump, I have nothing more to say. If, however, by atmosphere it is intended to signify any envelope, akin in density even to the upper regions of that surrounding our own globe, then would I say that to me the moon has always seemed airless. Now I have seen stars disappear behind all parts of her limb, both illuminated and unilluminated, elevated and depressed, rugged and plain, and a more absolutely instantaneous phenomenon I am unacquainted with. I have even seen a star disappear and reappear among the mountains and valleys on the serrated edge of the moon, but without the faintest indications of distortion or diminution of light. I was, though, never so impressed with the idea of a total absence of any lunar atmosphere as I was on the occasion of the occultation of Saturn by the moon on the night of May 8, 1859, of which an account will be found in pp. 242 and 243 of Vol. XIX. of the Royal Astronomical Society's "Monthly Notices." The definition was remarkably fine, and with a power of 255 the whole of the detail of the planet was seen in a style suggestive of the engravings in works on astronomy. Now all this detail, both of immersion and emersion, was sharply visible up to the very limb of the moon. With my eye and the power I employed, I am convinced that I could not have missed any phenomenon having its origin in refraction to the extent of 1″. Nothing of the sort, though, was visible.

I must in candour, however, add that on two separate occasions when I have been observing partial solar eclipses I have noted an appearance which would seem to lend some colour to the theory that an atmosphere of considerable tenuity does surround our satellite. This appearance took the form of two exceedingly small thorns, as it were, of light, at the extremities of the solar cusps, suggesting the idea of the sun's limb turning *very* slightly outwards at these points. The first time I saw this was on

September 28-29, 1875, when it was also witnessed by my wife and Mr. J. Lister Godlee, of the Equity Bar. Neither of them had any experience in observing, but each saw these little points at once, on viewing the eclipsed sun. The accompanying illustration of this, drawn at the telescope, is copied from the R.A.S. *Monthly Notices*, Vol. XXXVI., p. 41. I witnessed a repetition of this curious effect on May 17 last, and it may be interesting to put on record here that, having viewed it with an ordinary diagonal solar eye-piece, I removed this, and substituting a plain Huyghenean one, projected the image of the sun on to a screen, under which circumstances the "thorns" were just as visible as ever.

WILLIAM NOBLE.

HUNTING ALLIGATORS. — J. Russell, a son of Major Russell, famous during the Florida War, now makes a precarious living in South Florida as a guide to visiting sportsmen. For a bonus of two dollars he will dive into the current of the muddy St. John and bring up an alligator. He actually brings them out of their holes. Strange as this may seem, it is the only safe way to approach an alligator. They dig holes in the river-banks, just below the surface of the water and crawl into them. Jim dives down, crawls in rapidly, and seizes the saurian by the tail, who, startled, immediately backs out. Jim holds on, keeping his legs stiff till clear of the bank, when he darts away, and the alligator, rising to the surface for an instant to see what is the matter, is slain by waiting gunners in a boat. This has become common sport on the Upper St. John River.

THE DIFFUSION OF BACTERIA.—The researches of M. Pasteur and Darwin have shown how earthworms may aid the diffusion of small organisms, some of which may produce disease. Professor Schnetzler states that the dejections of earthworms always contain numerous living bacteria and their germs (the hay-bacterium included). It is clear that bacteria in enormous quantity float in the air about us; and we have at easy command, Professor Schnetzler points out, a small apparatus traversed by about 8,000 cubic centimetres of air per minute, which may inform us as to those floating germs. This is no other than the nasal cavity, on the mucous surface of which air-particles are deposited. To observe these he advises injecting the nose with distilled water (completely sterilised) by means of a glass syringe previously calcined. The liquid so obtained is put in one perfectly clean watch-glass, and covered by another. With a microscope magnifying 700 or 800 one finds, among various particles in the liquid, some real live bacteria. If the liquid be kept a few days in a clean glass tube hermetically sealed, the bacteria are found to have increased very considerably. One sees *Bacterium termo*, *vibrio*, *spirillum bacillus subtilis*, even some *infusoria*, and spores and fragments of fungi. Professor Schnetzler has further successfully cultivated the organised germs by means of a mixture of gelatine and distilled water. Why do not those bacteria in the nasal cavity always multiply and develope and penetrate to the windpipe and lungs? Their progress is, doubtless, opposed by the vibratory movements of cilia (or minute hairs) in the air-passages, and the weakly alkaline reaction of the nasal mucus may (it is also suggested) be unfavourable to some of them. Cohn has proved that bacteria producing acid fermentation perish in liquids with alkaline reaction. Infectious bacteria may, however, multiply to a formidable extent on living mucous surfaces, witness the growth of the *micrococcus* of diphtheria, brought by the air into the air-passages; also the *bacterium* of anthrax. The *bacillus* of tubercle, as Koch has lately shown, may be transmitted from one person to another by the air-passages. Professor Schnetzler thinks hay fever may also be due to bacteria entering the nose. While the development of bacteria on normal mucous surfaces is usually limited, millions of them are found in the dejections of healthy children.

SUN-SPOT THEORIES.

THE following extracts from a letter by the editor to the editor of the *Standard* will answer many queries:—

Sir,—My attention has been directed to Mr. Archibald's comments on an article in *The Standard* of November 22, respecting the great sun-spot and the aurora of the 17th inst. On referring to the article, which I had not before read, I observe that it speaks of the views of Sir E. Sabine, as "doubted by some students of these phenomena," &c. The statement is strictly correct. Students of the phenomena—that is, of sun-spots and magnetic disturbances—do not for the most part doubt that there is a connection of some sort between sun-spots, auroras, and magnetic disturbances; but some of them (M. Faye, the eminent French astronomer and mathematician, for instance) unquestionably do. The connection between sun-spots and terrestrial magnetism is not what is understood by the "sun-pottery" of which the writer of your leading article speaks with well-merited contempt. Almost every astronomer (Professor Young says every astronomer except Faye—but Faye has a following) admits the connection between sun-spots and the condition of the earth's magnetic elements; but I know of no astronomer of standing who believes in the suggested connection between sun-spots, and storms, rainfall, famines, and so forth, in detail, though many may believe that for the whole earth, or over large areas, slight changes may arise, akin to the observed fact that the temperature of the earth as a whole varies as the sun-spot period progresses.

The only question really of interest is, whether any weather predictions of the least value can be made on systems deduced from sun-spot observations. This idea was thrown out, it is well known, as a reason for a special endowment of research; but it was, and is, rejected utterly by the scientific world, even by many who are by no means opposed to the principle of endowment. When it was submitted to the Council of the Astronomical Society, in 1872, only four supported the appeal for endowment thus backed, three of these immediately retiring from the Council (stating the rejection of their views as the reason). In somewhat the same proportion that the Astronomical Society was then divided on the question the astronomical world may now be divided.

But I doubt whether even a twelfth of the astronomers of our time favour "sun-spottery"; and those astronomers who do are chiefly men whose astronomy has been but the routine work of large observatories, whose opinions about astronomy would be about as valuable as a tailor's views about anatomy. For the rest, two or three meteorologists, a few logicians (always the most illogical of men), very few physicists, and one or two who are astronomers among chemists and chemists among astronomers, are the chief advocates of the modern astrology.

Richd. A. Proctor.

London, Nov. 21.

EARTHQUAKES IN THE BRITISH ISLES.—IV.

THE next earthquake which seems to merit notice is the one which occurred on Oct. 23, 1839. For a fortnight before, slight earth-tremors had been experienced at Comrie, in Perthshire; but the shock, which took place on the 23rd (though it seemed to have spread from this neighbourhood as a centre), was felt over nearly the whole of Great Britain.

A gentleman who felt the shock at Monzie gives the following graphic description of what was experienced at that place:—"At thirteen minutes past ten in the evening, we heard a sound like that of a numerous body of cavalry approaching at full gallop along a grassy sward. When this had continued a few seconds, we felt two or more abrupt concussions, as if a solid mass of earth had struck against a body more ponderous than itself and rebounded. The rattling of furniture, combined with the subterranean thunder, and the reeling of what we had hitherto deemed *terra firma*, communicated at this moment a feeling of the terrific which made the stoutest heart quail. The sound passed off as before, far to the east, carrying fear into other districts." The terror was so great at Comrie that the people ran out of their houses, and assembled for prayer in the secession meeting-house, where religious exercises were continued until three in the morning. Two distinct shocks were felt while the people were thus engaged in prayer; but neither of them was so intense as the first.

We might quote many instances of the energetic action of this shock, but we shall content ourselves with two, which appear to us the most remarkable. A great dam has been formed on Cringate Muir for the supply of water to the manufactories on the Carron. The reservoir had been carefully surveyed by two of the best engineers in Scotland, yet it was burst by the shock of this earthquake, and great damage was done to property by the rush of water into the vale below. The other effect of the earthquake is perhaps yet more remarkable. We quote from the *Witness* (Edinburgh newspaper) of Jan. 22, 1840:—"A small tract of boggy land in Morayshire, which, during the winter seasons of at least the last hundred years has been invariably more than half under water, has remained dry ever since the earthquake of last October; and several wells in the neighbourhood of Inverness, which derive their springs from fissures in the old red sandstone of the district, are only now slowly beginning to yield part of their wonted supply."

The earthquake which took place in the autumn of 1863 will be in the remembrance of most of our readers. It is chiefly interesting inasmuch as it bears so close a resemblance to the earthquake of October 30, 1868. On the whole it would appear to have been the more violent of the two. The district over which the disturbance extended in 1863 was also somewhat more extensive than that over which the effects of the later earthquake were experienced.

In 1863, the region of most violent action was in the neighbourhood of Ross (Herefordshire) and Abergavenny. There, effects were experienced which showed that a very moderate increase in the energy of the subterranean action would have rendered the earthquake a destructive one. The Golden Valley in Herefordshire, along the banks of the river Dore, was violently shaken. In fact, this earthquake seems to have affected in a particularly marked manner the beds of certain rivers in the West of England. The valleys of the Wye, and those along which flow some of the tributaries of that river, were much shaken. A the seat of Colonel Clifford, at Llaneilio, a wall was fissured by the shock. At Ashfield, near Ross, the walls of two houses which were unfinished were partly thrown down; and at a place called Bishop's Wood, lower down on the Wye, a house near the river was rocked with so much violence that a gentleman who was asleep in a heavy old-fashioned four-post bed was nearly thrown out.

Much doubt was thrown on the statement that the earthquake was accompanied by a roaring noise, and the editor of the *Geologist* expressed his opinion that those who imagine they had heard such a noise must have deceived themselves. But the evidence we have on this point is far too clear to be discredited in this way. The Rev. H. C. Key, of Stretton Rectory, near Hereford, compared the noise which he heard to that of "a very heavy and long train rushing furiously through a station." And the gentleman who was nearly thrown out of bed, as above stated, relates that so violent a noise accompanied the shock that he imagined an explosion of gunpowder had taken place in a barge on the Wye, and he rushed to the window to see what were the effects of the supposed catastrophe. The Rev. W. S. Symonds, Rector of Pendock, who wrote an interesting paper on the subject of this earthquake for the *Popular Science Review*, says that he received the following information from a friend, who is thoroughly to be relied on:—"A man rose unusually early, and was engaged loading a cart with potatoes, which he had promised to deliver before his day's work commenced; when on a sudden, 'he heard a dreadful noise come roaring up,' apparently from a wood to the westward, and his cart rocked so violently that he was nearly thrown out of it. The trees all around him rocked violently to and fro, and the rooks rose cawing from the wood; the small birds also twittered, and took wing with notes of distress. The thunder-like noise appeared to roll off towards the east."

That the earth was shaken with considerable violence in the western parts of England during the earthquake of 1863 is shown in a remarkable manner by the effects experienced in Carmarthen Bay. Eight hours after the occurrence of the earthquake, a large column of water, shaped somewhat like a cone, and "of a dark brown colour, as if charged with earthy matter" was seen to roll forward into the bay. A small vessel with which this mass of water came in contact, "was violently pitched about, and the water thrown completely over it."

The events recorded during the last English earthquake, in 1868, had no special interest, save that which they derived from their relation to the occurrence of a phenomenon which is so unusual in our country. The shock would seem to have been one of very moderate severity, since beyond the displacement of a few light articles of furniture it produced absolutely no disturbance whatever in the buildings which were shaken by it. No walls were fissured, nothing was thrown down—in fact, nothing remained to show that the most imposing terrestrial phenomenon known to man had been experienced in our country.

The most interesting circumstance connected with that last earthquake, and that which preceded it by a few days only, in Ireland, is that they occurred during a brief cessation of the activity of Mount Vesuvius. The volcano had been in violent eruption until almost the very day of the earthquake in Ireland. It remained at rest for a few days, but the rest was only apparent; the mountain was about to be shaken by an outburst even more energetic than that which it had before given vent to. But during these few days' rest there not only occurred two earthquakes in the British Isles, but a third was experienced in Wallachia. At last the energetic action of the imprisoned fluids and elastic vapours beneath Vesuvius resulted in the formation of a new cone, through which enormous volumes of lava forced their way. We can hardly doubt that the earth-tremors experienced in the British Isles were due to the action of the subterranean matter which had been temporarily prevented from escaping through the crater of Vesuvius.

FRENCH AND ENGLISH RAILWAY SPEED.

THE French claim to be quicker in railway travelling than we are. A comparison is made by a writer in *Annales Industrielles*, who takes for the case of England data recently furnished by M. Gerhardt for twelve of the principal English lines. M. Gerhardt distinguishes commercial speed and mean speed. The former is that appearing from a comparison of the whole distance run and the whole time, including stoppages; the latter from a comparison of the same distance with the real time of travelling, deducting losses of time through diminished speed at departure or arrival, at junctions, &c. Taking express trains, it appears that the mean speed in England, with one exception, exceeds 60 kilomètres ($37\frac{2}{5}$ miles) an hour, and reaches or exceeds, in seven cases out of twelve, 63 kilomètres (39 miles); on the Great Northern particularly it is over 74 kilomètres (46 miles). The commercial speed is under 55 kilomètres (34 miles) only in one case, exceeds 60 kilomètres ($37\frac{2}{5}$ miles) in five, and on the Great Northern it reaches 66·5 kilomètres ($41\frac{1}{5}$ miles). The mean speed of French express trains, on the other hand, is from 59·5 to 69·8 kilomètres (37 to $43\frac{1}{2}$ miles) an hour; the commercial speed, 52·4 to 63·4 kilomètres ($32\frac{1}{2}$ to $39\frac{1}{2}$ miles) an hour. A difference between the two countries of at least 10 per cent. is recognised. Attention is called to the fact that in France junctions must not be passed at a higher speed than 20 kilomètres ($12\frac{2}{5}$ miles) for passenger trains, and 10 ($6\frac{1}{5}$ miles) for goods trains; hence a loss of time in slowing before the junction (one minute), in passage (one minute), and in regaining normal speed (one minute); or three minutes lost at each junction. In England all latitude is allowed in this matter.

[Whatever value the metric system may have, and however desirable it may be to introduce it into statistical and scientific literature, we cannot admire the way in which some of our contemporaries—as the *Times* in the above instance—publish statements in which the metric measures are used, without any figures to show (as we have done above) what are the corresponding English measures.—Ed.]

Reviews.

PROFESSOR DE MORGAN.*

PROFESSOR DE MORGAN was great in mathematics, distinguished in logic: but he was greatest, and should be most distinguished, for the protest which his life bore against the Evil Doctrine of Expediency. He not only taught the true doctrine—he practised it; he bore witness to it when witnessing to it was not the way up in the world. The paths by which many as profound in science as he, as well able to stand on their merit, with as little

* *Memoir of Augustus de Morgan.* By his Wife, Sophia Elizabeth De Morgan. With Selections from his Letters. (London: Longmans & Co.)

[illegible] wards, sought advancement in his time, he w[illegible] forsook the companionship of many persons dear to him, he gave up offices which were agreeable to him, when right and expediency pointed different ways. Men thought him sometimes mistaken; some even said he was too precise (perhaps because his conduct shamed them more than they cared to acknowledge), but what he thought right he did, befall what might befall. When he saw his duty a dead sure thing, he went for it there and then. No nobler lesson can be taught than what he taught his whole life through. He never held high official position, he earned no great wealth; but he left behind him the treasure of a worthy name. Superlatives are not needed to gild his fame: he was emphatically *an honest man*. If this is a common career, the world is fortunate; but we err greatly if the lesson taught by De Morgan was not much needed in his lifetime: is it not much needed now

As to outward forms De Morgan was not what is called (absurdly enough) a religious man. Wearied early by the precise and formal religion, on one side, which required such and such observances daily, and on the other side by the gushing religious sentimentalism which urged him to the feet of "dear Mr. Simeon," he retained a belief which he was not eager to confess, because, as he said in his will, "such confession has always been the way up in the world."

It was and is the way up in the world to seek preferment and position by flattering those who can give it, by hiding the truth from those who do not like to hear it, by adulation so cleverly veiled that it looks like the applause which springs from true esteem and sympathy. Of this De Morgan was incapable. He resigned one office, and declined a higher office in the Astronomical Society, because he recognised "wrong-doing in the body politic:" he would not allow himself to be put in nomination for the Royal Society, because, by doing so, he would have seemed to take part in a system of which his logical mind disapproved; to the end of his life he remained plain Augustus De Morgan, "a man of few letters," B.A. of Cambridge, and a Fellow of the Astronomical Society, and worthier so than he would have been with the right (easily obtained) to add half a page of titles to his name.

Mrs. De Morgan's biography of her husband is, therefore, a book which, apart from its intrinsic interest, would be deserving of careful study. But it is full of interest. Parts of it possess the same kind of interest which was so marked a feature of his "Budget of Paradoxes"—by which, probably he is more widely known than by any other of his works. The account of his connection with the Astronomical Society, and of the feelings with which he regarded the earliest manifestation in that body of the "bias towards imitation [query "imitation"] "of political action by which Englishmen spoil so many of their extra political associations, will be read with interest by those who have seen that foolish spirit, after dying out again, become yet once again rife, til the society has become practically valueless. His difference with University College, and final secession from a body which had, for the sake of expediency, forsaken its principles, form a history well worth studying. He maintained, and, as the event proved, rightly, even as regards expediency, but with unquestioned truth on the ground of justice, that a university should depend on its professors, not the professors on their university. When he found that foolish men bore sway, he justly thought "the post of honour was a private station."

We learn from this book De Morgan's views on school and college training. Here, as in other things, he held that "the way up in the world" was not the best way. Success in examination secured by cram, he regarded as a discredit rather than a triumph. The wideness of his own reading had "spoiled his degree;" but he had read for love of knowledge, not for a degree; and he sought to instil this love, not mere skill in writing out answers, into his pupils.

We do not share his esteem for formal logic. From his own words, we might judge how idle is the study of logic to make men reason rightly; for he says that if the following were presented to a writer on logic without warning, he would not see the fallacy in it; whereas we hold that no man of sound reasoning powers, unspoiled by logic, can fail at once to see the fallacy:—

> "To say nothing of those who succeeded by effort, there were some who owed all to fortune, for they gained the end without any attempt whatever, if, indeed, it be not more correct to say that the end gained them. But for every one who was successful with or without effort, at least one could be pointed out who began, but abandoned the trial before the result was declared. And yet, so strangely is desert rewarded in this world, there was not one of these faint-hearted men but was as fortunate as any of those who used their best endeavours."

To say that all the faint-hearted succeeded without effort, and that they were at least as numerous as all who succeeded without effort *plus* all who succeeded with effort, is obviously absurd; and if writers on logic to whom the statement was presented, with or without warning, would all fail to see the absurdity *at once*, then writing on logic must seriously impair the reasoning process.*

The book is throughout delightfully written. Many letters to some of the most eminent men of the century, and a few letters from them, add greatly to its interest. De Morgan, as all who have read his Paradoxes are aware, possessed a quaint and dry humour, and was full of antiquarian lore. It is delightful to run through his letters, catching his references to all sorts of out-of-the-way matters, and noting the strange play of a mind full of scientific and mathematical knowledge, around subjects seemingly of but little interest in themselves.

The tone with which Mrs. De Morgan writes indicates fullest sympathy with her husband's tone of mind and mode of thinking. Here and there, where mathematical expressions occur, the text requires correction. Thus, there was certainly never any contest between x and dx, though there was between $\dot{x}$ and dx. But such points are few and far between.

ELECTRO-MOTORS.†

THIS little book being the first on what we may call the latest development of electrical science, it behoves us to extend to it a more than usually charitable spirit of criticism. Nevertheless, we cannot forbear giving expression to the disappointment we experienced in perusing its pages. We had hoped to be favoured with an account of the latest experiments and discoveries concerning the conversion of electricity into motion. Much to our regret, however, we can find little but what might have been read in the magazines months since, while many of the more recent proceedings pass unmentioned. It is difficult to conceive a book on motors which makes no reference to

* *Again, De Morgan says, this* is really hard:—

For every *Z* there is an *X*, which is not *Y*.
Some *Y*'s are *Z*'s.
Inference, some *X*'s are not *Z*'s.

Surely it ought to be perfectly obvious. We leave it as an exercise for non-logical readers.

† *Electro-Motors:* a Treatise on the Means and Apparatus employed in the Transmission of Electrical Energy, and its Conversion into Motive Power. By J. W. Urquhart. (Manchester: W. T. Emmott; London: Trubner & Co.)

the little "Griscom," nor could we imagine it possible for a chapter to be written on "Electric Railways" which ignores the well-known labours of Edison. These and other deficiencies, coupled with an excessive attention to introductory matter, which, from the smallness of the book, is unwarrantable, detract considerably from the value of what might, and indeed ought, to have been a most useful work. The illustrations are far too few for the subject, the first appearing on p. 29.

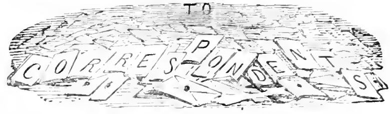
Anent the language, it is noticeable for what may be styled its angularity; and the author would have been amply repaid for any extra care he might have bestowed in striving to make it more palatable and smooth. A certain laxity of expression is also to be observed in places; thus, we read on p. 20, that the "current is generally *assumed to arise* at the surface of the zinc plate, which *therefore* begins to dissolve."* For those, however, who know something of the science of electricity, but little of its application, there is plenty of profitable reading to be found in the little book before us. To such we can recommend it.

A Vessel Struck by Lightning.—During a severe thunderstorm which burst over Glasgow last Friday evening, the lightning struck the mizen-mast of the steamer *Prussian* at Govan, killing one man and injuring four others.

A. C., who has tried it, is authority for the following:—Take one-fourth cup of strong vinegar, crumb finely into it some bread. Let stand half-an-hour, or until it softens into a good poultice. Then apply, on retiring at night. In the morning the soreness will be gone, and the corn can be picked out. If the corn is a very obstinate one, it may require two or more applications to effect a cure.—*Scientific American.*

Burdens upon Commerce.—"It is asserted," says the *New York Herald*, "that there is no other port in the world where a ship, from the hour she enters to the hour she leaves it, is taxed so heavily as here in New York. As soon as a vessel appears off Sandy Hook the system of legalised piracy begins. Every knot she makes brings on board a different set of harpies, and they cannot be driven off until their exorbitant demands have been satisfied. When her anchor is cast, she is invaded by a fresh detachment of uniformed toll-gatherers, and still later, when she hauls up to one of the so-called wharves, another gang of officials is promptly on hand with a money demand which must be satisfied, under the pains and penalties of confiscation. The Chamber of Commerce has at last undertaken in earnest a reform of this legalised system of blackmail. The question is one of the highest importance, and we hope that this representative commercial body of the city, the State, and the country, will not allow the subject to drop until it has worked out a remedy. Our whole shipping industry is outrageously taxed and oppressed. We have in the body of our laws—federal, State, and municipal—protection for everybody and everything except the unfortunate owner of a ship and the crew who sail her. The exactions of the Barbary pirates were hardly more oppressive than those now demanded by the port officers of New York. The legal fees eat up nearly all the profits of a voyage, no matter how successful. The extortion is so great, that it is almost a wonder we have any commerce at all."

* The italics are our own.



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of Knowledge: *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

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*** *All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

[640]—You lately suggested that the dark side of the new moon should be watched to see whether the rim of light was brightest at the equator, the object being to detect increased atmospheric refraction where the sun's rays had been most powerful for the previous fortnight.

Last evening the new moon was above the horizon long enough after sunset for favourable observation, and I think the atmospheric conditions here enabled me to see the dark part with more distinctness than it is ever seen in England. To the naked eye the rim of light was very vivid, the irradiation effect on the illuminated side most remarkable, so that the dark moon looked like an acorn in its cup, the bright crescent being so distinctly larger; and the greatest intensity of illumination along the dark rim seemed concentrated near the southern cusp.

Getting out my telescope, a Dollond's "Student" (3 in.), new effects were observable. The dark side was so bright that, keeping the illuminated crescent out of the field, I could identify most of the larger objects on its surface. The Mare Humorum was as plainly distinguishable as in the map attached to your moon book and to Mr. Webb's book. The dark spot numbered 272 (Grimaldi) was equally plain. A distinctly luminous spot was noticeable, just corresponding, I thought, to the position of "La Hire" in the map, and I could have picked out a quantity of other detail.

But the most important fact observable seemed to me the character of the illumination of the "dark" rim. In the telescope, that which appeared to the naked eye as light shining round the orb was plainly visible as simply the bright higher surface lying along that limb of the moon seen in contrast to the great expanse of grey plains covering the dark surface (or, let me say, the half-lighted surface, for it is ridiculous to describe it as dark) from the Mare Humorum down nearly to the northern pole. And the apparent extra illumination of the rim near the southern cusp was intelligible at a glance in the telescope. A great quantity of high land brightness laps over the moon at that part, the grey plain lying further back. In the telescope no greater brightness was observable near the rim, at 276 for example, than on the surface at 188.

A bright star in Libra, Iota, or Zeta, I think (or was it Alpha?), was prettily occulted while I was watching all this a little before eight o'clock, and nothing could have been more instantaneous than its disappearance. A. P. S.

Simla, India, *Oct.* 16.

ARC ON LUNAR DISC.

[641]—Yesterday (the 17th) I happened to look at the moon about 5¼ p.m., and was astonished to see a very fine arc of light completing the circle. I at once applied a power of 80 in a 3-in. telescope, but the arc of light had vanished. In its place, however, I now saw, quite distinctly, the whole of the dark portion of the disc having a dull, greenish tint. This was, of course, 6d. 6h. after new moon. Looking without the telescope, I again quite distinctly saw the fine bright arc, but again the telescope dispelled it. I now looked with a much higher power, with an ordinary field-glass, and with a good binocular, but in every one the bright arc had disappeared, though with the naked eye it still remained. I repeated the experiment several times with the same result.

[illegible] your correspondents to [illegible] I send you this notice [illegible] believing that it was too long [illegible] and indeed had forgotten [illegible] SENEX.

[illegible] is not unusual, under [illegible]. Our correspondent's observa[illegible] is of exceeding faintness, as the [illegible] or binocular sufficed to render it [illegible]

[illegible] BAROMETRICAL OBSERVATIONS.

[illegible] A Query [illegible] (631, p. 408), the following [illegible] of [illegible] observations issued by the [illegible] the instrument must be mounted in [illegible] corrections for (1) index error, (2) ca[illegible] are combined in one general correction, [illegible] and given in the Kew certificate with each [illegible]. For the correction for temperature—*i.e.*, [illegible] what it would be at 32° Fah.—a table is [illegible] correction + or — can be immediately found [illegible] half-inch of the mercury, and for each degree [illegible] thermometer. The correction for altitude—*i.e.*, to [illegible] mean sea level"—is also given by a table for [illegible] column (27 to 31), and for each degree [illegible]. These are always additive, as the barometer [illegible] lower as we ascend above sea level.

[illegible] referred to may be found on pp. 80 to 89 in Mr. Scott's "[illegible] Use of Meteorological Instruments," and in Mr. Mar[illegible] "Hints to Meteorological Observers."

G. R. WYNNE.

MAGNETIC DISTURBANCE.

[illegible] "magnetic perturbations" in connection with the [illegible] Aurora Borealis of Nov. 17, 18 and 20, were generally [illegible] at the North of England. The traffic over public tele[illegible] was very seriously delayed, and for intensity and con[illegible] the strongest I remember ever having witnessed. They [illegible] constant (positive), and did not change their direction [illegible] facilitating measurements. The wires running east [illegible] suffered the greatest.

[illegible] enclose measurements, taken at intervals with "Tan[illegible] galvanometer," extracted from diary:—

Nov. 17, 10.15 a.m. Wires running E. and W., 50°; N. and S. 30°.
Nov. 17, 10.35 a.m. Earth currents increased in intensity follow[illegible] E. 60°, W. full deflection. Change in direction [illegible]. Traffic on E. and W. wires totally stopped from 10.35 [illegible] 12.15 [illegible]. Wires giving full deflections at these times; [illegible] currents very powerful, 70°.
Nov. 18, 10.5 [illegible] Strong earth currents prevailing, but change [illegible] E. and W. wires, 60°; N. and S. comparatively [illegible]. These strong currents prevailed until 1.15 p.m.
Nov. 20, 8.20 a.m. E. wires, 40°, W. wires, 63°, N. and S., 10°.
[illegible] 11.30 a.m. E. „ 60° W. „ 65°, „ „ nil.
[illegible] 1.55 p.m. E. „ 65°, W. „ 70°. Variable.

Gawtree Hogg's' Farm. E. PRINCE.

PAINTS FOR LANTERN-SLIDES.

[6]44 — W[illegible] some reader tell me what paints are best used for [illegible] C. T. B.

CORSET-WEARING.

645 [illegible] of the remarks of your correspondent under [illegible] that as tight lacing, as distinguished [illegible] the shape of the waist is actually [illegible] tends to become round, and that the [illegible] antero-posteriorly, but laterally.

[illegible] there is a lateral expansion of the lower [illegible] during inspiration, as well as in other [illegible] lateral movement which corset-wearing [illegible] as yet many women will have to be [illegible] of corset-wearing rather than of its [illegible] and unhealthiness. Perhaps one day we shall believe [illegible] intended to cover the body, and not that we are to [illegible] to the "last new style" and "latest fashion," [illegible] may be.

[illegible] the "Rational Dress Association," referred to by [illegible] correspondent, makes its doings known to the world in [illegible]. Those of us who cannot evolve a rational scheme of [illegible] consequences are, willy-nilly, dependent upon dressmakers, and what is their guide? A. H.

SKULL MEASUREMENTS.

[646]—As "F. R. M.'s" question in KNOWLEDGE, No. 51, asking for skull measurements, does not appear to have been answered, I venture to send you a statement :—

		C. Index.
1.	Dolichocephalic, at or below ...	·73
	Sub-dolichocephalic...............	·70 to ·73
2.	Orthocephalic	·74 to ·79
3.	Brachycephalic, at or above ...	·80
	Sub-brachycephalic	·77 to ·79

These are the figures given by Professor Boyd Dawkins; they differ slightly from Dr. Thurnam's, who gives for—

1.	Dolichocephalic	·70
	Sub-dolichocephalic	·71 to ·73
2.	Orthocephalic	·74 to ·76
3.	Brachycephalic	·80 to ·89
	Sub-brachycephalic	·77 to ·79

The average cephalic index for the modern English skull would be not less than 75·77, according to Dr. Thurnam. Mr. L. O. Pike has stated that the English of the present day are one of the longest-headed peoples in Europe, and, in Wiltshire, the longest without exception. Professor Welcker, cited by Dr. Thurnam, gives the breadth indices of—

Little Russians and Finns	·79
South Germans, Great Russians, and Magyars ...	·80
Swiss, Slovaks, Calmucks, and Tungusians	·81

Europe contains no typical dolichocephalic (·70 or ·71) now.

J. MAGENS MELLO, M.A., F.G.S., &c.

EFFECT OF ALCOHOL ON PIGS.

[647]—Two doctors having conducted, at the expense of a rich Swedish philanthropist, a series of experiments upon pigs, for the purpose of ascertaining the effect of alcohol on the internal organs of drunkards, fifteen pigs were treated daily upon various descriptions of alcohol, and then killed, after the process of alcoholisation had gone on for some time. Each pig had a different description of liquor. One had whisky, another had brandy, a third absinthe, and so on. When killed, their vital organs were found to be marked with small white spots, resembling ulcers. Their flesh was sound, but when sent to market it was seized as unfit for food. A dispute is now going on between the experimenters and the police as to whether the inspector of the market was not mistaken. This being the effect of their experiments on the pigs, what state must a man's body be in who drinks regularly either whisky or brandy? I should say like the pigs, or, if not worse, upon their vital organs. [?]

E. C. R.

[Alcoholisation and taking alcohol are rather different things. I have recently had rather interesting evidence of the real value of the use of so-called stimulants. When lecturing daily, and also travelling long distances, I always adopt a very light diet: tea, dry toast, and an egg for breakfast; nothing then till six, when I take tea, dry toast, and a chop; after lecturing, I take a biscuit or so with cheese, and a glass of whisky-and-water, "cold without." I tried this season the effect of omitting the whisky. Result—sleeplessness till one or two in the morning. No other harm, but weariness during following day. Taking the whisky-and-water again, after trying this a night or two, acted as the most perfect sedative. R. A. P.]

LUMINOUS SEA.

618—In 1871 I was ordered to South America for the benefit of my health, and with a view to having as long a sea-trip as possible, I took passage in a sailing-vessel. While lying becalmed a couple of degrees south of the equator I had the opportunity of observing the grand phenomenon of a luminous sea, and I must say that of all the phenomena I have witnessed, none gave me greater pleasure than that alluded to. About 10 p.m. the luminosity commenced, and the whole of the sea, from the centre we occupied to the horizon all around, appeared to be one mass of phosphorescent light. Even the stars above seemed dimmed, and the sails of the ship were brightly illuminated, while every cord in the rigging was clearly distinguishable. I drew up a bucketful of the water from alongside, and found that directly the bucket touched the water the phosphorescence suddenly ceased for a few minutes in the immediate vicinity of the ship. For about ten minutes the water in the bucket was as dark as ink, but after that time again shone out, though immediately a finger was dipped in it again became dark. I have no doubt that the effect was due to certain marine animalculæ, the name of which I cannot recall to mind, and the light appeared to me to have a bluer tinge in it than given off when a vessel drives through the water. With regard to the depth to which this phosphorescence occurred, I believe that it was confined to the surface in this case, because when I dipped a lead line some 8 or 10 in. below the surface I failed to make out the lead. At the time several dolphins were swimming about, and I noticed that at whatever point one of these fish made its appearance, the inky darkness contrasted strangely with the illuminated portion of the sea. At midnight the glare gradually decreased, and about one o'clock had entirely disappeared. A stiff breeze sprung up within a few minutes, and our good ship bowled along at the rate of nine knots the hour. When off Cape Horn I again saw a portion of the sea illuminated, but the effect was nothing like my former experience in grandeur. However, it did us one good turn by showing the approach of a large iceberg. RESSORP.

STORM IN A PICKLE-JAR.

[649]—I have lately kept in my room a homely sort of weather-glass, consisting of an oil flask turned neck downwards in a glass pickle-jar nearly full of water. It is not a very accurate instrument, but interesting observations may be made with it. For instance, the warmth of a finger and thumb on the bowl of the flask in a few seconds causes the air within to expand sufficiently to drive the intruding water further down the neck. It is also more sensitive to slight variations in the weight of the atmosphere than far more expensive instruments. During the storms of wind on Nov. 1 and 3, the barometer fell, and almost all the water was driven out of the neck of the flask, but not without a very perceptible struggle; and it was most interesting to watch the storm reproduced in almost incessant movements in the narrow neck; and before the storm outside seemed to abate at all the pickle-jar told me that the worst was over, and the water, still struggling, began to rise towards its old position. A. M. F.

DEATH-WARNING.

[650]—A friend of mine (Dr. Goodall Jones, of Liverpool) related to me the following account of a case of premonition, which I thought might prove interesting, as it is well authenticated. The names and dates Dr. Jones will give if required.

He called on a female patient on *Sunday afternoon at three o'clock*; her husband met him at the door, and said that he was about to come for him, as the patient was worse and delirious. On going upstairs the doctor found the poor woman in a very excited state, asserting that her brother (a Liverpool pilot) was drowning in the river, "which," said the husband, "is impossible, as he is out at sea, to the best of our knowledge." The doctor did what he could to soothe his patient, and left convinced that it was a case of ordinary delirium; but in the next morning's paper he read with surprise the account of the pilot's death by drowning *in the river on the previous afternoon at three o'clock.* J. SINCLAIR.

A PHENOMENON.

[651]—When in Switzerland last year, in September, in the morning, about 10 o'clock, we saw a beautiful and curious phenomenon, and I should be glad to know if it is common, and its causes. We were *en route* from Interlaken to Berne, standing on the deck of a steamer at Därligen, waiting for it to start. Above us, to the south or south-east, rose a steep, abrupt hill to a great height, and at the top it was fringed with firs, which stood out like very small Christmas trees, dark green against the sky. In one spot, however, these trees were of a bright, transparent silver, as if turned into crystal, and among and above them there glided, erratically and in all directions, apparently four or five small bright stars (about the size of third or second magnitude stars). These larger stars were plainly visible to the naked eye, but with my glasses I could make out that in this one spot the air was one glinting, glittering mass of tiny bright specks, all moving in every direction. We called the attention of the passengers to it, and many were the conjectures as to what these appearances were, and why they were. Some said birds, others falling snow, but no one gave a satisfactory explanation.

I should add that we were in the shade; that the sun was just, and only just behind and below the fringed sky-line, as we found on starting; that it was a bright day and clear; and that somehow the sun must be the cause of the phenomenon, for directly we moved off he appeared, the little stars disappeared, and the transparent fir trees returned to their natural dark green. N. R.

[Most probably the firs covered with ice-crystals, and the ice-crystals which active air-currents carried round and above the firs, were just in that position (about 22° from the sun) at which the arc of a solar halo would be formed.—ED.]

Answers to Correspondents.

HINTS TO CORRESPONDENTS.—1. No questions asking for scientific information can be answered through the post. 2. Letters sent to the Editor for correspondents cannot be forwarded, nor can the names or addresses of correspondents be given in answer to private inquiries. 3. Correspondents should write on one side only of the paper, and put drawings on a separate leaf. 4. Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.

R. B. W., SUBSCRIBER (2), S. D., THOS. THOMAS, REMEX, G. H. A., DISCIPULUS, and many others. I will at an early time give a brief account of the Hamiltonian method and of my experiences with it. GRAVITY. Your mistake lies in taking no account of the increase of your namesake as the sun is approached.—ASTRONOMICAL JUMBO. Your question could not possibly be answered in KNOWLEDGE. It is a long and arduous matter to explain the calculation for determining a comet's orbit from three observations.—PARALLAX. Find the right ascension and declination corresponding to the altitude and azimuth. You can then at once determine the longitude and latitude of a point on the earth having that star at its zenith. We cannot undertake to solve such problems as are dealt with in every book on practical astronomy.—T. H. D. Sculling is as bad as rowing for the chest, unless corrected by other exercises. The picture of an American oarsman represents a sculler.—L. ORME. Tail at least a hundred million miles long; least possible distance from earth rather a troublesome matter to calculate, and of no great interest, as the comet can nowhere approach the earth within many millions of miles.—W. B. Thanks; the illustration is absurd, of course, but near enough for *Times'* science.—M. H. C. You will find that the mistake about tangential force was corrected by myself at the earliest opportunity. See foot-note, p. 300. It was a printer's error. About Newcomb, I have forgotten what you said; but I know that what I described as erroneous he himself admitted to be so. As regards Dr. Siemens's theory, it would not much matter, I suppose, whether one particular objection failed, if another held. If one link breaks, proving another sound does little good. But I hold you mistaken as to the difference between the effects where solar atmosphere is limited and where it is assumed to be unlimited. As to cloud-bands, *what* is it you assert? Do you say that straight bands never seem arched?—H'SETT. Though I do not publish your letter, I thoroughly agree with you. The account you refer to is in a scientific sense utterly inadmissible.—H. K. L. It has never happened to me to want to know about degrees of freedom; perhaps some reader can tell where to find this mathematical expression explained.—J. SMEATON. Thousands have entertained that theory about comets' tails; but it will not stand inquiry.—J. SLUMINGTON? PENNIWAYTOR? J. SLENERIWIJTER (?). No, a cannon-ball does not rise after leaving the mouth of a horizontal cannon.—J. PARRY. It pains me to have to say that the comet as thus far observed travels not only on the Sabbath-day (which I take to be Saturday), but also on Sunday. But you must not desert it on that account; or, if you do, then to be consistent you should desert the earth also; for she does, too: aye, and moreover rotates, and reels, and nutates, and accompanies the sun on his cosmical rush through space.—S. SPENCER wants name of best manual on the Metallurgy of Gold, and methods of seeking mining, &c.—S. E. C.* We hardly differ so much as you seem to think. I quite think that, speaking logically and reasonably, the views of a man like Darwin about religion, a future life, &c., may be of great interest. (So a pound out of his pocket would be worth twenty shillings, if he chose to give it.) But you know that there are many who are prepared to *howl* if they learn that you do not hold the same views as they do on certain religious questions. Now, many prefer not to be howled at, and therefore keep their views on such matters to themselves. To ask such a one privately what his views are is all right enough, especially if he happens to be a personal friend. (Just as it is quite legitimate to ask a man for a pound for some charity.) But to regard his reply as something which may be proclaimed on the house-tops is altogether wrong. If you want to know what may be done in the way of howling, read some of the comments of certain religious papers on tha letter, which should never have been published. X. Impossible to say without seeing the specimens; and we cannot make arrangments for the forwarding of such things. Dr. Ball was mistaken about the height of the tides in those remote times.—J. BATTLE The maps for November and December will be the same in shape and character as the rest; they will also be published separately, price 2d. each.—A. H. LEE. Fear long time must elapse before the pressure of other subjects so far subsides that papers on philology can appear.—F. Y. (1). The tail of a comet is a variable appendage; most probably the tail of one week is quite different from the tail of the next week; (2) the comet of 1843 was seen from the earth

[illegible]

number will be of one kind, your chance is 1-8th + 3-8ths, or one-half; so that the betting should be even. T. A. Yes; if the condensation could be effected with sufficient rapidity, and in a sufficiently short time.—J. V. M., John Edwards, R. S. Standen, H. Moulton, Opifex, Geo. Harrison, S. Garratt, Thomas Lyons, A. M.D, A. H—d, G. E. Clarke, and very many others. Thanks for interesting letters; the phenomena are discussed, with due consideration of your evidence. Louisa Byng. What is the soul or immortal part? Also, when did man cease to be an animal?—A. O. W. White. Know of no books graphically describing the nebular hypothesis. P. A. Thanks for fly letter, but the kick did not necessarily indicate life. May it not have been merely the result of sudden increase of temperature? When his "crackling" curls and twists, we do not infer that piggie is alive.—Ossifer. That was an evil jackdaw, but not intelligent. Cats "sleep on their heads," apparently, when electrical conditions prevail; it must be uncomfortable. The meteorological society should keep a corps of trained cats to foretell weather for them. Sun spots seem certainly associated with great and widespread magnetic disturbances of the earth, not with the other things you mention.—A. H. Emerson. That contributor no longer replying.—R. Lewins, M.D. I see no impertinent curiosity in asking the question in the way you suggest, but if the question was asked with the object of publishing the answer, which the event seems to show, then there was room, I think, for objection to the proceeding. As to the views less reticently expressed in private, would he have cared to have had them published?—T. Stevens. That theory about the Star of Bethlehem seems scarcely to merit attention. The heliacal rising of Sirius is a *common* phenomenon, depending on refraction and other variable conditions. But, in any case, are we to associate astrological superstition with the customary views of Christians about the birth of Christ? Would not that be conceding a great deal?—H. V. The comet did not pass through the sun; but its outskirts probably grazed the sun's surface. The solidity or gaseity of the comet would not affect the thermal result of an actual collision.—J. Turner. Comet's orbit not what was thought.—T. A. R. Other subjects crowd us, so that there is scarcely room for that.—Dewi G. Such communications should not be sent to editor, but to the publishers; the editor does not keep by him spare copies to send out. If delay arises, though, the editor is blamed all the same. Fact bat. No, certainly; you are not troublesome, but most patient. The real trouble is that kindly and considerate questioners are more than we can deal with. As to quotations, as a rule, if one is not certain it is best to go to the author: the *tempora mutantur*, &c. (as you mention), and *nemo repente* are illustrations; but I think the *calculus mus* usually comes out right. I happen to know most of the "Ars Poetica" by heart, so that the change of tense was wilful. The explanation of Foucault's Pendulum experiment requires rather more space than can be given here. Will give it shortly in these columns. The principle is not akin to that which explains the fall of a stone to the east of the vertical, though both depend on the earth's rotation. Sir E. Beckett's "Astronomy without Mathematics" is a delightful work. It is not a text-book. Mars. Your question a little difficult: "What foci should exist in each case between the object-glass, eye-piece, and speculum for a reflecting telescope of 200 magnifying power?" What is the object-glass of a reflecting telescope?—E. D. W. True of 1877 and of 1878 up to November. But nothing remarkable in sun and planets. Difference must have been in our own air. Pallas. (1) Mr. Proctor is not a member of that Church, (2) and therefore can give no details such as you ask for. (3) I suppose the engraver means a rising sun. (4) Comet is receding. (5) The Editor can and will persuade Mr. Proctor to name each month the planets of the month and where they are to be looked for.—C. R. Davis. Yes, that would be a solution of the fifteen puzzle, if it did not happen that, as originally propounded, that solution was excluded. It is widely known, however.—Faber. It seems useless to try to recognise any law in our English modes of spelling. Spelling "traveler" pleases Americans, and does not please us. Phonetically there should be but one "*l*." But we do not spell phonetically. (Oddly enough, Pitman, the phonetist, in his shorthand writes immediately with two *m's*).—A. Aitken. Hard-hearted being. You tell "J." (p. 423), having let ABC be the given triangle, and found O the centre of inscribed circle, to draw OD, OE, OF perp. to AB, BC, CA, and to inscribe circles in each of the three quads thus formed. These will be the required circles touching each other and sides of ABC. "If J. wants it for 'use' you can send proof; but if he only wants to bother some of his fellow readers he might find the proof himself. It would be a pleasant employment for him for a few minutes." *Would* it? It would take him all his time, I fancy, to prove it for any case but an equilateral triangle. Try it yourself; you will find that *if* J's problem is solved, the angles DOE, EOF, and FOD are all equal, therefore their complements the angles B, C, A all equal—Q.E. *n n* D.—J. A., Stockport, wishes to know how old oil paintings, having a thick, hard coating of dirty varnish, can best be restored.—S. R. C. (1) Comet's nucleus has not passed over any star. (2) "Things divine" to one man may be blasphemies to another, and *vice versâ*, what this last reverences the other may abhor. If I should tell you it "hurts my feelings" to hear men talk of a Being who must be not only Almighty, but All wise, as if he could bo an unreasonable despot of the Oriental type, to be propitiated by fetishes, I hope you would "take the remark in the kindly way in which it is meant." I wonder, by the way, whether you can view Darwin's rejection of the idea of a jealous God with a tithe of the horror with which he, probably, viewed that idea, regarded as an explanation of one of the saddest of nature's laws. (3) I take it you do not play whist. Let me recommend it to you as a valuable rest after hard mental work. (4) Instructions for making a sun-dial would occupy too much space just now. Subjects crowd in so, and our price so limits our space, what can be done but to omit some ?—F. C. G. Not in our line.—T. S. B. Neither is your subject.—F. W. Foster. All others greatly approve of his articles.—Harry Sweeting. Feeling yourself "able to perform that original piece of work," you offer full explanations of optical illusions, in a series of papers "probably going through a whole year of Knowledge." In the first you will explain a common looking-glass, in the next Pepper's ghost and the living head. "There are plenty of diagrams." You "hope that we will help you to become a popular science writer," and in a postscript, you "could write equally well on any other scientific subject." We will help you as far as we can, by advising you to wait until you have learned to write unequally well on different scientific subjects.—C. Gray, M. Morrison, J. Hargreave, and many others who have written about aurora—many thanks.—T. W. Bosworth, Septimus B., and others. Know nothing personally of Mr. Stanley, the African explorer.—P. Ebbutt. Pressure of correspondence prevented.—J. Greenfield. (1) Yes, Mr. Fothergill's view is as inconsistent with the narrative as the narrative with scientific possibilities. (2) If the earth reversed her rotation for 10 degrees, or even stopped rotating for a second, the heat generated would melt most of her globe. Imagine a mass at the equator travelling more than 1,000 miles an hour brought suddenly to rest! In latitude 60 north half that rate! Where we are, about twenty miles a minute! How would you like if you were in an express train, going only one mile a minute, to be brought suddenly to rest? *Did* I say that if a planet were to reverse its orbit no change would take place? I must have been dreaming. I meant to say (and think I did say) that if a planet had chanced to have had a retrograde iastead of an advancing course, I believed (Laplace notwithtasuding) the solar system would have been quite as stable as it is. Those other subjects must really not be dragged in. Those who crave most to hear what science has to say about them, are just those who get angriest when science does speak her mind. Perhaps the truest thing science can say is *De minimis—de minimis minimorum—non curat scientia.*—J. C. S. Thanks. Will try to find space. Questioner asked for *any* solution.—E. M. Ryves. Thanks; a clerical error.—R. R. Baldrey. Emphatically no, I say with you: the creature you refer to is an idol, and a very hideous one.—H. C. (1.) Subject nearly done with; it was originally to have been more briefly dealt with. (2.) Darwin meant simply that science has only to give its own teachings, not to concern itself with other matters. People who want to show that Buddhism, or Mahommedanism, or any other *ism*, can or cannot be reconciled with science, are perfectly free to do so. It is no affair of science. (3.) So many things are *possible* in the sun. (4.) Cremation rather an undesirable subject. So few care about it. For my own part, I care nothing what is done with my body when I have done with it. If chessmen were made of my bones, that were about as much as I could want, and more also.—J. Fraser. Have no room for your theory of comets' tails; quite inconsistent with the evidence.—F. Barrett. Much gratified. Star maps naturally concluded with ended year. The stars come year after year the same, Knowledge must not do so. In *Cornhill Magazine* for November, there is an account of comet. J. L. Have given as much space as can afford to rain-band spectroscope.—Experto Crede refers J. to "A sequel to first six books of Euclid," Longmans, p. 152.—Osborne Prangley. Thanks. Subject very difficult. Touched on further in my book on "Sun." Doubt if anything known to us helps towards solution.—Sogn. *Christian Commonwealth* is not a paper we see, unless sent to us; so we have no means of knowing what they may have replied to the criticism they invited. If their response pleased you, they evidently know for whom they write. Your letter about Orkney auroras is not written quite so clearly as wo could wish, or it should appear. Perhaps you form your style on the *Commonwealth*.—Sphere. Know nothing better than Todhunter.—S. Grove. A good idea.—T. Smith. They would fall in same time.—Scalpel. Bicycling is said to be good for chest. I doubt it, noting the attitude of bicyclers at top speed. Word "knickerbocker" has no meaning: simply derived from Washington Irving's story.—J. W. B. "Instantaneity" is the right way.—Puer. You surprise me. In America they clear and fill a car quickly enough.—J. Alston. Only moderate rowing; tricycle better for most. Cannot remember any microscope at stated price.—H. G. Pinfield. Usually called "power 2 linear." They talk of 6,000 magnifying power, but it has never been attained.—J. A. Ollard. Thanks. On last point, I doubt whether it is wise to study Euclid without the letters. My own experience is that the more you ease the work in such matters the better the progress in geometry.—Ignoramus. Question would open door to too much gratis advertising.—A. Crevasse. No time to solve problems. The offices which Knowledge can discharge are limited, —amongst them private tutorial work is not now included. —Cairngorm. Has that theory of comets' tails (viz., that comets are transparent bodies, and tail shows the track of solar rays through finely-divided matter) been suggested? Not by more than ten million persons, I should say; but certainly more than two millions. It is hopelessly wrong.—A Correspondent notes that the book mentioned by Mr. Fothergill, p. 407, is the "Green Hand," not the "Green Land." 'Tis true. It is also true that the "Green Hand" is one of the cleverest books (sea-books) ever written. What a disappointment Mr. G. Cupple's next sea-book, "The Two Frigates," was!—A. McLean. That would be the only way to make the Star Maps useful in Southern Hemisphere. Comet's path not looped, though much twisted. Account of comet rather too long and too full of less important details.—Upsala. (1) *Are* the diameters major and minor of the axes of cometic orbits so very distinct? If you can draw us a picture of, say, the orbit of Venus—one foot in diameter, to show without close measurement, the difference of the diameters, we will have a steel engraving made of it. (2.) Does that Gossip note read like anger? Then it very little represents our meaning. Pardon me, but the inter-planetary (not planitary) theory we were dealing with wanted hydrogen and water vapours. Yours (if you have one) possibly does not. When we sit on *that* theory it will be time to correct our mistaken notions respecting it. Oliver Goldsmith's remark that "mathematics seems a science to which the meanest intellects are equal," represents a favourite idea of those whose intellects—if this view is correct—cannot be among the meanest, because they find mathematics too many for them.—Hamlet Electrator. "As all things have emerged from darkness, what would they become if they returned thereto?" Would they not be "in the dark?" We are, as to your meaning. Give us an easier one next time.—Step. H. Saxby. Many thanks.—S. E. W. Roorda van Eysinga. We will consider about Scientific Politics.—A. F. O. The orbit would not be appreciably affected in shape near perihelion.—John Donald. It is unquestionably a physiological fact that a person weighs more after a meal than before one, strange though it may seem. Moreover, incredible though it may be deemed, "the air in the stomach which food displaces" is *not* "the heavier."—Wm. Moon, Jun. Thanks for Mr. Barber's theory of the hollowness of the planets. But what nonsense it all is!—M. Dorette Walker. The biochemic treatment of disease is not a suitable subject for these pages.—C. F. W. The sun was eclipsed (visible at Babylon) on April 19, 481 B.C., Oct. 2, 479 B.C., and on Feb. 17, 478 B.C., the second being the most important of the three.—W. B. Clarke. Such questions must be addressed to publishers. Editor cannot forward copies; has none by him to begin with, and, by the way, to finish with, too. —J. W. Stainforth. Thanks.—B. A. Brain troubles pouring in on us. That "of" for "have" is a common mistake among the uneducated; you or I could hardly fall into it, except when ill.—Ge. Eoon a misprint, I should say, for eozoon. Certainly organic, the foremost geologists say.

EGYPTOLOGY.

The figure was one of the kind called in Egyptian "Shabti" or "Ushabti," *i.e.*, "respondents." These figures were conventionally supposed to represent the deceased as one of the blessed become one with Osiris—the *justified* dead being always styled "The Osirian M or N." These porcelain-faced clay *ushabti* were buried with the dead to act as his representatives—to *respond* for him, in fact—in the under world, and to do work for him (which otherwise he would have to do for himself) in the fields of Aahlu, where certain labours of sowing, ploughing, reaping, &c., had to be gone through as part of the probationary work to be done in the under world before the final translation of the deceased to the heaven of heavens. These figures are represented with the flail, sickle, and [illegible] The present statuette appears to have been inscribed for [illegible]. Some of the hieroglyphs are unintelligible [illegible] and the inscription is evidently not complete. [illegible] the mention of a panegyry, or religious festival, but I cannot make out the [illegible].

[illegible] about the statuette in question. [illegible] deceased persons [illegible] several such, in various materials, buried with [illegible] there are many hundreds of them in every Egyptian Museum.

[illegible] was borrowed by the Greeks [illegible] converted into [illegible]. A. B. E.

BOTANY.

A. [illegible] (21) is correct in supposing that the carbonic acid [illegible] by plants is due to decomposition of organic matter. In [illegible], and in the various parts of the plant, such as the flower and fruit, which are incapable of themselves of absorbing [illegible] nourishment from the air, the presence of oxygen is necessary to convert the material in the other portions into the tissues of these growing parts. Carbonic acid is expired at all times, but is only inspired under the influence of light, but this inspiration is greatly in excess of the expiration of the same compound, and it is quite possible that the carbonic acid expired by one class of cells may simultaneously be absorbed by another and contiguous class. It appears, then, that the breathing of plants is not quite analogous to that of animals, for while in the latter the inspiration of oxygen is accompanied by destruction of matter, and subsequent removal as carbonic acid, in plants we have a conversion of matter into other forms which are for the most part retained, a small portion only being wasted as gas. Furthermore, we find a double action occurring in plants—absorption and expiration of oxygen and of carbonic acid, which result in the production of new tissue, whereas in animals we have only inspiration of oxygen and expiration of carbonic acid, and the accompanying changes are destructive. The distinction drawn between plants and animals was not intended to be absolute, as will be seen on reference to the last sentence, which commences with "the great difference;" the insertion of any sentence which could be construed to mean that there was no resemblance between plants and animals being, as it was thought, specially avoided, as I was well aware of the expiration of carbonic acid (indicative of oxidation) by the leaves, as mentioned in one of the preceding paragraphs; as also of the excretion of the same gas by the roots, whereby the preparation of plant food in the soil is forwarded, but concerning which no mention was made, as the article was already sufficiently long.

E. W. P.

Our Mathematical Column.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

No. XIII.

NEXT take the following illustration of a differential calculus, which is in many respects more important still than that considered in our last.

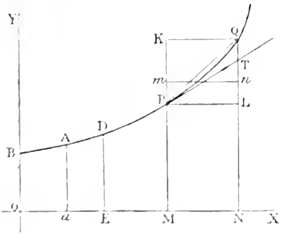


Fig. 1.

Instead of taking for the dependent variable the ordinate of a curve, [illegible] area as $aAPM$ (Fig. 1) measured from some fixed ordinate [illegible] ordinate PM corresponding to varying value of the abscissa $OM = x$. Putting $MN = \Delta x$, we have, if

$$u = \text{area } APMa$$
$$u + \Delta u = \text{area } AQNa$$
$$\Delta u = \text{area } MPQN$$
$$\frac{\Delta u}{\Delta x} = \frac{\text{area } MPQN}{MN} = \text{side } nN \text{ of a rect. } mN$$

equal to MPQN.

Now manifestly the smaller MN is taken the nearer is the rectangle PN in area to MPQL: it is not merely that the difference, the area PQL (PQ curved) is absolutely less, but it manifestly bears a constantly diminishing ratio to the area PN, until finally, when MN is taken small enough this ratio will be a vanishing one. Hence while

$$\frac{\Delta u}{\Delta x} = nN, \text{ we manifestly have } \frac{du}{dx} = PM = y,$$

or the differential coefficient of the area between a curve, the axis of x, a fixed ordinate, and the variable ordinate is this last-named ordinate. Here the language and notation of differentials are, I think, simpler and more natural than those belonging to the method of coefficients. We should say simply du the differential of the area, that is the small increment of the area, is equal to $y\,dx$, that is to the area under y and dx the differential of x, which is the same as saying that ultimately area PQNM = rectangle PN.

But now notice the power we have obtained for determining not only areas of surfaces bounded by curved lines, but also any function which might be symbolised by such areas. When we have written of any such area as APMa, or of any function which may be represented by such an area, the relation

$$\frac{du}{dx} = y$$

where y is some function of x, we can tell at once what u is, if only we can determine what function has y for its differential coefficient. For we have seen that no two quantities can have the same differential coefficient, unless either they are equal or differ only by a constant. (Geometrically this is much the same as saying that no other area but APMa has PM the ordinate of curve APQ for the measure of its rate of increase, except some area, as OBPM, EDPM, or the like, differing from aAPM by some quantity which remains constant while we vary OM, and with it PM.)

Now although determining what quantity that is which has some given function for its differential coefficient is by no means so easy or so sure a process as differentiating, yet in a great number of cases integration can be readily managed; in others it can be accomplished with more or less difficulty, and in yet others, approximations can be made to the desired integration, and the result we require can be determined with all necessary approach to exactitude.

The notation for the converse process to differentiation, or integration is as follows:—When we have a function u such that

$$\frac{du}{dx} = y,$$

we express the same relation by saying that

$$u = \int y\,dx.$$

To be more precise we may write

$$u = \int y\,dx + \text{a constant},$$

but the constant is in reality understood in the other form of expression. We may find a geometrical illustration of the equation

$$u = \int y\,dx$$

thus: Let APQ be a curve as before, $OM = x$, $PM = y$, $Mn = \Delta x$. Then area AQNa is the sum of a number of small rectangles like

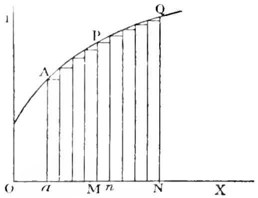


Fig. 2.

Pn, when these are made indefinitely thin. Now

$$Pn = y\,\Delta x.$$

Therefore the statement, area (or u) $= \int y\,dx$, may be taken to mean that we get the area between A Q, O X, and certain boundary ordinates, by summing a multitude of very thin rectangles like Pn between the corresponding ordinates. This is an indefinite statement, and $\int y\,dx$ is called an indefinite integral. When we take definite limiting ordinates as Aa, Q N corresponding to $x = Oa$, and $x = $ O N (say $x = a$ and $x = b$ respectively), we get the definite area A Q N a; and we write

$$\text{area A Q N } a = \int_a^b y\,dx$$

which means that from the value of $\int y\,dx$ when b is written for x, is to be subtracted the value when a is written for x, to give the area of the space between the ordinates corresponding to these values.

Be it noticed that what we have here said about areas applies to any quantity which might be represented by an area, and therefore practically to any quantity whatsoever. If we can obtain an expression for the small increment of any quantity u corresponding to any small increment of the variable, and can ascertain by any process what quantity that is which has such increment, we can determine u by the process of integration.

Examples will, however, best show the value of all this.

Our Whist Column.

By "Five of Clubs."

A WHIST CASE.

A and *B* are partners at Whist against *Y* and *Z*. *A* and *B* are four by honours, each having two. They claim two by honours and score them. Towards the end of the deal *A* says to *B*, "you had not two honours, had you, partner?" Before *B* replies in the affirmative the trump card is turned and quitted. *A* and *B* claim to score four by honours. *Y Z* assert that the claim is too late.—Hazard.

[It appears to us that the claim is good, provided *A*'s question was addressed to *B* in such a way as to be unmistakably the initiation of a claim. *Z* had in that case heard enough to know that a question was raised as to the honours, and he should either have waited, or gone on dealing with the understanding that the claim was made in due time, whether he finished his deal or not before the position of the honours had been fully recalled. If *A* being in doubt says "I *think* we had four by honours," he ought not to be worse off than if he had said "We *claim* four by honours." Law 50 seems clearly to imply that the adversaries by questioning the score, interrupt the dealer (that is, that he ought to hold his hand till the question is settled) and that they may legitimately do this if they can establish their claim. Had *X* stopped when *A* spoke, and *A* failed to establish his claim, *X* would have been free to deal again, had he mis-dealt in consequence of the interruption. We may infer that *X* *should* have stopped.—Five of Clubs.]

OUR esteemed correspondent, Mr. F. H. Lewis, has kindly selected and annotated three games of singular interest, one illustrating the advantage under certain conditions of keeping back the winning trump; the second, the advantage under other conditions of playing the winning trump; and the third, the necessity of keeping back the best of a plain suit at a critical stage in the game. The first of these games runs as follows:—

KEEPING BACK THE WINNING TRUMP.

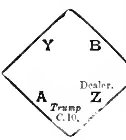
The Hands.

Y.
Clubs—8, 4, 3.
Diamonds—8, 6.
Spades—6, 5, 4, 2.
Hearts—A, Q, 9, 5.

B.
Clubs—Kn, 5.
Diamonds—A, K, Q.
Spades—Q, Kn, 9, 8, 7.
Hearts—10, 4, 3.

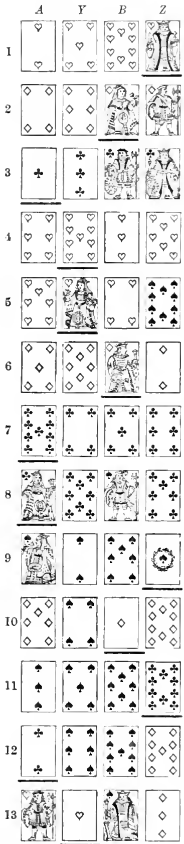
A.
Clubs—A, Q, 9, 2.
Diamonds—7, 5, 4.
Spades—Q, 3.
Hearts—Kn, 7, 6, 2.

Z.
Clubs—K, 10, 7, 6.
Diamonds—Kn, 10, 9, 3, 2.
Spades—A, 10.
Hearts—K, 8.



THE PLAY.

Note.—The card underlined wins the trick, and card below leads next round.



MR. LEWIS'S NOTES.

1. *A* leads from his longest suit.

3. *B*, trusting to his partner to protect the Heart suit, and being strong in both the other plain suits, leads a trump. *Z* having turned the Ten, properly heads the Knave.

4. *A* having the finesse in trumps, waits for another lead from *B*, but he should not have continued the Heart lead. *B* cannot be strong in trumps, and *A* knows that he can have no strength in Hearts. *A*'s proper lead here was the Spade Queen.

5. *Y* having no rentrée card, gives *Z* a discard. He properly abstains from continuing with Heart Ace. The discard of the Spade Ten shows *Y* that his partner had great numerical strength in Diamonds. It was open to *Z* to discard a Diamond, as the lead of trumps was from the adversary, but having four trumps originally, he had hopes of utilizing one of them.

7. *B* is in a difficulty. He knows Heart Ace to be with *Y*, but he knows also that he can have but one more Diamond, if any. As *A* continued the Heart suit, he probably wants the finesse in trumps. *B*, therefore, plays trump.

8. As *Z* discarded Spade Ten, *B* discards Spade Knave to show that his lowest Spade is equal to the Ten.

9. Acting upon this hint, *A* plays Spade Queen.

10. *Z* can count *B*'s hand. If he leads the winning trump, and draws the Club Two from *A*, he can then lead only Diamonds, and *B* will bring in his Spades.

11. *B* here properly plays Spade Eight. If *Z* passes it, *B* continues the suit, and *A* getting the discard of the Heart, *Z* loses the game. *Z* is not to be trapped. He knows he can save the game by forcing *A*, who has the losing Heart.

Q. T. V. asks why, at trick 7 (p. 410, col. 2), *B* should know that *A* had four trumps. "Correct Card," he says, indicates the higher as the proper card to play first, to show four trumps. What "Correct Card" says is, "Should partner lead trumps and you have four or more, make the signal," &c. and the signal consists in playing unnecessarily a higher card before a lower. Precisely: in *playing* such a card, not in *leading* it. As we lead the highest of a sequence and play the lowest, so to show four trumps we play a higher card before a lower, but return a lower card before a higher (this last being also the settled rule for showing that we held originally four cards of the suit). Thus, if my partner leads a small trump, and second player puts the Queen on, I holding Ten, Eight, Three, Two, play third hand the Three, and in the next round the Two, whether leading or playing to the trick; the play of the Three first round shows I hold four in the suit, so soon as the Two has appeared. But if, with the same cards, second hand plays a small card, and my Ten makes, I return the Two, and the third round then shows that I held four originally.—Five of Clubs.

X.—"*A* and *B* are partners. *B* leads when it is *A*'s turn; *Y* and *Z* call on *A* to lead from a particular suit, and *B* takes up the card [illegible] and *D*, however. [illegible] make no [illegible] two between [illegible] It is [illegible] even [illegible] against it. [illegible]

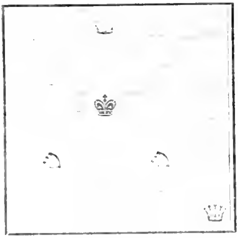
Our Chess Column.

By Mephisto.

PROBLEM No. 62.

[illegible] By J. A. Mil[illegible]

Black.



White.

W[illegible] and [illegible] in three moves.

INT[illegible]NAL CHESS TOURNAMENT.

[illegible] H.R.H. the Duke of Albany [illegible]

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Problems received with thanks from W. Mead, Sydney Spokes, M. Beyfus, G. Woodcocks, and Leonard P. Rees; will be examined.

Geo. Logue. If the position you sent is correctly copied, then there certainly is no mate in three, but six moves are required, [illegible] 1. R to QKt8 / KR to B sq.! 2. R to R8 (ch), if 2. K takes R, then K to Kt6 (ch), or if 2. R takes R, then 3. P Queens with a (ch), &c.

Additional solutions of Problem No. 59 received from John O'Keeffe, Tefsir, W. R. Edwards, Squire, R. S. Standen, H. A. N. Reprint Problem solved by H. A. N., R. J. P., T. S. L., Henry Freeman, J. P. Problem No. 61.—John Watson, John O'Keeffe. Problem No. 60.—We have not as yet received a correct solution of this fine composition, which, owing to its difficulty, is no more than we expected. John Watson calls it a teaser, and John O'Keeffe has the merit of sending us the only attempted (although incorrect) solution.

W. Mead.—The "Sussex Chess Magazine" received; we wish you success.

J. C. H.—A player may attain a high standard (not the highest) without theoretical knowledge. Solution correct.

The *Wanganui Herald* writes as follows:—"Mr. Proctor, after finishing his great lecturing tour, founded a periodical to which he gave the ambitious title of Knowledge.* In a recent number of this publication the editor, in reply to a correspondent, said it was 'an open secret' that the author of the 'Vestiges of Creation,' was the late Robert Chambers, one of the proprietors of *Chambers' Journal*. It happens that this 'open secret' has been long exploded among literary and scientific men *au courant* of what is passing in the world of science and letters. There is no reason for silence about the work. The 'Vestiges' was the forerunner of the greater work of Charles Darwin, and if Robert Chambers had been the author, William Chambers, in his memoir of his brother, would have said so; but he gives no hint of it anywhere. Again it is not probable that a sincere and conscientious man like Robert Chambers, who was self-taught, and never darkened the doors of a University, would have sneered (as the author of the Vestiges does) at Hugh Miller, who had not, either, received a University training. So much for the negative evidence against the Chambers theory. But this evidence is not now required. The authorship has been admitted, and it is known that the work was written by the late Professor Sedgwick. Professor Sedgwick's article in the *Edinburgh Review* abusing the author is now, since he is known as the writer, one of the curiosities of literature." This is news indeed. We should like to know who has been hoaxing our New Zealand friends.

* Not ambitious, surely. We named Knowledge in humble consciousness that knowledge is but the servant of wisdom.

NOTICES.

[illegible] for November and December, 1882, can now be had, price 2d. each, post-free, 2½d.

[illegible] Part XIII. (Nov., 1882), price 10d., post-free, 1s. 1d.

[illegible] Page and Index to Volume I., price [illegible], post-free 2½d.

[illegible] Case to Volume I., price 2s. each. Subscribers' numbers bound (including Title, Index, and Case) for 3s. each.

[illegible] Volume comprises the numbers published from the commencement to May [illegible], 1882 (No. 1 to 29).

The Second Volume will end with No. 61 (Dec. 29, 1882).

[illegible] will commence with the first [illegible] 1883.

The Back Numbers of Knowledge, with the exception of Nos. 1 to 8, 10, 11, 12, [illegible], and 32, are in print, and can be obtained from all booksellers and [illegible] from the Publishers. Should any difficulty arise in obtaining the paper, an application to the Publishers is respectfully requested.

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KNOWLEDGE
AN ILLUSTRATED MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, DECEMBER 8, 1882.

CONTENTS OF No. 58.

Science and Art Gossip.

A FRAGMENT of the great comet was seen by Mr. W. R. Brooks, of New York, which after a few days faded out of view. Prof. Schmidt's small comet, another fragment, apparently, of the great comet, has also disappeared, as well as other cometary masses seemingly thrown off from the great comet, or perhaps driven away during perihelion passage.

SPEAKING of invention, the *Operator* says :—" Above all, patience is needed. There are probably one hundred disappointments to one success, and the things that are valuable seem very hard to do. 'When I was at Menlo Park,' says Mr. Edison, 'I was once working with my assistants a long time trying to connect a piece of carbon to a wire; every time it would break. Then we would spend several hours in making another, and that would break. After working a day and two nights in this way, we finally accomplished our purpose. One of my assistants wearily got up and said :—'Well, I think Job got too much reputation on a small capital ?' "

IT is noteworthy that some of the most brilliant recent practical applications of electricity have been simply the development, by experiment and study, of familiar and apparently insignificant effects. Every telegraph operator has been familiar, ever since there has been a telegraph, with the phenomenon of the electric spark, and with the fact that a strong current will heat a conductor of high resistance; yet the electric-arc lamp is simply a development of the former and the incandescent lamp of the latter phenomenon. In the same way, the "polarisation" of batteries was known to telegraphists for years, and was regarded by them simply as an impediment to be got rid of; but the Planté and Faure accumulators are only developments of the same principle of "polarisation."

AN animated correspondence is proceeding in the *Railroad Gazette* (New York, Nov. 3) as to the comparative consumption of coal in American and English locomotives. The general result seems to be that the consumption in the former is much larger. One correspondent reckons it at double the amount, and accounts for it by three considerations :—1. That the loss by friction on curves is greater in America; 2, that inclines are more frequent; 3, that the entire heating surface of an American engine is of iron, the conductivity of which is greatly inferior to that of the copper or brass used in England.

THE same paper contains the official report of the fourth meeting of the Association of American Railroad Superintendents, at which a uniform code of train signals—by engine whistle, gong, and lamp, hat, or hand—was adopted, and recommended to the members.

AMONG the numerous substitutes for cod-liver oil which have from time to time been brought before the notice of the profession, dugong oil, which is an extract obtained from the dugong, an herbivorous cetacean inhabiting the warm seas of the coasts of Australia and the Eastern Archipelago, has met with a most favourable reception. Dugong oil is free from the unpleasant odour and taste which characterise cod-liver oil, and is much less liable to change in keeping. At ordinary temperatures it is opaque from the separation of its more crystalline constituents, but becomes clear and almost colourless when slightly warmed. The dose is the same as of cod-liver oil.

DR. MCCOLGANAN, in the *Southern Practitioner*, extols the value of the ether or rhigolene spray for the instantaneous relief principally of facial neuralgia. He first had occasion to observe its good effects upon his own person, he having suffered greatly from facial neuralgia. Since curing himself, he has had occasion to test its efficacy in about twenty cases. The result was invariably a most gratifying success. In many instances a permanent cure was established. He attempts to explain its action by supposing a complete change to take place in the nutrition of the affected nerve in consequence of the intense cold acting as a revulsive.

THE *Iron Age* (New York, November 9) says that Dr. Fritzgärtner, geologist and mineralogist to the Government of Honduras, reports that whole mountains of fine magnetic iron exist in Honduras, both near the coast and in the interior. The natives use clean fine ore directly in the forges; the iron produced is of superior quality, greatly resembling steel in all its characteristics. Semi-bituminous coal is very abundant along the Atlantic coast, and will before long become a valuable article of commerce along the Caribbean coast. It is said that the Government is so anxious to encourage the development of the industry that it will do all in its power to facilitate the transport of machinery, and will admit it free of duty.

THE Board of Trade have issued a new or revised scale for the wire gauges, and plainly intimate that unless very great opposition is offered, the Board will advise its adoption. The new scale is a compromise; it makes concessions to the thick-wire manufacturers, and takes an average of the Birmingham and Yorkshire gauges for the thinner sizes.

CHEAP brandy and absinthe are the cause of a large proportion of cases of insanity in parts of France. The United States Consul at La Rochelle, in his report on French brandies, points out the fact that no pure brandy is now made in Cognac and the district adjacent. He says [illegible] from potatoes, is imported, [illegible] and that the French artisans [illegible] peasants, who formerly used light wines, have of late years used [illegible] of this so-called brandy. He says, "Its characteristic [illegible] to produce an intoxication in which the patient [illegible] inclined to rage and physical [illegible] insanity is the inevitable consequence of persisting in its use, even for a relatively short period of time." It is at least worth the physician's [illegible] that there is no such thing as pure Cognac [illegible].

[illegible] UNDERGROUND TELEGRAPHY. A subterranean [illegible] cable is now being laid between Paris and the South of France, so as to place the French capital in direct [illegible] communication with Marseilles. Two hundred and fifty workmen are now engaged in laying the cable, which follows as closely as possible the national roads on the right bank of the Rhone. The cable is laid in iron pipes at a depth of [illegible] ft. 6 in. The joints of the pipes are covered with [illegible], and every 1,666 ft. subterranean chambers are established so as to facilitate repairs. [illegible]

AN International Electrical Exhibition is to be held at Vienna in August, September, and October, 1883. No charge is made for space, nor for motive-power for the general illumination, and no prizes are to be awarded. Exhibits not patented will be protected until the end of the year.

ONE or two who cannot understand that wrong may [illegible] wrong, have assumed that our just indignation at the Kew Gardens wrong-doings must have been aroused by some personal grievance; and one "weekly" assumes that because the Editor of KNOWLEDGE chances to reside at Kew, his wrath has been aroused for that he cannot overlook the grounds from his parlour windows. To all this we reply that we have never had any personal relations, good, bad, or indifferent, with the present Director (if he should not rather be described as the [illegible] proprietor) of the Botanic Gardens: that we neither know him personally, nor any one who (so far as we know) does so; and that half a dozen houses would have to be pulled down before even the great wall of the Gardens would be visible from our parlour windows. A manifest wrong is done to the public, Sir J. Hooker's paymasters; that is sufficient reason for the indignation which is felt by every honest man who knows the facts.

To see crowds along our streets, at night, with no brighter spectacle attracting them than the half seen preparations for a street procession, staring intently at [illegible] inscriptions announcing welcome to royalty at [illegible] per head, ten shillings for front seats," and [illegible] to get [illegible] of the draggled ends of cheap flags, suggests somewhat sad thoughts as to the worth of life to many. If there had been gladness of soul among the crowd one might have rejoiced to see how easily the many were pleased. But with the rush to see nothing, there was an air of gloom and disgust; and the favourite [illegible] were oaths and foul language. A significant [illegible]. To what proportion of our people, [illegible] in these days of advanced civilization, [illegible] of beauty and brightness? One feels [illegible] the charm given by art and literature [illegible] to life, after seeing how many, even [illegible] there are who know naught of what [illegible] the few.

IT is asserted that in the three years ended 1880 there were no fewer than 252 theatres destroyed by fire, or partly so, resulting in 4,370 deaths, and about 3,400 injuries.

WE give again this week the path of the comet during December. Fortunately during the past week the comet has not been favourably visible, so that an error of 20 m. in right ascension *throughout* in our last map can have done very little harm. The Editor was obliged to entrust the drawing of the path to another, being absent on a lecturing tour; and misunderstood instructions led to what might have been a rather troublesome mistake. (There was not time for a proof of the picture to reach the Editor, even had he been in town sooner.) The opportunity is favourable for noting what, we think, many readers seem not to understand. The Editor has other avocations, which, so far as he is personally concerned, are of many times greater importance than his work with KNOWLEDGE. It is a pleasure to him to give his time freely (practically a free gift) to converse with the readers of this magazine; but those other avocations cannot be always neglected. Occasionally it is only by a very hard struggle indeed that time can be *made* (there is no other word for it) for KNOWLEDGE; and for each of our many valued correspondents there are at least ten who simply waste the time thus with difficulty made available for editorial work. If some errors have to be corrected, it is not wonderful.

A POINT to be observed is that they *are* corrected and noted *here*, as carefully as if they were errors in some rival publication (if such there be). Yet often they have been occasioned solely by waste of time in searching through immense chaff-heaps for scattered grains.

THE work involved in correspondence may be inferred from the five-and-a-half columns of Answers last week. This *must* be cut down, as, even if there were time for the work, there is not space, without exceeding the limits which, at our present price, can be afforded. We are thinking of closing the "Answers to Correspondents'" section, as the only effective way of meeting a difficulty which threatens the very existence of KNOWLEDGE (though really giving evidence of its success). Probably that will be the better way; but for the present we content ourselves with the appointment of a rigid censor of letters (who will not allow the editor even to *see* most of them), and the limitation of the "Answers" to a single column.

WE give this week the opening paper of a series by Mr. Grant Allen, to be called the "Naturalist's Year." It will be continued weekly till the end of the year, afterwards fortnightly. The Christmas number of the series will deal with "The Mistletoe Bough."

THE first paper of Prof. Wilson's series will be given next week, subject "Our Bones," illustrated. The series will alternate with Mr. Grant Allen's.

THE Editor is having rather a busy time lecturing, at present. On Tuesday, Dec. 5, at Manchester in the afternoon, Bowdon in the evening; on Wednesday, Edinburgh; on Thursday, Falkirk; Friday, Galashiels; Saturday, Bonnybrook; Sunday, Glasgow; Monday (Dec. 11), Manchester; Tuesday, Hull, &c. This is more like his American and Australasian style of doing lecture work.

DR. HENRY DRAPER.

But a few short months ago we had to record the death of Dr. J. W. Draper, in the fulness of age, and after a life devoted to scientific, literary, and professional labours. We had it in our thoughts then that he left behind him three sons, all students of science, and one already so distinguished that there was every reason to regard him as following as closely in his father's footsteps as John in the footsteps of William Herschel. But those hopes must remain unfulfilled, and science must rest content with the good work which the young Draper was able to complete in the short space of life allotted to him.

Born in Virginia, on March 7, 1837—the son of an English father and a Spanish mother—Henry Draper was brought up in New York, and would have been recognised as a Northern American by all familiar with the diversities of type co-existing in the United States. He graduated in 1858 at New York University, where his father was Professor of Chemistry; and in 1860 he was elected to a professorship there. In 1866 he became Professor of Physiology in the Medical Department.

Dr. Draper's achievements in science have nearly all been associated with the application of photography to the increase of our knowledge. He, more, perhaps, than any man in our time, has shown the power of the photographic eyes of science. Thus, in 1857, he used microscopic photography to aid in a series of researches into the function of the spleen. He next became famous for his labours in celestial photography, making, *inter alia*, a remarkably fine photograph of the moon (which hangs before us as we write), with a 15½-inch reflecting telescope of his own construction. Later, he made a fine reflecting telescope of 2¼ feet in aperture, the speculum being of silvered glass. With this, in 1872, he attempted the then most arduous task of photographing the spectra of the stars. Later, using the sensitive gelatine plates, he achieved a marked success in this still difficult work. He brought the spectra of the stars into direct comparison with the spectrum of our own star, the sun, using as reflecting adjuncts to his telescope the planets Jupiter and Venus, to give the solar spectrum with sufficiently reduced light. His photograph of the diffraction spectrum in 1872—from near the G line to line O in the invisible part beyond the violet—has justly been regarded as one of his most successful achievements.

In 1874, Dr. Draper's reputation in celestial photography led to his being appointed Superintendent of the Photographic Department of the American Venus-Transit Commission; and he worked so successfully and disinterestedly in the discharge of the duties thus entrusted to him, that the United States Government did honour to themselves by causing a special gold medal to be struck at the Philadelphia Mint, bearing the motto, "*Decori Decus Addit Avito*,"* in which his father's fame is worthily linked with his own. In 1877, Dr. Draper undertook a long journey to the Rocky Mountains, to experiment on the effects of the greater steadiness and clearness of the air at an elevation of 11,000 feet above the sea-level. He led a party the following year to the same region to observe the total eclipse of July, 1878, and succeeded in photographing the diffraction spectrum of the corona.

During the autumn and winter of 1880-81 he photographed the nebula in Orion. Our contemporary *Nature* says "last autumn and winter" he took such photographs, which "were the first he ever made;" but this is an error: in April, 1881, we had the pleasure of examining in his laboratory the first one-inch negatives he had obtained, showing a marvellous amount of detail in the nebula, closely resembling what is shown in the drawings made by Trouvelot at the Washington Observatory, and later—in May, 1881—we saw the improved positives (much enlarged) of the Great Nebula. Of these, which had been then recently completed, one lies before us as we write, bearing the date on which it was presented to us, "May 16, 1881." Later he applied photography to the more difficult and delicate task of recording the spectrum of the nebula in different parts, and he also photographed the Spectrum of Wells' Comet.

But the work with which his name will chiefly be associated is that which for this reason we have left to the last, his recognition—still by aid of celestial photography—of the existence of oxygen, and probably nitrogen also, in the sun. Of the ingenious methods by which he mastered the difficulties in the solution of the problem of comparing the spectrum of our air with that of the sun, we need not speak here. They would occupy, indeed, much space; but they have been already fully described by us elsewhere. Suffice it, that the result satisfied all save a very few—whose opinion was perhaps biassed—that oxygen is present in the solar atmosphere in such a condition that, emitting more light than it absorbs, it makes its presence known by bright lines.

The loss sustained by science in the early death of so honest and zealous a worker is that which we must chiefly consider here. But it is impossible for those who knew Dr. Draper personally to omit some reference to his qualities as a man. Kindly, genial, and bright, he was a living contradiction to the common idea that the ardent student of science must be a man of worn and gloomy aspect, serious, if not morose, in disposition, uncheerful in temperament. He spoke of the results of patient, long-continued toil, as a boy might talk of a trophy won at cricket or base-ball. He passed lightly over the wrongheadedness of envious (because less successful) workers in his field of labour. Blessed with the companionship of a wife who shared his aspirations, encouraged his labours, rejoiced over his successes, and sympathised when less complete success than he had hoped for rewarded him, he pursued his work earnestly and zealously. With that lady, all who know her and knew her husband's worth will warmly sympathise. We sorrow ourselves in the loss of a most valued friend, with whom we had hoped to foregather again before many months were past, and for years, if life had been granted us, to have heard in his own country (our home before long), and from his own lips, the recital of his hopes and fears, his partial failures and his final triumphs. Of the same age as himself, within sixteen days, and recognising in him, as we thought, a man of enduring constitution, we should have hoped for him a longer space than for ourself by many years. But it was not to be, and science has to mourn the premature death of one of the most faithful of her servants.

* He adds renown to fame inherited.

Aerial Navigation.—M. De Comberousse, in a discourse pronounced at the funeral of the late Henri Giffard, made this significant admission:—"An intimate friend of Giffard told me yesterday that he carried to the tomb the secret which he had long sought for, and which had revealed itself to his eyes during his last years. He added that our colleague shrank back from his own discovery, and, filled with horror, put an end to his existence." In other words, he saw at length that aerial navigation must prove the suicide of civilisation.

A NATURALIST'S YEAR.

I.—AUTUMN BUDS.

By Grant Allen.

HOW full of promise for the coming season is this little forked spray of hawthorn, which I have picked from the hedgerow, already thickly covered with the buds and leaves of next spring's foliage. In a certain sense, [illegible] one may fairly say that the naturalist's year begins [illegible] truly in late autumn. It is then that many of the [illegible] life cycles start on their appointed course; it is [illegible] that next year's seeds are sown, that next year's [illegible] are rudely formed, that next year's eggs are buried [illegible] in the sheltering ground. Take, for example, the [illegible] of foliage and flowers. To the casual observer, it [illegible] as though these most notable of all external objects, [illegible] clothe the trees and the fields throughout the whole [illegible] began their yearly course with the first return of [illegible]. In reality, however, many or most of them have [illegible] on in embryo forms from the preceding autumn. This is the case even with annual seedlings; for if you cut open a seed, you will find that it consists of either one or two seed-leaves (according as it belongs to one or other of the two great flowering stocks), and these seed-leaves, with their enclosed bud, are already perfect in the ripe fruit, although they do not expand and develop their feathery head until the spring comes with its warmth and moisture to continue the arrested cycle of their growth. With some precocious plants, indeed, the young seedlings [illegible] actually sprout in great numbers during the autumn, struggle on somehow through the cold season, and start fresh with redoubled vigour in March or April. This is especially the case this year in England with the little goosegrass or cleavers, which is now growing abundantly in every hedgerow here, and is struggling among the brambles [illegible] briars as if it meant to hold its own bravely till the frosts are over.

But what is true of the annuals to a certain extent is far more deeply and universally true of perennials, like this bit of hawthorn. In all trees, for example, the buds which represent the future branches for next year's growth are produced and elaborated in the preceding autumn. As the [illegible] leaves fall off in October, the living chlorophyll and protoplasm which formed their active functional parts are withdrawn into the permanent tissues of the tree; and [illegible] withdrawal, aided by various internal chemical [illegible], chiefly of the nature of oxidation, leaves the [illegible] colouring matters of the foliage far more prominent [illegible] before, and so gives rise to that glow of crimson and [illegible] which we commonly know as autumn tints. Then the protoplasm and the other vital principles go in part to form [illegible] for next spring's growth, but in part also to pro- [illegible] the buds which are to live through the winter as [illegible] of the coming summer. Outside you see [illegible] enveloped in dry brown scales, which make [illegible] to the eyes of their enemies, who [illegible] devour these rising hopes of the [illegible]. Clearly, [illegible] brown protective coverings [illegible] by the buds through natural selection [illegible] and by natural destruction or [illegible] of all the greener or more noticeable buds. [illegible] however, as in the familiar case of the horse- [illegible] themselves are so large and visible that [illegible] possibly be overlooked; and this difference [illegible] has noticed for himself, since we very seldom [illegible] the winter buds on hawthorn or elms, but we [illegible] to observe them on the horse-chestnut. Under [illegible] the buds could never have escaped at all, if they did not possess some special and extra means of protection; and as a matter of fact we know that the embryo horse-chestnut leaves are protected by peculiarly gummy and resinous scales, which effectually ward off all insect or animal foes. Wherever we find very noticeable winter buds, indeed, we almost always find some such device for ensuring their survival, and in the few instances where we cannot detect any such device, it is safer to conclude that we have not yet fathomed all the tricks and chances of nature, than to conjecture hastily that no protective plan at all exists for their benefit. Tastes that are not nasty to us, may be very nasty to many a grub or caterpillar; leaves that seem scentless to us, may be unpleasantly pungent to the little smell-pits on the antennæ of many a flying insect; hairs, and scales and glands that look utterly meaningless to our clumsy eyes, may prove fearful and deterrent enough to many a prowling beetle or weevil. Depend upon it, there never was a worse bit of philosophy invented (which is saying a good deal) than that famous Greek phrase of crystallised human vanity—"Man is the measure of all things."

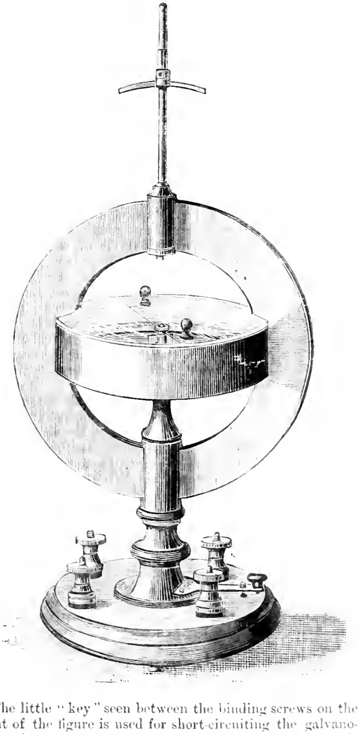
The scales have another function to perform, however, besides that of keeping off unwelcome visitors from the young leaves. They act as great-coats or cloaks to cover the dormant living germs from the cold of winter. Everybody knows that frost kills plants; and everybody has noticed that if the foliage expands in spring too soon, it is very apt to get nipped off by a late return of morning rime. That suggests how much need the buds have for a close, warm covering. Indeed, Mr. Darwin has shown that leaves are astonishingly sensitive even to comparatively slight changes of temperature, and that the so-called sleep of leaves, and many other curious modes of motion in plants, are due to the necessity for protecting the foliage from nightly chills. Those delicate plants which, in the course of their spontaneous variations, happened to hit out any peculiarity tending towards self-preservation in this direction, have gone on and thrived; those which failed to do so have been cut off generation after generation by every colder night. Now, what is thus true of the vital matter in leaves generally, is especially true of the vital matter in very young and undeveloped leaves. It cannot resist the slightest frost. Hence natural selection has in the course of long ages ensured the best possible means for keeping the true inner bud warm and snug. If you pick off some of these small brown scales, you will see how closely they are packed together, overlapping one another in regular rows, or imbricated as the technical botanists call it. That is an unusually good word, imbricated, by way of scientific terminology; for it means, arranged like tiles on a roof; and in fact the scales do really lap over one another just like the Italian tiles that one sees on cottages in Southern Europe. These short, broad, brown, close-set scales are themselves by origin abortive leaves; or, to put it more truly, they are leaves which have given up their original function of digesting fresh material from the air, and have taken to the new function of protecting their more active sisters from the sharp teeth of the frost. Underneath the brown outer pieces, however, you come at last to some tiny bright green knobs; and these shapeless little things are the living parts which carry on the continuity of the bush from one season to another. As soon as spring sets in, they will be supplied with fresh living material from the reserve stores in the permanent tissues of the hawthorn, and they will then swell quickly within the brown covering, showing at first a little pinkish tip, and finally spreading out as thin, pale green leaves, full of very active chlorophyll—giving them the beautiful spring hue which we all love and admire so much in the first days of returning sunshine. Some trees carry this principle of provision for the future one step further, and lay up their flower buds as well as their leaf buds four months beforehand. For example, look at this little sprig which I have just picked from the overhanging alder. You see at once that it is covered by two kinds of buds, one of which clearly foreshadows the future foliage, while the others are just as distinctly unripe catkins. At the very first approach of warmer weather in earliest spring, the alder catkins burst out at once into full bloom, and so succeed in getting their tiny cone-like fruits well set by wind-fertilisation, long before even the willows and the elms have been duly impregnated by the honey-seeking bees.

THE AMATEUR ELECTRICIAN.*

ELECTRICAL MEASUREMENT.—VI.

HAVING described the more important units adopted in electrical measurements, it behoves us next to direct our attention to the apparatus employed in making such measurements. Of all the instruments used for this purpose, none are so generally adopted as the galvanometer. The ordinary form, consisting of a coil of wire surrounding a magnetised needle, which is deflected by the passage of a current through the coil, may, however, be more fitly described as a galvanoscope.

But "to obtain accurate results, we require accurate observations, made on accurate instruments, by accurate methods." The tangent galvanometer is an instrument which, if properly handled, is capable of recording most accurately, and as its construction is somewhat easy, a detailed description of it will doubtless be of some service. The illustration (for the use of which we are indebted to the courtesy of the proprietors of the *Electrical Review*), represents, with one or two little omissions, the tangent galvanometer used in the telegraph service. It is made chiefly of brass, but good *dry* wood, although, perhaps, less elegant, will answer the purpose quite as efficiently. In the base plate or block, $6\frac{1}{2}$ in. in diameter, are four brass terminals or binding-screws, and supported by a short stout pedestal is a flat ring, $1\frac{1}{2}$ in. wide, with an external diameter of 8 in. It is about $\frac{1}{2}$ in. thick, with a deep groove $\frac{1}{4}$ in. wide cut on the outer edge. In this groove several layers of No. 35 copper wire are wound, enough to offer a resistance of about 250 Ohms, the ends of the wire being attached to two of the above-mentioned binding-screws. Outside this fine wire a few layers of No. 16 wire are wound and connected to the other pair of binding-screws. Care must be taken that the insulating material is not rubbed off the wire, and it would be advisable to fill up the groove with some insulating substance. Where elegance or neatness is desired, it would be best to lead the wires, through the pedestal, to the base, and make the connection underneath. The needle-case is fixed across the centre of the vertical ring, and consists of a box about an inch deep inside, with a glass cover through which the needle can be seen. The needle is rather difficult for an amateur to make, and to secure efficiency it had better be placed in the hands of a competent workman. Essentially it consists of a small magnet about $\frac{3}{4}$ in. long, with a fine brass wire, or pointer, about $4\frac{1}{4}$ in. long attached to it at right angles, an agate pellet being fitted in a cap provided for it. The whole revolves on a fine steel point. The base of the box is graduated into degrees of a circle on one side of the ring, and into divisions proportional to the tangents of the angles on the other side. A stout brass wire fixed to the upper edge of the ring carries a sliding tube with a slightly curved "controlling" magnet. The tube fits "spring-tight," to prevent it falling from any portion of the wire to which it may be moved, the function of the magnet being to increase or decrease the sensitiveness of the needle in proportion as it is raised or lowered.



The little "key" seen between the binding screws on the right of the figure is used for short-circuiting the galvanometer, but it may be ignored by the amateur. Its use is to bring the needle to rest speedily. In setting the instrument to take a reading, it should be turned round until the pointer is over the zero of the scale, and at right angles with the vertical ring. The magnet and the ring will then be in the magnetic meridian. The principle upon which the instrument is constructed is explained in any good text book. We may, however, say that the needle being very short in comparison to the diameter of the ring, the

* In "Measurement V.," on page 103, read ·1 for ·11, and ·08 for ·04; and on page 104 read $\frac{40}{6+6} = \dot{6} \cdot 0\dot{6} = 1 \cdot \dot{2}\dot{1}$ for $\frac{40}{6+6} = 6 \cdot \dot{0}\dot{6} = 1 - 212$.

[illegible] will be but slightly [illegible] by a deflection of the former, and, consequently, [illegible] of the current will be in proportion to the [illegible] of the angle of deflection.

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

By Amelia B. Edwards.

XIV.—TEL EL-MASKHUTA.

OUR difficulty when attempting to identify Tel Aboo-Soleyman with the mound of Pa-Tum is the absence of monumental evidence. No such difficulty confronts us, however, when we interrogate the mound of Maskhuta. Evidence of every description—monumental, documentary, be it direct, indirect, circumstantial, inferential—lies ready to hand. Our embarrassment, if we are embarrassed, is the embarrassment of wealth.

I will endeavour to state this evidence clearly and briefly.

First in order stands the fact that the neighbouring village preserves its ancient name. The name of the [illegible] the mere mound would seem to have varied from time to time; or, more correctly perhaps, the mound would seem to have been equally well known during the present half-century by some three or four different names, as Tel Aboo Kesched, Tel Aboo Kesheeb, Tel-el-Sakeeyah, Tel-el-Masroota, Mashoota, Mahuta, and [illegible]. This multiplication of names, arising from [illegible] circumstances, is a common feature of modern Egyptian topography. Aboo Kesched, or Kesheeb, is "father" Kesched, or Kesheeb, and means probably that some holy man of that name elected to live on the mound. Tel el Sakeeyah, "the mound of the water-wheel," shows that once upon a time a water-wheel was erected on the spot, and so on. In the same way, Wady Tumilat is sometimes called Wady Seba Biar, or "the Valley of the Seven Wells." The inhabited village at Tel-el-Maskhuta, though a mere cluster of mud-huts, is at all events the genuine representative of the ancient city; and it is called *Ramsis* to this day. Lepsius, as we have seen,* found it so called in 1845; and in the last edition of Isambert's "Itineraire de l'Orient" (Guides Joanne), 1878 (the Egyptological parts edited by Mariette Pasha and Professor Maspero), it is expressly said, "*près du canal Abou Dibab*" (the New Freshwater Canal) "*se trouve Ramsis, qui rappelle évidemment une ancienne ville de Ramsès passée sous silence par les historiens profanes.*" "[Near] the Canal of Abou Dibab is found Ramsis, which evidently commemorates an ancient city of Rameses, passed over in silence by the writers of profane history."] I quote this passage to show that "Ramsis" is not, as it has generally been supposed, a merely fanciful name given to the railway station by the French constructors of the [illegible], but that it is actually a Pharaonic survival.

The mound itself, described by the *Times* correspondent as "of considerable height and size" (see the *Times*, Aug. [illegible]), is small in comparison with the mounds of Tanis, Memphis, Heliopolis, and other great capital cities. Its appearance, in fact, so disappointed Professor Sayce in [illegible], that he doubted whether it was indeed the famous "treasure-city" of Pharaoh. But, as I then pointed out in a letter to the *Academy*, a treasure-city, or [illegible] was not necessarily a place of very great extent. The name is elastic, and may apply to a small enclosure or to a mighty stronghold. In its ordinary acceptation, it would seem to stand for a military storehouse and fort, where provisions and arms were kept for expeditions across the desert, and where booty might be deposited. The mound of Tel-el-Maskhoota is, at all events, more than large enough to cover the ruins of a very considerable fortress; and of that fortress, the massive wall of circuit may yet be traced. The bricks of which this wall is built are stamped, according to the testimony of Professor Ebers, with the name of Menephthah, the successor of Rameses II. The mound, which has never been excavated, is thickly strewn with fragments of granite and with immense quantities of potsherds; but the one relic which has chiefly made its reputation is a huge monolith, sculptured on the one side with a group of three figures, representing Rameses II. between the gods Ra and Tum, and, on the other side, with the name of this Pharaoh in a royal oval, six times repeated. So long ago as the time of the first French expedition, this important monument was first discovered, and there it still lies: the last traveller to report upon it being Professor Sayce, in 1880. Till of late years it was the only work of art known to exist at Tel-el-Maskhuta; but in 1876, when the new Freshwater Canal was in course of excavation, M. Paponnet, chief engineer of the works, discovered under a bed of alluvial deposit, at a spot closely adjoining the mound, the remains of a paved causeway, or *dromos*, and two fine sphinxes engraved with the ovals of Rameses II. There can be no doubt that the causeway and the sphinxes formed part of the approach to a temple, and further excavations in that direction would in all probability lead to the discovery of an avenue bordered by sphinxes, and finally to the remains of the temple itself. Another, and a very interesting relic—which, however, is far from being unique—was brought from Tel-el-Maskhuta in 1845 by Dr. Lepsius, and by him presented to the Museum of Berlin. The relic in question is an enormous brick of sun-dried clay, measuring rather more than 17 in. long by $9\frac{1}{2}$ in. wide, and nearly 5 in. thick. It is made of alluvial mud, from clay-beds found in the neighbourhood, mixed with chopped straw, and stamped with the oval of Rameses II. There are plenty of these bricks to be found in and about the mound; but they must not be confounded with the bricks of Menephthah more lately discovered by Professor Ebers in the wall of circuit. It is important that we bear this distinction in memory. If, however, the mound of Tel-el-Maskhuta be in truth the mound of "Raamses," then these bricks—the bricks of Menephthah, no less than the bricks of Rameses II.—were unquestionably made by the hands of the Hebrews in Goshen.

Finally, some four or five miles westward of Tel el-Maskhuta, going towards Tel-el-Kebeer, there lies to the south side of the Sweetwater Canal a large sheet of water called Lake Mahsamah.* This lake, which is utilised as a reservoir by the Canal Company, was formerly fed from the annual inundation of the Nile.

I must now ask those who have accompanied me in the present inquiry, to go back over some of the ground we first traversed, and to examine whether the mound of Maskhuta, in its position, its surroundings, and in regard of such few ancient remains as have been there discovered, or are yet visible upon the surface, answers more satisfactorily to the Pa-Rameses of the monuments and the "Raamses" of the Bible, than Tanis, Pelusium, Heliopolis, or any other site as yet proposed by Egyptologists.

(To be continued.)

* [illegible] p. 260-261.

* See Map of Wady Tûmilat, vol. ii., p. 357.

HOW TO GET STRONG.

THE WAIST.

WE have given enough chest exercises to last our followers for months; but it is not well to limit exercise to any one portion of the trunk, as those do who pin their faith on rowing, or boxing, or tricyling, or running, or any other special kind of bodily training.

We come now to certain muscles which are usually very much neglected in this country, especially by the fairer, and in this respect certainly the weaker, sex. When we hear men talking of wearing stays, or find that they are even thinking of such an absurdity, we have in reality the clearest evidence that the abdominal muscles have been neglected. A man in decent condition should as soon think of taking to crutches as to corsets.

Weak abdominal muscles are readily detected in walking. If a sense of distress across the abdomen and around the loins is felt after moderate walking exercise, especially after a slow walk, if the shoulders begin to hang forward, or the trunk lean forward from the hips, we may be sure that the waist muscles want attending to. This also shows that walking affords them exercise. But it is not the best exercise for them.

Wearing a corset, or shoulder-straps, or a backboard, will prevent you from feeling this sense of distress about the waist. So will lying on your back all the time. If you like, you can adopt these measures. In that case we are writing, not for you, but for others not quite so lazy or so unwise.

Taking, first, walking exercise, directed to the special purpose of strengthening the abdominal muscles, observe that a long wearisome walk will do more harm than good in the long run. Take a sharp, steady two-mile walk, at not less than three and a half miles an hour, and not more than four; keep the head up, shoulders well back, the body erect, the abdomen slightly forward, but not enough to hollow the back. Half a mile walked in this way will do more good than four or five miles at a dragging pace. The heart and lungs have good space to act in, and you presently find that they do act, and with energy. It is in maintaining this attitude that the muscles around the waist are exercised.

In running, which ought to be a daily exercise with all men in good health (though, as we have said, not suddenly or rashly begun, but moderately), the waist muscles are called into play if the style of running is well chosen—shoulders held well back, body upright, and strides long and energetic.

Turn now to indoor exercise for the waist.

Here is one which will very quickly harden the abdominal muscles. Sit on a bed with the toes hitched under the cross-bar of the foot-board (you can pad the bar if it hurts your instep at all), so that when you lie back your head falls on the pillow. (Pitch the pillow out, however.) Sway the trunk steadily backward till you are lying in a horizontal position. Then steadily draw it upwards again, and sway it over till the shoulders are well over the knees, keeping the trunk straight throughout both movements. Draw in the breath as you sway backward, and expel the breath as you sway forward—doing each to the full extent of your lungs. Thus you combine good chest exercise with excellent work for the waist muscles. The exercise need not, of course, be taken on a bed. You can sit on the floor with the feet held by a strap, or by the lower part of a sufficiently solid and heavy piece of furniture (be very careful on this point). Or in pleasant weather you can take this exercise in the open air,—as indeed most of the exercises suitable for waist strengthening.

Here follow two forms of exercise which are recommended by Blaikie. They *can* be taken in the open air, but most would prefer to limit their use to indoors, especially the first one:—(1.) Lie flat on the back. Taking first a deep, full breath, draw the feet upward, keeping the legs straight and close together, until the legs are vertical. Lower them *slowly* till horizontal, then raise and repeat, till you find you would much rather stop. (2.) Keep the legs down, and first filling the chest, draw the body up, keeping the trunk quite straight, till you are erect. Then sway slowly back; repeat as often as you find it convenient. You need not go on for half-an-hour, or even a quarter, unless you like. With practice you will find that you can not only do this pretty often, but lift a heavy weight along with you.

(To be continued.)

THE ATMOSPHERE OF SPACE.

ON the last lines of p. 399, Mr. Proctor says that M. Faye's calculation of the quantity of inter-planetary air that the sun would collect around himself under the conditions stated by Dr. Siemens, "forces us to reject absolutely and decisively such an atmosphere as Dr. Siemens and Mr. W. M. Williams have imagined." This forces me to reject absolutely and decisively such a bracketing of my imagining with that of Dr. Siemens.

The atmosphere which I have imagined is simply and exclusively that which would remain after all the solar accumulation to which M. Faye alludes is completed. I start at the very outset with the assumption that this has been done not only by our sun, but also by every other orb in space.

The density of this residuum of inter-planetary and interstellar atmosphere depends upon its inherent gaseous elasticity, and this elasticity is the material manifestation of heat. If no heat were radiated into space, it would be the vacuum imagined by the astronomers who are "enjoying the joke" of an universal atmosphere; but neither their amusement nor their formulating can disprove the necessity of the universal extension of atmosphere matter into all space that is receiving solar, stellar, and planetary radiation, unless they can prove that the laws of Nature cease to operate at the limits which they assign to our terrestrial atmosphere.

W. Mattieu Williams.

TRANSITS OF VENUS.

By Richard A. Proctor.

(Continued from page 419.)

I SHALL next show how Halley and Delisle contrived two simple plans to avoid the manifest difficulty of carrying out in a direct manner the simultaneous observations, described at p. 418, from stations thousands of miles apart.

We have seen that the determination of the sun's distance by observing Venus on the sun's face would be a matter of perfect simplicity if we could be quite sure that two observations were correctly made, and at exactly the same moment, by astronomers stationed one far to the north, the other far to the south.

The former would see Venus as at A, Fig. 6, the other would see her as at B; and the distance between the two lines [illegible] and [illegible], along which her centre is travelling, as watched by these two observers, is known quite certainly to be 18,000 miles, if the observers' stations are 7,000 miles apart in a north and south direction (measured in a straight line). Thence the diameter, S S', of the sun is determined, because it is observed that the known distance, [illegible], is such and such a part of it. And the real diameter in miles being known, the distance must be 107 times as great, because the sun looks as large as any globe would look which is removed to a distance exceeding its own diameter (great or small) 107 times.

But unfortunately it is no easy matter to get the distance, [illegible], Fig. 6, determined in this simple manner. The distance, 18,000 miles, is known; but the difficulty is to determine what proportion the distance bears to the diameter of the sun, S S'. All that we have heard about Halley's method and Delisle's method relates only to the contrivances devised by astronomers to get over this difficulty. It is manifest that the difficulty is very great.

Fig. 6.

Fig. 7.

For, first, the observers would be several thousand miles apart. How, then, are they to ensure that their observations shall be made simultaneously? Again, the distance [illegible] is really a very minute quantity, and a very slight mistake in observation would cause a very great mistake in the measurement of the sun's distance. Accordingly, Halley devised a plan by which one observer in the north (or as at A, Fig. 5) would watch Venus as she traversed the sun's face along a lower path, as *a a'*, Fig. 7: while another in the south (or as at B, Fig. 5) would watch her as she traversed a higher path, as *b b'*, Fig. 7. By timing her they could tell how long these paths were, and therefore how placed on the sun's face, as in Fig. 7; that is, how far apart, which is the same thing as determining *b a*, Fig. 6. This was Halley's plan, and as it requires that the duration of the transit should be timed, it is called the method of durations. Delisle proposed another method, viz., that one observer should time the exact moment when Venus, seen from one station, *began* to traverse the path *a a'*, while another should time the exact moment when she *began* to traverse the path *b b'*: this would show how much *b* is in advance of *a*, and thence the position of the two paths can be determined. Or two observers might note the *end* of the transit, thus finding how much [illegible] in advance of [illegible]. This is Delisle's method, and it has this advantage over Halley's, that an observer [illegible] to see *either* the beginning or the end of the transit, not *both*.

[illegible] consider, except in a general way, the [illegible] conditions which affect the application of these two methods. Of course, all the time that a transit lasts the earth is turning on her axis; and as a transit may last as long as eight hours, and generally lasts from four to six hours, it is clear that the face of the earth turned towards the sun must change considerably between the beginning and end of a transit. So that Halley's method, which requires that the whole duration of a transit should be seen, is hampered with the difficulty arising from the fact that a station exceedingly well placed for observing the beginning of the transit might be very ill placed for observing the end, and *vice versâ*.

Delisle's method is free from this objection, because an observer has only to note the beginning *or* the end, not both. But it is hampered by another. Two observers who employ Halley's method have each of them only to consider how long the passage of Venus across the sun's face *lasts*; and they are so free from all occasion to know the exact time *at* which the transit begins and ends, that theoretically each observer might use such an instrument as a stop-watch, setting it going (right or wrong as to the time it showed) when the transit began, and stopping it when the transit was over. But for Delisle's method this rough-and-ready method would not serve. The two observers have to compare the two moments at which they severally saw the transit begin—and to do this, being many thousand miles apart, they must know the exact time. Suppose they each had a chronometer which had originally been set to Greenwich time, and which, being excellently constructed and carefully watched, might be trusted to show exact Greenwich time, even though several months had elapsed since it was set. Then all the requirements of the method would be quite as well satisfied as those of the other method would be, if the stop-watches just spoken of went at a perfectly true rate during the hours that the transit lasted. But it is one thing to construct a time-measure which will not lose or gain a few seconds in a few hours, and quite another to construct one which will not lose or gain a few seconds in a journey of many thousand miles, followed, perhaps, by two or three months' stay at the selected station. An error of five seconds would be perfectly fatal in applying Delisle's method, and no chronometer could be trusted under the conditions described to show true time within ten or twelve seconds. Hence astronomers had to provide for other methods of getting true time (say Greenwich time) than the use of chronometers; and on the accuracy of these astronomical methods of getting true time depended the successful use of Delisle's method.

Fig. 8.

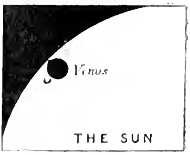


Fig. 9.

Then another difficulty had to be considered, which affected both methods. It was agreed by both Halley and Delisle that the proper moment to time the beginning or end of transit was the instant when Venus was just within the sun's disc, as in Fig. 8, either having just completed her entry, or being just about to begin to pass off the sun's face. If at this moment Venus presented a neatly defined round disc, exactly touching the edge of the sun, also neatly defined, this plan would be perfect. At the very instant when the contact ceased at the entry of Venus, the sun's light would break through between the edges of the two discs, and the observer would only have to note that instant; while, when Venus was leaving the sun, he would only have to notice the instant when the fine thread of light was suddenly divided by a dark point. But unfortunately Venus does not behave in this way—at least, not always. With a very powerful and very excellent telescope, in perfectly calm, clear weather, and with the sun high above the horizon, she probably behaves much as Halley and Delisle expected. But under less favourable conditions, she presents at the moment of entry or exit some such appearance as is shown in Figs. 9 and 10, while with a very low sun she assumes all sorts of shapes, continually changing, being for one moment, perhaps, as in one or other of Figs. 9 or 10, and in the next distorted into some such pleasing shape as is pictured in Fig. 11.

Fig. 10.

Fig. 11.

Accordingly, many astronomers are disposed to regard both Halley's method and Delisle's as obsolete, and to place reliance on the simple method of direct observation first described. They would, however, of course, bring to their aid all the ingenious devices of modern astronomical observation in order to overcome the difficulties inherent in that method. One of the contrivances naturally suggested to meet such difficulties is to photograph the sun with Venus upon his face. The American astronomers, in particular, consider that the photographic results obtained during the transit of 1874 will outweigh those obtained by all the other methods. European astronomers failed so thoroughly with this method in 1874 that they place no reliance on it whatsoever.

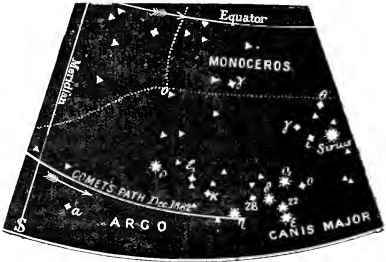
COMET'S PATH.

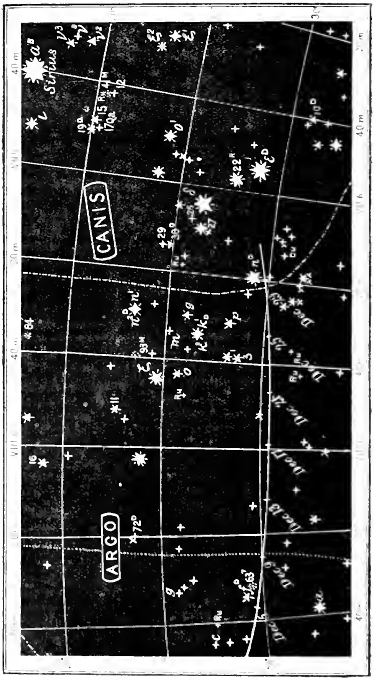
We have to give this week the comet's path (both pictures) again, a strange mistake (though easily explained) having crept into the maps given last week. The path, deduced from Chandler's estimates was, through a misunderstood instruction from the Editor, who was away from town, thrown twenty minutes eastward, and thus a much more marked discrepancy than actually exists between Mr. Hind's and Prof. Chandler's results was made to appear staringly on the maps. Those now given are correct. The dates from the small map are as follows:—

December 8, at 4 a.m.		December 27, at 2 45 a.m.	
,, 12 ,, 3·45 a.m.		,, 31 ,, 2·30 ,,	
,, 16 ,, 3·30 ,,		January 3 ,, 2·15 ,,	
,, 19 ,, 3·15 ,,		,, 7 ,, 2·0 ,,	
,, 23 ,, 3·0 ,,		&c., &c.	

ERRATUM.—DOLLOND'S 3-INCH "STUDENT'S" TELESCOPE. We beg to correct the following compositor's error which appeared in your last issue under the heading of "Extracts from letters respecting the Student's Telescope," namely:—"3. With power 160, ζ Ursæ Majoris" should have been "ξ Ursæ Majoris." The latter is a difficult test, while the former is an easy one, and may mislead.—DOLLOND & Co.

40° above horizon.





DR. SIEMENS' SUN THEORY.*

By M. Hirn.

TO the most serious objection presented by M. Faye against the new theory of the conservation of solar energy by Mr. Siemens, another may be added, which is also important. This objection can be presented in few words.

There is no agreement at present respecting the real heat of the sun. Fr. Secchi raised it to millions of degrees. Other physicists, especially in France, lowered it to some twenty thousand degrees. According to the magnificent experiments of Mr. Langley (Alleghany) the last-mentioned is in any case a minimum. What is thence certain, if we take as our basis the fine labours of our regretted *confrère*, Henri St. Clair Deville, on dissociation, is that none of the chemical compounds known to us on earth can exist on the surface of the sun. All, even those most stubborn in our laboratories, would be dissociated and reduced to their constituent elements. This, moreover, is what is admitted in the actual theory of the sun adopted by M. Faye.

The natural and direct consequence of this fact is that the chemical compounds which Mr. Siemens supposes to be dissociated gradually in space by solar radiation, might well, in returning in the elementary state under the action of gravity towards the central sun, restore and regenerate the heat employed in dissociating them in space; but this recombination could only be produced at a considerable distance from the solar photosphere; and the compounds thus formed, in falling on the surface of this, would be completely dissociated afresh. This act would, therefore, use up all the heat before developed in the process of combination. It follows evidently from this that the return of the elements towards the centre would be of no avail towards the conservation, or rather towards the continual reproduction, of the solar temperature.

It seems to me that Mr. Siemens' theory can be subjected to another decisive critical test. [What follows is one of the disproofs of Dr. Siemens' theory, which I have given in my article on "The Sun as a Perpetual Machine," in the *Cornhill Magazine* for May or June last: but M. Hirn's mode of presenting it is neat and effective.—R. A. P.]

If the solar radiation—let us say the heat, visible or invisible, emitted or returned by any star—effects in its progress the chemical dissociation of the hypothetical compounds disseminated in interstellar space, the intensity of this radiation should necessarily be reduced by the actual work done, and all which helps in this work is lost to the visibility of the star.

It follows, thence, that the brightness of the sun, the stars, the planets, should diminish according to a law *much more rapid* than that of the inverse square of the distance. I say *much more rapid*; I ought to say *extremely rapid*. In fact, from the moment when [we admit that] the recombination of the elements at the sun's surface would be capable of restoring the emitted heat, it is evident that all that emitted heat would in its turn be employed in dissociating the chemical compounds in space. That the sun should thus be continually maintained at its full energy, it would be necessary that the distance at which it is visible, far indeed from being illimitable (as it probably is), would be, on the contrary, moderate, for wherever it was still visible, there would be light *not employed in chemical dissociation*, and, consequently, there would be still a *possible* loss definite in amount. Nothing in the aspect of the planets and their satellites authorises, it seems to me, the admission that there is any other reduction in the brightness of light than that which results from the law of the inverse square of the distance from the central orb. We see stars whose light has taken at least three years in reaching us; others whose light has been travelling probably thousands of years. None of this light, then, has been employed in chemical dissociation: none of it can be restored in the way indicated by the theory (otherwise most ingenious*) of Mr. Siemens.

[The objections thus far formulated do not affect Mr. Williams's equally ingenious and more original theory: what follows does, I think. R. A. P.]

May I be permitted, in closing this note, to return to the objection formulated by M. Faye, and to render it in some sort probable [this, considering what follows, is very good] by a numerical example? In an important work which I am engaged upon, on the "Constitution of Stellar Space," I naturally examine the consequences which the resistance of a gas spread through space would have upon the motions of the planets. I extract from this work an example bearing on the application of analysis to the motion of our earth. According to Laplace, the diminution or increase which can be ascribed within 3,000 years to the duration of our sidereal year, taking full count of the uncertainty of the observations, would be 90 seconds at the utmost [taking more recent observations and tests of the older observations into account it can be shown that there certainly has not been a change of one full minute in the length of the year in 3,000 years.—R. A. P.] "Accepting as real a *reduction* of this amount, I examine what density a gas should have to cause such a reduction, and I show that it would suffice that one kilogramme of matter in the form of vapour should be present in 700,000,000,000 cubic mètres, in other words that the density should be 0·000,000,000,001,43 kg. [In our English way of presenting this relation we should say that 2·2016213 lb. Av. of vaporous matter would be distributed through 24,721,606,700,000 cubic feet, from which (as a standard gallon of water, specific gravity 1, contains 277·274 cubic inches, and weighs 10 lb. Av.) the careful reader can at once determine the maximum specific gravity of the interplanetary ether from the relation—

$$\text{sp. gr. required} = \frac{0{\cdot}22016217 \times 1728}{24{,}721{,}606{,}700{,}000 \times 277{\cdot}274}$$

$$= \frac{22016217 \times 1728}{2{,}472{,}160{,}670{,}000{,}000{,}000 \times 277274}$$

I leave him to work this out, but it will come out manifestly not far from

$$\frac{1800}{100{,}000{,}000{,}000 \times 300{,}000}$$

$$= {\cdot}000000000000006$$

where the density of water is 1: or roughly about

$${\cdot}000000000005$$

where the specific gravity of air at 39·2° F., bar. 29·9, is taken as unity. R. A. P.] We are far, then, it will be seen, from the reduction to a 2,000th, or even to a 1,000,000th,

* Translated [illegible] from [illegible] addressed to the Paris Academy of Science.

* M. Hirn's little compliment reminds me of the story of Cuvier, and the author of the "Dictionary of the Academy": "You ask me to give you my opinion of your definition of a crab," he wrote. "'A crab is a small red fish, which walks backwards;' it is capital. True, a crab is not a fish, it is not red, nor necessarily small, and it does not walk backwards; but in other respects the definition is excellent."

adopted by Mr. Siemens [also from the 100,000th suggested by Mr. Williams]. If, instead of considering solely the resistance opposed by such a gas to the motion of our planet, we carry our thoughts to the consequences which its existence would have on the existence of our own air, we find that unless we multiply our 700,000,000,000 of cubic mètres by 100,000, and reducing the density sought to 0 000,000,000,000,000,1 kg., our atmosphere would, in a few instants, be swept off (*balayée*) by the frictional action [*pression exercée en amont*] of the interplanetary atmosphere.

[What follows is curious.]

M. Faye is perfectly justified in saying that it is not this or that degree of rarefaction, but *void* (*of matter*, that is) that the astronomer requires, to ensure the stability of motion demonstrated by his analysis. This void doubtless brings to the ground the doctrine, which some pretend is so clear, which attributes all the phenomena of the universe to the movements and shocks of material atoms independent of each other. It will be necessary, one day or another, that this doctrine should yield up its life, that its defenders should resign themselves to the admission that there is something more in the world than matter in motion. In a remarkable letter to Bentley, Newton said that no man possessed of a power of forming a sound opinion in matters of philosophy could admit that between two bodies which seem to attract each other at illimitable distances, something does not exist which causes this relation; but he adds forthwith: "Is this intermediary material or immaterial? I leave this for the reader to decide." For that great genius there was certainly no uncertainty (*l'incertitude n'existait certainement*] on this last point; bu the refrained, perhaps with good reason, from proposing to his contemporaries a solution which might have seemed to them unimaginable (*insaisissable*), and which, it seems, is still so for so many minds in our own time.

DEATH-WARNING.

THE letter of Mr. Sinclair (650, p. 439) in last week's Knowledge, suggests to me to relate an even more extraordinary circumstance which occurred in my own family some years ago. The Baroness (my own mother-in-law) had a maid, a Westmoreland woman, who came from a place called Bongate, near Appleby. Subsequently to the death of her mistress she became our housekeeper, and died in the house whence I write these lines, after a continuous service of thirty-five years with mother and daughter. Before leaving her native county she had known a woman by sight, but, to the best of my belief, was not sufficiently intimate with her to speak to her. Well, one night she dreamed that this woman (of whom, be it particularly remarked, she had neither seen nor heard anything for some years), she dreamed, I say, that this woman took a piece of cord from a drawer, went into an outhouse, and hanged herself; and that, after some time, her daughter came in and cut her down. So appallingly vivid was this dream that when she came down to dress her mistress the next morning, she, in an agitated manner, told her of it, giving the details as I have given them here. Some little while afterwards a friend sent her a Westmoreland newspaper, which contained, *inter alia*, an account of the suicide of the subject of the maid's dream, and report of the inquest, whence it appeared that on the very night on which the dream occurred this woman did take a piece of rope from a drawer, did go into an outhouse and hang herself: and that her daughter did subsequently come in and cut her down! The point to be noted in this strange (but absolutely true) story is, I venture to think, the narration of the dream by G. to the Baroness, within two or three hours of its occurrence, thus precluding any *ex post facto* embellishment of it when the news of the objective suicide arrived. I inclose my name and that of the principal actors in the matter. N.

THE LIBRATION OF SENSATION.

IN my little book of "The Revised Theory of Delight, I showed, at length, that the received explanation of the phenomena of the *ocular spectra* is full of discrepancies and insufficient. And in that work and my previous lectures on Light] I endeavoured to explain my hypothesis of the Libration of Sensation, or that tendency of the nervous reaction from an initial sensation, to one of an opposite kind, and in the ratio in which that initial sensation was a departure from the *mean* state, or state of repose of the nervous system. This law not only holds good with respect to the sense of sight, but to the whole human system, and thus we find that the great law of compensation, which holds in the Kosmos, also obtains in the human constitution—viz., that whatever aberration takes place in *excess* of a mean state must be compensated by an equal and opposite one in *defect* of that state.

The fact that the sentient eye is the only "colour box," and that external to this there is nothing but mechanical vibrations, is not sufficiently present to the minds of most persons to prevent them from reasoning as if colour were a property of the vibrations themselves. This is the case with reference to the phenomena of the *ocular spectra*, which are regarded as external effects instead of, as they are, internal phenomena of the sentient being, due to the reactions of the nervous system, and which may be experienced after an initial sensation, though the eye be closed against all external vibratory action. An initial impression of a black spot in a white field is succeeded by a sensation of a white spot in a black field. An impression of a dark colour in a white field by its light, opposite and complementary colour, in a black field, and *vice versâ*.

We find, then, that similar changes in colour to those produced by the cooling of beads, alluded to by your correspondent in last week's issue, also occur in the retina by the decadence of an initial sensation, for the complementary spectra are entirely subjective phenomena. After a very strong initial sensation of colour, the sequent spectra endure a sufficient length of time to enable any one to experiment with them. For instance, after being dazed by the sun, the spectrum of any one of the sequent sensations or spectra, say, dark red on a white field, will become light green in a dark field, and will become dark red again in a light field. Here, then, the vibratory reaction is changed within the nervous system itself, so as to produce sensations of different colours. In consequence of these and other investigations I came to a conclusion very similar to that of your correspondent, which I expressed in a letter to the editor of the *Builder*, April 23, 1881, in the following words:—"It is curious that, with the endeavour to establish the close analogy between light and sound, that a body appearing of a certain colour has never been accounted for, as we account for a musical string responding to the note to which it has been attuned, and to that vibration only. In like manner, bodies only emit that colour vibration to which their molecular constitution is attuned." W. Cave Thomas.

Reviews.

THE FARM IN THE KAROO.*

Our [illegible] to disseminate knowledge, we cannot fail to [illegible] our readers the book before us, for [illegible] ostensibly for boys, it is full of information [illegible] South Africa, its physical features, natural productions, its people, both British, Dutch, and native, with their mode of life and various industries, such as ostrich farming, the mode of inoculating cattle against cattle plague, &c., &c., all of which will be read with pleasure by those desirous of knowing something of life at "the Cape;" nor is the antiquary and anthropologist forgotten, as the following quotation, descriptive of the cave paintings of the Bushmen, will show:—

A [illegible] brought them at last to the cave, or series of small [illegible] mountain side, and here on the rocks had been painted by the Bushmen various figures of animals.

"These fellows evinced a wonderful talent for drawing," exclaimed Marston. "Just look at that pig. I couldn't have sketched it better myself. A blue pig and a red hippopotamus. And what is this figure? Something of the deer species."

"With only one horn!" said Fred. "It reminds one of the unicorn."

"I always thought that that fighting animal was a myth," [illegible] Marston, "but there he is, sure enough."

"[illegible] figure has been often put forward as the original [illegible], but my father considers it is intended for a [illegible] animal which has very straight horns, and the Bushmen [illegible] only the profile, have delineated but one," said George.

"What [illegible] supposed to have used for paint?" asked Charley.

"[illegible] they sometimes used the red clay which [illegible] their bodies and blankets; but they also used [illegible] pyrites, or peroxide of iron. I don't know [illegible] for the blue; probably copper ore."

"[illegible]," exclaimed Marston. "What are these?"

"[illegible] arrow-heads," said Fred. "I am so glad you saw [illegible]. [illegible] evidently been one of their workshops, for here are [illegible] of manufacture."

"[illegible]," [illegible] Frank, "just look at that great lump of black [illegible] must have been brought from a long distance, for [illegible] it in this neighbourhood. I have often found [illegible] and arrow points on the plains, and have a few [illegible] home."

"[illegible] of these with me," said Fred, putting several [illegible] May I have them?"

"[illegible] as you like," George replied, "for these things [illegible] treasures in this country. I took some down to [illegible] Grahamstown, who is a very great connoisseur [illegible] an excellent geologist, to whose opinion [illegible]. When any stone or metal new to us is found we [illegible]. It was he who pronounced a stone from the [illegible] diamond, and thus opened up the diamond fields. [illegible] brilliant stones had been passed by with [illegible] their being prettier crystals than those [illegible]."

"[illegible] here?" said Marston.

"[illegible] jasper, I believe. My father [illegible] banks of the Vaal River picked up a [illegible] the 'Star of South Africa.' He [illegible] a very beautiful shape, and much [illegible] it in his waistcoat pocket for [illegible] caps there and whenever [illegible] came in [illegible] of gnoos, he was [illegible] not dreaming that [illegible]."

"[illegible] he ever [illegible]."

"[illegible] remember the very spot [illegible] about the diamonds [illegible]."

"[illegible]," [illegible] Marston. "It would have been [illegible]."

* [illegible] By Mrs. Carey Hobson.

"Is not this a grinding apparatus?" inquired Charley; "I have seen round stones like it in collections of stone implements at home."

"A muller: so it is!" answered George; "and, you see, here is full evidence of what I told you, as to what the *little folk* used for paint. Cubes of peroxide of iron, some of them still whole, others broken and ground up. This rock seems to have been slightly hollowed so as to hold water. Generally speaking, the grinding-stones are quite flat. The Hottentots still use them. They grind the coarse salt with them, also coffee, and even their snuff. No doubt Kaatje has one with her, upon which she grinds our coffee after having roasted it."

We believe that all who read will see at once that the author writes from personal knowledge of the country, and indeed, she informs us in the preface that she has resided for more than a quarter of a century in the colony, and she very evidently has not put her eyes in her pocket during that time. She also vouches for the truth of the wonderful adventures with snakes and wild beasts which she relates, which will certainly add zest to their perusal.

New South Welsh Coal.—The output of coal in New South Wales in 1880 reached 1,466,180 tons. In 1830 the amount of coal raised in the colony was, in round figures, 40,000 tons; in 1840, 30,256 tons; in 1850, 71,216 tons; in 1860, 368,862 tons; in 1870, 868,564 tons; and in 1880 as above, showing a very great expansion during the last 30 years.

Anglo-American Brush Electric Light Corporation. —The following is a copy of a resolution passed by the Board of the above Company on Nov. 29:—"Resolved, that a call of £3 per share be made on the £4 paid shares of the Corporation, to meet the cost of extension of works and machinery, and manufacture of stock, the same to be payable in instalments of £1 each on Jan. 1, Feb. 1, and March 1, 1883."

Birds and Telegraph Wires.—At a recent meeting of the Electrotechnic Society of Berlin, Herr Massmann read a paper on some observations which he had made on the Imperial telegraph lines at the instance of the Secretary of the Post Office. He found that in districts where there are no trees, the smaller birds of prey, such as crows and magpies, are very fond of roosting on telegraph poles, while sparrows, starlings, and swallows frequently alight on them in great numbers. This leads to a fouling of the wires with excrement until they look as if they were plastered. The soil has, however, no damaging effect, as the rain washes it off, unless, indeed, the acid excrement tends to the decay of the wooden poles. Swallows like to build under the eaves where wires run into telegraph offices, and sometimes cause an "earth" contact. Contacts between wire and wire are frequently caused by large birds, such as bustards, storks, swans, and wild ducks. They cause the wires to swing, and sometimes to break. Accidents of this kind were frequent when the wires ran by high-roads, along which young geese were driven to their pastures. Smaller birds, even partridges, are generally killed by the shock of striking the wires. They do not cause much damage to the lines. Holes are often pecked through the poles by woodpeckers (the *Picus martius*, or black woodpecker, the *P. viridis*, or green woodpecker, and the *P. major*, or piebald woodpecker). These birds spare no kind of wood, unprepared pine and oak poles, as well as poles treated with sulphate of copper, chloride of zinc, or sublimate of mercury. Some even state that they will attack creosoted poles. The theory that the birds mistake the vibration of the wires in the pole for insects humming is doubted by Herr Massmann, who declares that they often find insects in the dry poles.

Letters to the Editor.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street,* W.C. If this is not attended to, delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

"Let Knowledge grow from more to more."—Alfred Tennyson.

EARTHQUAKES IN THE BRITISH ISLES.

[652]—Permit me to mention one or two earthquakes which are omitted in your articles.

In 1134 an earthquake occurred, and "flames of fire burst out of certain rifts of the earth with great violence."

1249-50. A shock overthrew St. Michael's-on-the-Hill, without Glastonbury, and did much damage at St. Alban's. It was also felt in Somersetshire. At the same time, part of the town of Winchelsea was swallowed up by the sea, and great damage was done in the fens of Lincolnshire.

In 1328, on Nov. 14, occurred "the greatest earthquake ever felt in England." This remarkable statement rests solely on the authority of Dr. Bascome, in whose work ("History of Epidemic Pestilences") there is unfortunately no reference to his source of information.

1350. In Ireland, according to Short, an earthquake caused the demolition of cities, and great "loss of people."

1734. In August, 100 houses and five churches were destroyed in Ireland.

1749. A shock occurred at Leadhills (Scotland), which caused people to run out of their houses. This happened about the very time that Lima was destroyed.

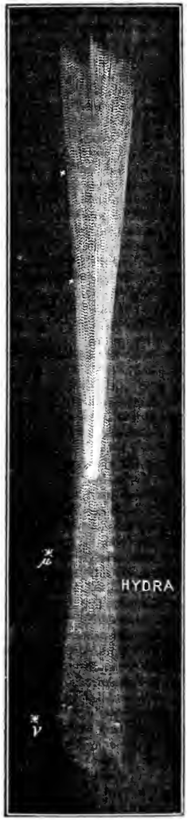
1750. London was shaken by two earthquakes in this year. The first occurred on Feb. 8, and, besides causing great alarm, overthrew a chimney in Leadenhall-street, another in Billiter-square, part of a house near Horsleydown, and a slaughter-house in Southwark. The second took place on March 8, and, though more violent and of longer continuance than the other, did little damage beyond breaking the chinaware in the shops, and bringing down some of the stones from the towers (then nearly erected) of Westminster Abbey. This latter shock was felt at Cheshunt, Hertford, Ware, Copthall, and Beckenham. It was these two shocks, following so closely in succession, that caused the panic about a month later (April 5), when many people passed the night in boats and carriages. A third shock was felt at Nottingham, Retford, Scopton, Tuxford, and elsewhere, on Aug. 23.

Allow me, in conclusion, to notice a slight anachronism in the first paper (p. 340). An earthquake is mentioned as having caused some damage on the banks of the Thames in 1247, apparently on the authority of Matthew Paris, and in the following paragraph we are told that, in 1248, "the western parts of England were shaken with an energy far exceeding anything which has been known in recent times," the shock doing serious injury at Bath and Wells. In reality, it was the former of these shocks, that of 1247, that was the more serious. Short calls it "one of the greatest earthquakes ever felt in England," and adds that it was most severe about London and Thames side. How widespread it really was, is now hard to determine. According to the Annals of Multiferuan, the shock was felt "throughout the whole west." That might mean anything, but Hanmer tells us that it is the "west of the world" that is meant. Teleon (Ware's Annals), on the other hand, says that Ireland "and the rest of the world" was affected, while Florilegus asserts that it was only England. From the reference made by Short to the earthquake of 1248, it seems to have been a local one confined to the neighbourhood of Bath and Wells. Yours truly,

J. A. Westwood Oliver.

THE COMET.

[653]—I enclose a sketch of the comet as I observed it with a pair of good field-glasses on Oct. 24 at 4.30 a.m. (local) at sea, in lat. 32° 22′ N., long. 31° 34′ W. The comet, on this occasion, showed an appearance which I had not noticed before. It appeared to be enveloped in a cone of faint light, which at one end merged into the tail, and at the other extended about half the length of the tail beyond the nucleus, and gradually faded away. It seemed as though particles were being actually swept from the tail by a resisting medium. The sky was very clear at the time, and there



were no signs of approaching daylight. The appearance was confirmed by Dr. Copeland, of Dunecht, and others. The folded-over appearance of the tail was also very marked, but this had been noticed for some days. The southern edge of the tail was more clearly defined than the northern. The comet was then near the stars μ and ν Hydræ. The following morning the moon was above the horizon till daylight, so the appearance was lost.

Transit of Venus Expedition, J. H. Thomson, Lt. R.A.
Barbadoes, Oct. 30, 1882.

[illegible]

[illegible] corsets [illegible] letter [illegible] Dr. Leigh in letter [illegible]

[illegible] is diminished, pro- [illegible] continued exer- [illegible] upper and middle parts [illegible] the great difference [illegible] woman, one used to the support [illegible] she will doubtless feel their loss"; [illegible] support, the wearing them will [illegible] she never experienced before.

[illegible] one is as bad as the other. The great [illegible] what I feel is really the pith of the whole [illegible] to apply the corset and continue [illegible] until the figure is formed; there will [illegible] to its wear afterwards; in this case there is [illegible] figure, because there never has been any [illegible] there must be a development. Neither [illegible] compression; the corset simply fits the [illegible] glove ought to fit the foot and hand. [illegible] inelegant rather than elegant, [illegible] the undraped figure of a modern corset- [illegible] with the Venus of the Art Galleries. [illegible] ask him to imagine what is far more [illegible] Venus, even of Milo. I doubt very much whether [illegible] of Milo is a Venus at all; the theory that the [illegible] seems much better. Ed. He will find that he [illegible] with a vengeance.

ALFRED CHADWICK, M.D.

[illegible] correspondent's letter, relating to the question of [illegible] to omit for want of space. Noting [illegible] Venus of Milo was almost certainly a Victory. [illegible] most celebrated Venuses of antiquity intended to [illegible] beauty? Again, would the draped Diana of [illegible] correctly described as a dowdy? Ed.]

USE OF THE TEAZEL.

[illegible] in his most interesting article on the teasel, [illegible] used by [illegible] for "fulling purposes." Now, fulling [illegible] process which every woollen manu- [illegible] wherein the cloth is continuously run [illegible] during the process, saturated [illegible] the same principle as washing flannel [illegible] It is often called milling, and [illegible] the cloth obtains during the process [illegible] which the teazel makes. The cloth [illegible] always from one end, until [illegible] The wool curls under the [illegible] our own hair curl when well [illegible] that the wild teazel has [illegible] when cultivated. The former [illegible] those next [illegible] the [illegible] "button."

A WOOLLEN MANUFACTURER.

Answers to Correspondents.

[illegible]

[illegible] H. and [illegible] W. H. [illegible]

[illegible] C.G. of frustum, considering that the fr. is the difference between two cones or two pyramids. H. A. B. Due to difference between mean time and apparent solar time. VAGIE SIMONS. Word "stand" may be used in either of two senses, one correct the other not, in reference to one who walks. E. A. SMITH. Do not know where such transfer slides obtainable.—BARNUM. Thanks; over-crowded.—P. Q. R. That way of describing size of comet is, as you say, quite absurd.—J. JACKSON. Noted. Can give no replies about trade articles.—J. W. B. Quite correct; equivalent in absorptive action.—G. J. O. End of Universe of Stars.—P. C. G. Yes; that is the neatest form of the proof; but then it was just that form questioner could not follow; so we gave a fuller one.—J. S. HARRIS. It would make no difference; checked motion means heat, whatever changes may take place. On other point, it seems unlikely. D. RAMSAY. See notice about those star maps. W. V. S. Wants a column; space wanted.—NEWTON CROSLAND. "Fatuous fallacies of false philosophy!" But if "Darwinian theories swept out of the minds of all intelligent persons," why not be content? S. C. A series of volumes could be formed out of the discussion whether *Vis Viva* rightly applied to product of mass and square of velocity. It is only a name, anyway; and means only that product. QUZUM. Wants an article or a series. Think of our difficulties, and if these cause necessary omissions, X Quzum.—H. ALEXANDER. Pardon me, it *would* do harm to insert your guesses as forecasts.—F. J. BUTT. Thanks.—EXPERIMENTALIST wants to know how a wooden substance may be reduced to a fibrous pulp.—GRADATIM. (1) If you cannot find the proof you want in Airy's Tract on "Precession and Nutation," you are studying a subject a little beyond you. Read articles 28, 29, 30, and 31, and interpret the expression added to I. in 31, as the second term of the expression for the precession is interpreted in 29; and then ask whether you should have sent me again to my bookshelves to hunt out the passage. (2) When eccentricity moderate, there is no marked difference wherever the perihelion may be round orbit.—W. R. DAVIES. I have no back numbers. JAS. GRUNDY, INDICUS. Noted and referred. F. C., B. WEBBER. Quite hopeless for us to try to find space.—X. Z. Sir G. Airy at Greenwich, and Professor Piazzi Smyth at Edinburgh, both proved that. W. K. GILMORE. Fatally attractive theory! W. M. B. BEAUMONT. Thanks. M. S. Many thanks. Will try to find room for your interesting diary notes. C. H. ROMANES. Have endeavoured to obtain a satisfactory explanation of the flap experiments, but have not succeeded. One correspondent (private) has noted rather different results. The subject is hardly suited to our columns. E. R. M. Fear cannot tell you where to get books for Hamiltonian method. I got all I wanted in Holywell-street. W. J. Thanks. M. B. ALOFR. Many thanks, but our "Jorkins" already appointed.—J. A. J. Thanks. Questions about books cannot be inserted. They lead to multitudinous replies, and some gratis advertising. R. A. G. From improved orbit earth certainly did not pass through comet's tail.—COSMOS. Glasgow, Sunday, December 10; subject, "Birth and Death of Worlds." Bind star maps as may be preferred.—R. THOMSON. The centrifugal and centripetal tendencies compensate each other while the orbit is elliptical. When frictional resistance comes in there is no such compensation, whatever the form of the orbit.—L. R. SHORTER. Fear the computation useless, the accounts on which it is based being quite inexact. A DISAPPOINTED ONE. Wanting to please all—there's the "reason why." Won't do so any more, or make promises which others prevent me from fulfilling.—X. You might submit those questions to Professor Owen.—JANE CARR. If that is right, all the leaders of modern biological science are wrong.—DAVID DEANEY. How can a book be sacred *per se*? Certain persons *must* decide what books are sacred. Dear me: if you were right, how much labour I might have been saved at King's College in learning what are the specific decisions by which this or that book took its place, or was refused a place, as a sacred one! As for "germs of truth," there are germs of truth in a good many things, but that don't make them all revelations.

ELECTRICAL.

W. P. See "Gossip," KNOWLEDGE, No. 57.—A. E. NEAL. 1. Not without a deal of calculation, and, even then, the result would be not an atisfactory. 2. A medical coil would be of no use to produce an electric light. 3. The hole in the covering of the carbon-manganese mixture in the Leclanché cell is to allow any gases evolved in the porous pot to escape. ALPHA. Will try to find room for a short article on the subject soon. J. J. L. 1. The current depends so much on the quality of the iron employed and on other kindred points, that it is unsafe to predict a result. I purpose saying a little on the subject in the articles on "Measurement." — Each of the plates forming the field magnets takes about ¾ of a pound of wire. 2. The resistance of the armature is not necessarily 7 Ohms when the same size wire is used. Of course, you can use thicker wire, but with the same core you would have fewer turns, and consequently less E.M.F. On the other hand, an increase in the size of the armature would necessitate a proportionate enlargement of all parts. It is evident that if the resistance is reduced (the E.M.F. being kept constant) the current-strength must be increased. 3. Not efficiently or economically. The armature should be wound in sections to produce a current of such proportions. Have you the convenience for making a Gramme?—W. G. Woolcombe. 1. The length depends upon the kind of spark you require. About 5 in. would be a useful length. 2. The bobbin ends 3 in. in diameter. 3. Core (a bundle of soft iron wire), half-an-inch in diameter. 4. Paper, well gummed. 5. Boxwood would answer very well. 6. Any good text-book on electricity.

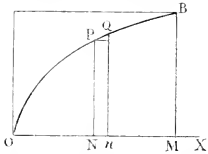
Our Mathematical Column.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

No. XIV.

Here are a few simple examples of the process of integration as explained in the last lesson:—

OPB is a parabola, OX its axis, the equation to the parabola being $y^2 = mx$. To determine the area OBM, when OM = b.



Draw ordinates PN, Qn close together. Let ON = x, Nn = Δx. Rectangle Pn = $y\Delta x$. Then, since the area is the sum of all such rectangles as Pn between O and BM when they are made indefinitely thin, we have area OBM $= \int_0^b y\,dx$

$$= \int_0^b \sqrt{mx}\,dx$$

We have to find out what expression that is which has $\sqrt{mx}$ for its differential coefficient. We may write this $\sqrt{m}\,.\,x^{\frac{1}{2}}$, and we know that in differentiating x raised to any power, the index sinks by unity and appears also as a factor in the differential coefficient. Therefore $x^{\frac{1}{2}}$ must be the differential coefficient of $x^{\frac{3}{2}}$ multiplied by a factor which is altered into unity when multiplied by $\frac{3}{2}$: that is to say, the factor must be $\frac{2}{3}$. Hence

$$\int \sqrt{mx}\,dx = \sqrt{m}\cdot\frac{2}{3}x^{\frac{3}{2}} + \text{a constant.}$$

(The student should differentiate this expression to make sure that its differential coefficient is $\sqrt{mx}$). Giving to x first the value b, and then the value 0, we find

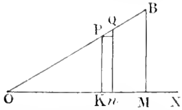
$$\text{area OBM} = \frac{2\sqrt{mb^3}}{3} + C - (0 + C) = \frac{2\sqrt{mb^3}}{3}$$

or, since OM = b, and BM = $\sqrt{mb}$; area OBM = $\frac{2}{3}$ rect. BO.

Of course, there is no occasion in practice for all that has been here written out.

Take another case, to show how such problems are dealt with:—

Required the volume of the right cone produced by the revolution of right triangle OBM around OM, OM = a, BM = b.



Put OK = x, Kn = Δx. Then PK, the volume produced by the revolution of rect. Pn around OX = π (PK)^2. Kn

$$= \pi\left(\frac{b}{a}\right)^2 x^2 \Delta$$

$$\therefore \text{required volume} = \frac{\pi b^2}{a^2}\int_0^a x^2 dx$$

Now obviously the expression of which x^2 is the differential coefficient is $\frac{1}{3}x^3$ + const. (Differentiate, and see.) Hence

$$\text{volume of cone} = \frac{\pi b^2}{3a^2}.a^3 = \frac{1}{3}\pi ab^2$$

uppose the following problem set:—

In the cone last considered the density of successive thin circles such as the one formed by the revolution of Pn, varies as the square of OK: required the mass of the cone formed by the revolution of OBM.

Proceeding as before, we find mass produced by revolution of Pn around OX $= \pi\left(\frac{b}{a}\right)^2 x^2 \Delta x \cdot \rho x^2$, where ρ is the density at a unit of distance from O along OX. Hence in this case

$$\text{Mass req.} = \pi\left(\frac{b}{a}\right)^2 \rho \int_0^a x^4 dx = \frac{\pi\rho}{5}\left(\frac{b}{a}\right)^2 a^5 = \frac{1}{5}\pi\rho a^3 b^2$$

These examples are only intended to give an idea of the use of integration; we shall consider later the principles by which areas, volumes, masses, lengths of arcs, &c., are determined. Let it suffice, in this preliminary view, to note how problems which, dealt with geometrically, would require more or less of skill or artifice, can be dealt with easily and systematically by integration.

Our Whist Column.

By "Five of Clubs."

PLAY FOURTH HAND.

(*Continued from page* 424.)

First, when late in the game you have the King card and a small one, and the play shows that, though led by your left-hand adversary, the suit is your partner's, the remaining cards in your hands being all losing ones. If in this case you let your partner's card win, you are obliged to win the next trick in the suit and lead a losing card. But if you take the trick with the King card and lead the small one, you are leading through strength up to weakness, and your partner may finesse deeply, and perhaps make all the tricks in the suit. Usually the case occurs in the first round of the suit; but it may also happen in the second. Thus, suppose a suit originally led by your partner from Knave, Nine, and three small ones, you holding King, Queen, and one small one, play the Queen, and fourth in hand takes the trick with Ace. Later on (trumps being out) the latter your adversary on the left leads a small one (having held originally Ace, Ten, Eight, and a small one). Your partner plays the Seven, third hand a loose card. If you play the small one, and your partner leads the suit again, your King makes, but you have to lead a losing card, and the rest of the tricks probably go to the adversaries. But if you take the trick with your King and lead the small one, your partner makes three more tricks in the suit.

The second case is one in which you must let the adversaries take the trick. When you hold the best, fourth best, and small card of a suit, and a second best is led by your left-hand adversary, who also holds the third and fifth best, you must pass the trick. If you win it you must lead through his tenace and lose the other two tricks; if you pass it, he must lead up to your tenace, and you win the other two tricks.

When, fourth in hand, you have won a trick very easily, it is often good to return your enemy's suit; for the original leader must then play as if third in hand, hoping for no support from his partner. In trumps this is not safe, however. Even if third hand is really as weak as he seems, you play the enemy's game by continuing the suit. But in trumps it is always possible that a winning card may be kept back to support more effectively later a strong game of the enemy's.

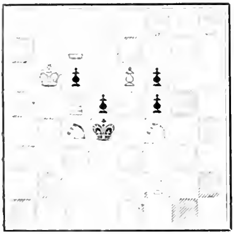
Our Chess Column.

By Mephisto.

PROBLEM No. 63.

By G. Woodcock.

Black.



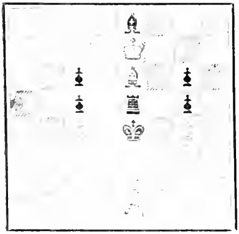
White.

White to play and mate in three moves.

PROBLEM No. 64.

By A. B. Palmer.

Black.



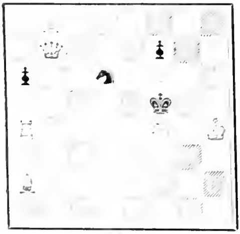
White.

White to play and mate in six moves.

PROBLEM No. 65.

By G. H. T.

Black.



White.

White to play and mate in [illegible] moves.

SOLUTION.

Reprint Problem, p. 410—

1. Kt to KB5 (ch) / K to Kt5
2. Q to B sq / Anything
3. Q to R3 (ch) / K takes Q
4. Kt to B2 (ch) / Mate.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Notice. We cannot guarantee a reply in the same week's issue of Knowledge for letters received later than Monday morning.

W. H. P.—1. Q to R. 2, and mate in two moves follows.

A. Cyril Pearson. Thanks for problem, which is welcome. We quite agree with your criticism of the two problems; nevertheless we were justified in publishing them. We like to publish easy problems. Our intention, however, was to publish each of these two problems in harmonious connection with more difficult compositions; but owing to circumstances over which we had no control, the two problems appeared too prominently in our columns. As to the idea in Eichstadt's problem not being good, we certainly differ from you; pray look at Problem No. 54, in No. 47 of Knowledge, and give us your opinion of it.

J. Hughes. Problem received; will be examined.

F. J. C., John O'Keeffe, C. T. Grey, Francis J. Drake, John W. Fowler.—Manuscripts returned.

R. J. P., W. H. B. H.—In Problem No. 60, if 1. Q to Kt3 (ch) 1. P to B5, and there is no mate in two moves.

T. Steele Sheldon, S. Basson Lello, Tyro.—If 1. Kt to QKt6, 1. P to Kt6, there is no mate possible.

Old Meldrum. How about 3. K to B sq.

A. McD. If 1. Kt. takes P., 1. K to B5, 2. K. takes P., 2. P. to Kt6.

C. H. Brockelbank.—Variations correct.

W. C. Thomas, J. V. B., W. G. Reynolds, R. T., A Novice.—Solutions incorrect.

R. Sargeant, jun.—1. P to Kt6 and no mate possible.

Correct solutions of Problem No. 60 received from Herbert Jacobs, Leonard P. Rees, Francis J. Drake, John Blain. No. 61. S. Bassan Lello, Herbert Jacobs, T. Steele Sheldon, Berrow, Francis J. Drake, H. Seward, R. J. P., T. T. Dorrington, T. S. L., Geo. H. Bonner, John Simpson, A Novice, J. P. No. 62.—John Simpson, R. J. P., Berrow, T. T. Dorrington, H. Seward, S. Bassan Lello, John Watson. Reprint. Herbert Jacobs.

W. H. B. H., Tyro, Old Meldrum. Solution of No. 61 incorrect.

NOTICES.

The Star Maps for November and December, 1882, can now be had, price 2d. each, post-free, 2½d.

Just published, Part XIII. (Nov., 1882), price 10d., post-free, 1s. 1d.

The Title Page and Index to Volume I. price 2d., post-free 2½d.

Binding Cases for Volume I., price 2s. each. Subscribers' numbers bound (including Title, Index, and Case) for 3s. each.

The First Volume comprises the numbers published from the commencement to May 26, 1882 (Nos. 1 to 30).

The Second Volume will end with No. 61 (Dec. 29, 1882).

The Third Volume will commence with the first issue of 1883.

The Back Numbers of Knowledge, with the exception of Nos. 1 to 8, 10, 11, 12, 31, and 32, are in print, and can be obtained from all booksellers and newsagents, or direct from the Publishers. Should any difficulty arise in obtaining the paper, an application to the Publishers is respectfully requested.

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KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, DECEMBER 15, 1882.

CONTENTS OF No. 59.

Science and Art Gossip.

THE snowstorms of the last week impeded traffic much more seriously than much heavier snowstorms do in America. But this is not to be wondered at, for with us snowstorms of the kind are infrequent; in the Northern States of America not a winter passes without several of them, so that there they must be prepared for them at the penalty of very serious misfortune if they fail. Still, we might do better, especially in the large cities, and on important lines of railway traffic. A few more plough-engines, for example, to clear away the snow on the main lines, would be a desirable addition to the rolling stock of at least the Northern companies. In cities, improved arrangements for street-clearing are very much needed; but under the present system, which makes every pound saved at least ten shillings gained by those who ought to see to such matters, we are not likely to see soon a change for the better.

As may be supposed, the storm had a terrible effect on the telegraph service. North of the Trent the state of affairs was alarming. The poles carrying the wires were in many places blown down, while in other places the wires were rendered useless by being connected to earth by means of the vast accumulations of snow. It is easy to conceive that it would take some days to effect the necessary repairs. It is to be hoped that the lesson thus rudely bestowed by nature will not be forgotten.

WHAT one notices most, however, when we have a spell of bitter weather, is the utter inefficiency of our methods for warming even those who are willing to pay well for warmth. Our railway carriages are in this respect simply a disgrace to a civilised community. Any one who has to travel at night by a train without sleeping-cars has practically to travel at the risk of his life; for if the weather should be exceptionally cold, he has no means of protecting himself against it effectually, let his shawls and wrappers be ever so numerous or so thick. Even if he can keep his body warm he has to breathe cold raw air. Many a fatal attack of pneumonia has been brought on in night travelling in this country, though the sufferer has not died in the railway carriage, and so has not given evidence against the absurd inference, humorously drawn by Mr. Bright from statistics, that a man is safer in a railway carriage than in his bed-room.

THE transit of Venus was not on the whole well seen in Europe, though in some places favourable weather prevailed. We shall not here repeat the records which have appeared in the daily papers, stating where the transit was seen, where not, how many photographs were taken in this place or in that. The interest and value of all such observations can only be determined hereafter.

WE note, however, that at some places the arc of light seen in 1874 round the part of the disc of Venus which was outside the sun just before first internal contact and just after second internal contact, was seen on this occasion; but it was incomplete, forming two arcs or horns of unequal length, extending from the cusps of the solar disc, and only partially enclosing the body of the planet. This is very easily explained. The edge of Venus at the time of transit is, of course, that part of the planet's surface at which the sun is in the horizon (either rising or setting), for inhabitants of Venus, if such there be. The atmosphere of Venus along that region may be clear or clouded,—where clear, it would refract the sunlight, and the arc of light would be formed; where clouded, the sunlight would only be refracted *above* the cloud layer, and if this layer were three or four miles above the sea-level, as it might very well be, about one half of the atmosphere would be below, and ineffective in producing refraction. Here, therefore, the arc of light would be lost. [N.B. This explanation does not apply to Mr. Brett's Vitreous-Venus-Atmosphere Theory.]

A CORRESPONDENT ("Hallyards") writes as follows:—"The zodiacal light was certainly, but not very clearly, visible on several clear evenings of the last week. This is my seventh winter here (Pornic, Loire Inférieure, France), and I never before saw it till January. The fact may, perhaps, be worth noting, as possibly connected with the comet, great sun-spot, aurora, and electric storm."

AT LAST!—The Electric Power Storage Company (Limited) announce that from Jan. 1 they will be prepared to receive applications for the supply of electrical accumulators for lighting or motive-power, and for the undertaking of complete installations of electric lighting of districts, private houses, and establishments, railway trains, or ships.

A BILL has been prepared bearing the names of several Home Rulers, and will be introduced next session, to provide for the purchase of the Irish railways on or after Jan. 1st, 1884.

THE *Metallarbeiter* calls attention to a discovery affecting the utilisation of the coal tar and ammonia developed in blast furnaces, by processes more or less similar to those in use in the manufacture of gas. Those who know the important position occupied in gas companies' budgets by the proceeds arising from the sale of such products, will readily appreciate the value which such a discovery would possess for the iron trade if the description of its merits is correct.

TELEPHONE EXCHANGES.—Some interesting statistics have recently been published concerning telephone exchanges. It is stated that there are 12,325 subscribers in Boston, U.S., 4,060 in New York, 2,422 in Paris, 1,600 in London, 600 in Vienna, and 581 in Berlin. It is estimated that there are upwards of 100,000 in the whole of the United States, certain small towns with a population of less than 1,000 having 30 to 50 subscribers. Consequently, in these latter places, there is a telephone to every 20 inhabitants; while in New York and Zurich it is 1 to 200; in New York, 1 to 500; Brussels, 1 to 800; Paris, 1 to 1,000; Berlin, 1 to 2,000; London, 1 to 3,000; and St. Petersburg, 1 to 4,000.

We learn from the *Railway Age* (Chicago) that the Northern Pacific Railway is to run for some hundreds of miles under the shade of trees, planted to protect it from storms and snowdrifts on the open prairies. The company has set a large force of men to work at planting them, and is offering every inducement to the settlers on its property along the line to cultivate forestry.

In a leading article on the novelist whom we have just lost (and, for our own part, we deem such a loss far more serious to the world than many others about which much more is said), the *Times* makes the startling assertion that it is with Anthony Trollope's "Mr. Crawley" that Miss Austen's "Mr. Collins" must be compared, and leaves the impression that "Mr. Crawley" is a development in recent times of the "Mr. Collins" of Miss Austen's days! Could false criticism go much further than this? Could two characters, both clerical, be imagined much more unlike than the two here? If it had been Collins and Slope; but Collins and Crawley!—not contrasted—but compared! Crawley, whose worst faults were better than Mr. Collins's best virtues—supposing for the sake of argument that he had any positive virtues. We all of us love Mr. Crawley, even when we feel how much more truly brave was that dear wife of his; but as for Mr. Collins, one feels it would be a relief to see something in Mr. Collins worthy of so positive a feeling as hatred. What marvellous bits of drawing they both are! But it angers one to think that the man who could draw as Trollope did here, should have left so many [illegible] imperfect sketches.

I have long owed Mr. Walter Besant "one." I was in New Zealand, travelling from Dunedin, where I had given what I fondly regarded as a most successful course of lectures, to Christchurch, where afterwards I was as [illegible]. I was "recuperating," *more meo*, by [illegible] the particular book I was reading being the "[illegible] Butterfly." Alas, in full enjoyment of this most [illegible] book, I was suddenly confounded,—slapped, [illegible] the face,—by finding my vocation (or one of [illegible]) included, amongst others, as illustrations of [illegible] human experiences. "One might as well," [illegible], Mr. Besant (I acquit the late Mr. Rice) [illegible] a lecture on astronomy, or" so forth [illegible]. And now, at the beginning of his Christmas [illegible] "Let Nothing You Dismay," Mr. Besant says [illegible] exactly at four (in North England), early in May. [illegible] a very wide meaning is given to the word [illegible] could have done nothing of the sort, [illegible] earlier there than in London (in May). [illegible] a few pages later, the Engleman implies (on the same [illegible]) past the middle of May. But that is not [illegible] that is the circumstances that Drury [illegible] are blue in one place, and a page or [illegible] that they are brown. I stand by the first [illegible] *early* in May the sun rose exactly at four; [illegible] this could not well have happened.

In the same pleasant story, by the way (for it should be hardly necessary to say that my wrath against Mr. Besant is not very warm—so that I still take pleasure in his stories), the mistake into which—so far as I can see—almost every one falls, is made of giving the opening lines of the familiar Christmas Carol thus—

> God rest you, merry gentlemen,
> Let nothing you dismay.

The original carol said nothing about "merry gentlemen," nor anything so meaningless as "God rest you:" but expressed simply the wish—

> God rest you merry, gentlemen:

as William, in "As You Like It" (Act. v., sc. 1), says, "God rest you merry, sir," *not* "God rest you, merry sir."

"An Observer" has sent us a response to our first note on corset wearing; unfortunately it reached us (owing to our absence from town on lecture-tour) too late for this number. It shall appear next week. "An Observer," like ourselves, is seeking to inculcate what is best, and though we do not agree with his conclusion, much that he notes in the course of his skilful advocacy of a—well, a difficult cause, is well worth noting.

The objects of the Rational Dress Society (President, Viscountess Harberton) are to promote the adoption, according to individual taste and convenience, of a style of dress based upon considerations of health, comfort, and beauty, and to deprecate constant changes of fashion, which cannot be recommended on any of these grounds. An annual subscription of 2s. 6d. constitutes membership. Hon. secretary, Mrs. E. M. King, 34, Cornwall-road, Bayswater.

Very misleading statements have been pretty generally made by newspaper writers and others as to the danger incurred by those "fairies" at the Savoy Theatre who are nightly electrically illuminated; and their ignorance on such matters is manifested by the assertion, amongst others, that the lamp on each fairy's head is supplied with electricity from an accumulator. Such an idea is simply ridiculous. As a matter of fact, each of these Savoy sylphs is supplied with electricity (generated as required, and not stored) by means of three specially-constructed Planté batteries enclosed in a gutta-percha case. The whole apparatus, which weighs less than three pounds, is worn after the manner of a soldier's knapsack, and is connected with the lamp by a flexible double wire. This arrangement is the joint production of the Swan and Siemens companies, but at present capable of much improvement in the matters of weight and the number of cells employed. A switch is placed on the top of the battery by means of which the current may be turned off at pleasure; and the light produced is equal to that of six candles. From this it will be seen that the wearer of the lamp runs no risk. There is no current capable of giving a severe shock, and practically there is no more danger from contact with the conducting wires than there is in walking under an ordinary telegraph wire. The statements we have referred to are amongst the least extravagant that have been made on this subject. It seems there was a notion that these "fairies" were lighted by a wire from the main dynamo machine which illuminates the entire building.—*St. James's Gazette.*

Answers to Correspondents are, as soon as possible, to be permanently restricted to a column in length.

A NATURALIST'S YEAR.

By Grant Allen.

II.—ANTS AND APHIDES.

On the path here an irregular procession of ants is making its way in two opposite streams, to-and-fro between the green grass-plot and the hummocky nest under the big elm tree. At first sight, the double current of little black beasts seems to obey no common law and to effect no common purpose. The ants cross and recross aimlessly from side to side, question one another in a meaningless fashion with their antennæ, and appear to find the width of the road a far greater difficulty for their dim sight than even its length. And yet if you watch them closely you will find that there is really a method in their apparently inane manœuvres; that the outward-bound messengers are making definitely, if tortuously, for certain fixed points on the grass-plot, and that the homeward-bound each carry in their mouths a small, round, greyish body. The fact is, they are taking home the eggs of aphides, or ant-cows, as they have graphically been called; and these eggs they will keep through the winter under ground, and will replace carefully in spring on their proper food-plants, so as to secure a fresh supply of their little cattle as soon as the warm season comes round again. This wonderful bit of provident care for the future, first distinctly proved by Sir John Lubbock, forms quite the high water-mark of intelligence and foresight in the insect world.

Aphides, as everybody knows, are those little green or brown flies (wingless in their commonest condition) which cover rose-bushes and many other plants, and which are familiarly, though very inaccurately, described in everyday language as *blight*. By descent they are very degenerate winged insects, but, having taken to an extremely simple and half-parasitical life, they have become exceedingly degraded in structure and functions, as almost always happens with sessile and parasitic creatures. It would take too long to go into the full history of these odd little insects, one of the prettiest and most effective objects one can look at under a low power of the microscope; but one may just say that the young aphis, as soon as it is hatched or born (for several generations are produced a-sexually without eggs during the course of a single summer), fastens itself upon the tissues of the food-plant where it first comes into being, sucks its juice uninterruptedly as long as it lives, and seldom moves at all from the place where it begins its monotonous existence. Though it has legs, it hardly ever uses them; and indeed, its whole organisation shows at once that it descends from more active ancestors, whose form it partly inherits, without inheriting their corresponding locomotive habits. Towards the close of each season, however, a generation of male and female aphides is developed from the imperfect types; and these complete forms produce eggs, which start the whole life-cycle of the race afresh at the beginning of the next summer. It is such eggs that the ants are now carrying in their mouths to the shelter of their subterranean home, in order to keep them safely through the winter, exactly as the Icelander keeps his sheep and cattle during the long, dark nights of the sub-arctic region.

But what is the good of the aphides to the ants? Do they eat them bodily, as we eat pigs and oxen; or do they keep them for some subsidiary purpose, as we keep cows and fowls for their milk and eggs? Well, if you look on a summer's day at a bit of dock covered with these tiny green insects, you will be pretty sure to see several ants prowling about in and amongst their groups, on food intent; and if you carry a small platyscopic pocket-lens (which every observer of nature ought to do) you will soon find out what they are after. Presently one of the ants will come upon an aphis which it seems to recognise as in good milking condition. At once it will run up to it, gently stroke the abdomen with its antennæ, and wait a second for the result. Then the aphis will lift up its abdomen, and quickly excrete a small drop of viscid fluid, which the ant proceeds greedily to devour. The viscid fluid is honey-dew, and I am credibly informed by stronger-minded persons who have made the experiment (which I will candidly confess I shrink from doing myself) that it is extremely sweet and pleasant to the taste. It is for the sake of this honey-dew that the ants keep the aphides; and so useful do they find these little cattle, that they not only preserve their eggs through the winter, but also actually build cow-houses over some of them, to preserve them as their own property.

Now, how can this curious instinct have been acquired upon both sides? That the habit is really instinctive seems certain, because, as Mr. Darwin points out, even very young aphides will yield up their honey-dew readily to an ant when stroked by its antennæ, but will not yield it up when similarly stroked by the hand of man with a piece of hair. This shows that the habit has become organically ingrained in the race—no antennæ no honey-dew. It also seems to me to show that the practice of yielding honey-dew has been developed by direct interaction between the ants and the aphides. It is not merely a case of the honey-dew being there and the ants coming to eat it, as is the fact with man and the potato, or man and the cow; for in those instances there is no mark of interdependence. The potato is not specially adapted for being eaten, nor the cow for being milked; but the aphis shows by its actions that it derives advantage from the ants, as the ants do from the aphides. When we find a flower and a bee correlated to one another's structure we know that while the flower feeds the bee the bee also fertilises the flower. If there were not a mutual benefit, natural selection could never have produced the mutual adaptation. For not only must the bee survive, but the flower must survive too. So with the aphides; the ant must do them some kind of good, or else they would never have become congenitally adapted to producing a sweet fluid on his behalf. Mr. Darwin suggested that the mere removal of the liquid might be an advantage to the aphides; they might be glad to be relieved of the useless excretion. It does not seem to me, however, that this explanation is quite satisfactory. We can hardly regard so sweet and nutritious a fluid as a simple waste product: it is rather, like milk, a special secretion than in the true sense an excretion. So far as I know, no animal ever gets rid of useful food-stuffs in any considerable quantities, except to feed its young, or for some other object tending to the preservation of the species. It seems more probable, therefore, that the aphides have acquired the habit of producing honey dew on purpose in order to supply the ants; and that the ants confer upon them some substantial benefits in return.

What are these benefits? Some of them, no doubt, we do not yet fully know; but others have already been made quite certain. In the first place, there is this very storing of the eggs during the winter, so as to replace them on the proper food stuffs in spring. That is a distinct and decided advantage to those species of aphides on which it is performed. Then again, there is the covering up of the colonies in little cow-houses, which serves to protect the aphides from the intrusion of unwelcome guests. Once more, it is well known that ants act as effective guardians over certain plants in which they possess a proprietary interest, and amongst others over those which form the green pasture grounds of the aphides. Every botanist knows that the inter-relation between plants and ants is intimate and intricate to the most marvellous degree. Some plants attract the ants by nectaries and sweet secretions, to protect them from caterpillars and similar foes; other plants guard themselves by hairs, moats, *chevaux de frise*, and like barriers or fortifications, from stealing the honey in their open flowers. It is easy enough to understand, therefore, that the aphides may, in the same way, have acquired the habit of excreting honey-dew under the influence of natural selection, working through the persons of the ants; because those which possessed these sweet secretions would thus gain protection for themselves, their eggs, or their food-plants, while those which did not possess them would be left to the tender mercies of an unsympathetic and hungry world. Just as the horse, the cow, and the dog, have survived the extinction of the other large mammals in Europe by their usefulness to men, so certain aphides have survived the remainder of their kin by their usefulness to the practical minded ant. This was all the more easy for them to effect, since their whole life is passed in merely sucking juice from the plant which they infest, and they can thus easily afford to spare a little sugar from the abundance of their food-supply, in order to strike a league of permanent friendship with so active and intelligent a force as that of the provident, locomotive, warlike ants.

LEARNING LANGUAGES.

By Richard A. Proctor.

(*Continued from page 427.*)

THE plan by which I learned enough of Latin and Greek to read most books in these languages with tolerable ease, was an anticipation in some degree of the Hamiltonian method, and may be useful to those who find a difficulty in getting books (now out of print) written specially in illustration of that method.

As I have said, I learned Latin and Greek in the usual way at school and college. I gave to them on the scholastic system much more time than I ever did on my own plan; yet I may almost set on one side altogether all that I so learned about those two languages. I should have learned the declensions and conjugations and the elementary rules readily enough after picking up the general idea of each language from a few hours study later on, with much more satisfaction, and, therefore, much more easily than I learned them at school, when as yet I had very little use for them. As for the rules, every schoolboy of the old Eton Latin Grammar days, knows that for any good the *Propria quæ maribus* did him, in learning what may be called the philosophy of Latin, he might as well have been learning Hindoo. He was much more particular to remember the sequence of words than to think of their meaning. I am not sure that a boy has learned very much when he has learned as a fact that you may term masculine the proper names which belong to males; but I know that ninety-nine boys out of a hundred (probably the hundredth too) pay no attention to this fact, important or otherwise, and limit their attention entirely to the words. To this day I can repeat rules from the Eton Latin grammar, the meaning of which is altogether new to me, for the simple reason that I learned and have retained the words of them, and now never thought of the meaning. I am quite sure that if any one had asked me suddenly when I was a boy to tell him about those four gods mentioned in my Latin rules—"you know the four I mean, my boy: let me see—m-m-m—Mars, Bacchus, Apollo, Virorum: tell us about Virorum," though I should have seen the joke, of course, it would yet have occurred to me as quite a novel thought that the words I had so glibly by rote, had a meaning, though a useless one for me at the time. I know, and any one who likes to try the experiment with his own boys will find it so, that such rules as I quoted in my last are learned simply by rote. Ask a boy, even a bright one (at the head of his class), what is meant by a deponent verb, not letting him merely quote his grammar definition, but asking him what it means, and the chances are ten thousand to one that he knows nothing whatever about it. The chances are a good deal more than ten to one that the first educated person you meet—the reader of these lines, perhaps—can tell you nothing to the purpose about a deponent verb (why it is called deponent, for instance); and I doubt if one in ten thousand needs to know or wants to know anything on the subject. It is not because our school teaching fails to give boys clear ideas about such things that I object to the system; but because the boy has no use or occasion for any knowledge on such subjects. Teach him the language, and very likely, later on, he may, if philologically inclined, find great pleasure in studying the philosophy of it; but don't waste time teaching him what he does not understand, and what would be utterly useless to him if he did. Make him feel how well worth while it is for him to be able to read Latin and Greek, by teaching him to read pleasant and instructive books in those languages. Make him feel that he is getting on—that, as week after week passes, he reads his Latin and Greek more easily. Show him the peculiarities of structure where doing so will help to make his reading come easy to him. If he shows interest in such matters, tell him (but don't make him learn by rote) about these peculiarities and their significance. But above all, make the task of learning the language as easy as possible to him; make it a pleasure to him, if he is a bright boy—make it as little as possible of a burden to him if he is a dull one. Reward rather him who tries to understand and make progress, than the boy who only cares to learn by rote what he may find in his books.

I learned almost all I know of Latin and Greek away from school and college, using that abomination to the scholastic mind—literal translations. I would read page after page of Latin—Cæsar, Cicero, Virgil, the "Satires" and "Ars Poetica" of Horace; in Greek—Herodotus, Xenophon, Homer, and the like (meaning of like simplicity of construction, eschewing for the time the more difficult writers, as Tacitus in Latin and Thucydides in Greek), with the translations ready for constant use. "The translations are abominable": granted, it is their great merit. Any one who has the least power of appreciating language, feels that he *must*, as quickly as possible, learn to do without their aid. But in the meantime they save the dreary, time-wasting work of turning over dictionaries and lexicons and grammars by giving at once the proper equivalent of each word and the right meaning (however badly expressed) of each sentence. "But this is an exceedingly lazy way of learning," says the schoolmaster. Awfully lazy, if you take only your thirty or forty lines; but quite the other way if you take ten or twenty pages. "The memory is not sufficiently exerted." Certainly it is not, if the learner is content to leave it unused; but if, after reading ten or twenty pages in this way, he reads them over again in the original, once and again, until, without the translation, he can follow the whole passage as Virgil or Homer wrote it, his memory will be sufficiently exerted.

He will have learned something too besides the meaning of so much Latin or Greek; he will have read and enjoyed a noble passage (I care not where he has been reading). Can any schoolboy, or man who has been a schoolboy, and even a successful one, say truthfully that he ever enjoyed the thirty or forty lines over which he had plodded with grammar and dictionary?

But as this sort of work continues, the student finds that the language itself has an interest for him. He feels that it is worth while to learn something about the grammar and structure of the language,—not the absurd things taught in schoolbooks, or not in the same absurd way, but intelligently. Of course, he will early have learned the rules for declining and conjugating—not feebly getting up declensions and conjugations by rote—but noting how the different forms of declensions and conjugations compare with each other, and with those in his own language, where such forms exist. This should at first be rather reading up than learning. Then the rules of syntax come to be considered. The schoolboy gains nothing by learning syntax rules by rote, whether they are like or unlike those in his own language; but one who has noticed or been told that as in English, so in Latin, the verb must agree in number and person with its nominative, or that the same holds in Greek except in the case of neuter plurals, has learned what is useful and interesting to him; while he is equally interested when he notes divergencies, as for instance the way in which particular cases are "ruled" in Latin or in Greek. The more he reads in either language, the readier he will be to note, and noting, to be interested by, the rules of grammar and construction. Of course, if he wants to *write* Latin or Greek, he must pay more particular attention to such matters; but not one man in ten thousand wants to write in a dead language—except to obtain marks in a competitive examination, and I am not writing for these (they must work according to the conditions of such examinations, conditions devised by those who have devised the utterly ineffective and time-wasting methods I have dealt with).

We come next to the Hamiltonian method.

(To be continued.)

The Electric Light.—A list of towns for which application to the Board of Trade for Provisional Orders empowering the applicants to provide electric light installations, has been prepared by the manager of the South-Eastern Brush Electric Light Company; 152 applications have been made, of which 51 are by the various Brush companies, 38 by other companies, and 63 by local authorities.

"The heart is a wonderful piece of mechanism," says Dr. Kronecker, "not merely because of the great force which it displays, or on account of the very perfect system of valves that it possesses, but also because it is able to go to work almost instantly as soon as it is fed, and because it utilises to the fullest extent, in the most economical manner, the force at its disposal. As soon as the liquid that it is expected to pump is withdrawn, it stops work entirely, and does not consume itself doing useless work, but keeps in good condition for a long time. When the heart works, it always works with its full strength and with suitable velocity; it is not at all affected by changes in the amount of stimulation it receives, and this is essential to its power of moving comparatively heavy burdens with constant uniformity. Under conditions that hasten the decomposition of food (such as heat), the mobility of its parts increases; under external conditions which retard the change (as cold), it moves more slowly."

THE CORSET AS AN AID TO BEAUTY.

By Richard A. Proctor.

(Continued from page 430.)

I APPROACH a difficult question, though not a doubtful one. Who shall by argument depose false tastes? And who can deny what "An Observer" has told us, that the recognition of something beautiful (Heaven knows what) in a pinched waist, has prevailed very widely and very long? "'Tis true 'tis pity; pity 'tis 'tis true." There can be no manner of doubt as to the just proportions (with a certain limited range of variation) of the human frame, masculine or feminine. Not Art has settled that, though Art assents, but Nature. I do not say that when wild in woods the noble (but generally beastly) savage runs, he or his "squaw," or "gin," or whatever he pleases to call the woman of his race, presents the perfect type of human beauty. The savage manner of life prevents this, save in a few very exceptional cases. Your average savage is apt to be lank and ill-shaped—especially about the calves; his body is as coarse in type as his face. Still, even among savages of certain races the typical form of human beauty is occasionally approached. You see the man with well-knit and fully-developed muscles, moderately-sized hands and feet, narrow flanks, chest deep and broad, the surface of the abdomen nearly straight from the chest downwards, but with that slightly greater curve from side to side (leaving depressions along either side of it) which the corset ruthlessly squeezes into the ridiculous circular waist of the stayed ones. Savage women, even of the families of the chiefs, are usually, for at least the greater part of their lives, still less shapely than their generally brutal lords (so astoundingly remote—are they not?—from any of the animals to which Darwin says they are akin). Treated in many cases as cattle, they do not develop into the graceful, lissome forms which the artist admires. Yet, even in their case, among some races and in special instances, we find the artistic idea of feminine beauty approached during the short—usually the very short—time that the women of savage races are in fully developed womanhood, but as yet not mothers of baby savages.

But it is not among savages, any more than it is among highly-civilised races, that we must look for beautiful and shapely forms;—observe, *not* for ideal beauty, which is not what we are inquiring about, but for those proportions which are developed in the healthiest, and strongest, and best representatives of a race, under the most favourable conditions, and during the stage of life at which the kind of beauty we are considering can alone be looked for: from early youth (boyhood past) to the prime of manhood in men; from the end of girlhood to a few years only beyond the time of first motherhood in women. There is an intermediate stage in the development of a race as there is in the lifetime of each member of the race, when the greatest physical beauty and grace are attained. This stage is that period of early civilisation, when as yet the natural has not been wholly absorbed in the artificial. Taking that stage of the development of the race which stands first for beauty of form as well as feature—the ancient Greek race—we find the type which the greatest sculptors the world has known—Greek, Roman, and modern—have delighted to represent. The Greeks in particular selected as their models (though not in our modern sense) men and women, youths and maidens, whose beauty of form was the result of adequate exercise (with little encumbrance of clothing), modelling forms belonging already to the best types. They show us, first, what Nature has selected as shapeliest, and next what the

The Apollo Belvidere.

The Diana of the Louvre.

artistic mind at the time when art was at its highest approved as most beautiful. That the proportions of the human body (naturally developed) in other races, or even in the present descendants of the Greek race, may be somewhat different, and still be beautiful, may be admitted. That Phidias and Praxiteles, if they lived now, still possessing all that observation had taught them in their own time, but with the power of comparing therewith other forms than those they studied, might slightly modify their views as to the most perfect type of manly and womanly beauty, may readily be granted. There is a range of variation within which perfect ideal beauty exists. (I do not use the word *perfect* carelessly, but mean it in its full sense. For, as there is no law of beauty which assigns a certain exact number of inches in height to man or woman, so is there none which assigns exact relative dimensions to neck and limbs.) We may even go a little further, and admit that a sculptor of the palmiest days of Greek art might be ready to acknowledge, *now*, that some of his conceptions of ideal beauty admitted of improvement; that, for instance, an Apollo or a Venus of his (a Phœbus or an Aphrodite, I should say), might have gained in delicacy and beauty had her hands and feet, wrists and ankles, been slightly smaller in proportion. He would have ridiculed, doubtless, the idea that the smaller the hands or the feet, the more beautiful they are; and he would certainly have recognised in the very smallness of the hands and feet of many beautiful women of our western races (especially in America) a defect instead of an excellence; still, he might have admitted that without appreciating these artistically imperfect forms (no more beautiful than a wizened arm is beautiful) the goddess of Melos, and the fair statues of Aphrodite, Artemis, Hebe, Phœbus, and so forth, might have had rather smaller hands and feet with gain rather than loss of beauty. He might even have admitted, though I think it doubtful, that waists somewhat smaller than those regarded as most beautiful in his day, might be as shapely, at least for certain types of masculine or of feminine beauty.

But these are questions of proportion, and even these changes or varieties can only be considered by an artist as admissible within certain limits. If a Greek or Roman sculptor had been asked to take two such forms—masculine or feminine—as are shown in the Apollo Belvidere and the Diana of the Louvre, and without altering other dimensions, to modify the waist measurement, so as to correspond to what many women and a few men try to attain by the use of corsets, he would have judged the task hopeless. With all his skill he could not have given beauty to a nude Aphrodite, representing a woman 5 ft. 4 in. in height and 18 in. round the waist. He might have made a quaintly effective statue, but it would have been in his eyes only a Grotesque.

Yet that would be a mere nothing to the attempt to model a statue from a corset-marred woman of the height and waist measurement just mentioned. The ancient sculptor's work, though grotesque, would represent a human being as Nature might fashion one, who does not give to all animals perfection of proportion. The corset-spoiled waist does not err in being out of proportion, but in being deformed. It is not merely the ellipticity of the natural waist that is wanting, but all the curves which a well-shaped waist possesses. A perfectly-formed waist, of man or woman—as for instance, the waist shown in

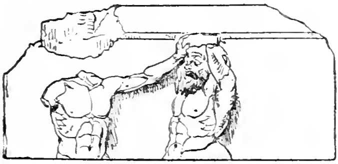


Fig. 1.

Fig. 1 (not the centaur's), and the waist of the Apollo Belvidere (which is, however, somewhat feminine in type) may be compared to perfect music, so beautifully are its proportions harmonised; a grotesque waist, such as I imagined above, might give pleasure like a quaint and fanciful air; but a corset-made waist is sheer discord to the artistic mind. Like the crushed foot of the Chinese lady, the compressed head of the savage, pierced lips and nostrils (aye, and pierced ears, too, fair ladies), the waist made by stays is not ill-proportioned, it is malformed. Yet even the waist thus distorted—the waist made by stays—is not so hideous as the waist when actually in its corset enclosure. For enfeebled though the stays-pinched woman is about the waist, she can still bend her waist a little when the stays are removed. The movement is of course ungraceful: there are no gentle curvings and undulations, as when an undeformed woman bends her shapely waist; but still there is a possibility of bending. With a well-tautened corset there is none; when the waist moves it moves all in one piece. The wearer may walk or even run (at her proper peril), or dance, or ride; the trunk, as a whole, may move in a variety of ways, just as the arm may, if you put it in splints; but there is no more possibility of curving the trunk between the hips and the chest than there is of bending an arm at the elbow when it is in splints from shoulder to wrist. Yet Nature probably did not provide abdominal and lumbar muscles for nothing, any more than she fashioned elbow and knee joints to no purpose.

(To be continued.)

New Company.—The prospectus of the Patent Electric Gas Igniting Company (Limited) has been issued. The Company proposes to light gas by means of a spark from an induction coil. This is comparatively a very ancient idea, and for some application of it the Company is to pay a sum of £75,000, £29,920 in cash and £45,080 in shares, the total capital being £100,000. We refrain from commenting on a scheme which looks for a large profit on so small an available capital.

THE GREAT SUN-SPOT.

We give the accompanying for comparison with our less satisfactory view, see page 431.

Great Sun-spot, Nov. 19, 12.

(J. W. Ward, Belfast, 4·3 in. Wray equatorial, Hughⁿ., power 113. Hodgson prism single surface reflection used.)

The spot at this time was decidedly of a *cyclonic* appearance, a huge forked tongue lying *spirally* over the umbra, and all round the larger spot there were shelving "tongues" distinctly seen projected into the blacker umbra.

"OUR BODIES:"

SHORT PAPERS ON PHYSIOLOGY.

No. 1.—BONES.

By Dr. Andrew Wilson, F.R.S.E.

If there is any one part of the human frame which more than another appears to be dead and lifeless in its character, that part is the skeleton. We are apt to translate our ideas of what a *living* bone should be, from that which a *dead* bone is—hard, firm, dense, unyielding, and, above all, lifeless, material. Now this is very far indeed from the true state of matters. The physiologist tells us that bone is not merely a thoroughly living tissue, but that it is literally living in all its parts. Furthermore, a little reflection will teach us that as bones have to grow, they must needs do so by processes similar to those through which other parts of the human frame increase. If we cut a bone it bleeds; and this fact alone shows us how plentifully bone is supplied with blood-vessels, carrying the nutrient fluid for its repair and growth. Again, there was a period in our individual history when bone was not. Bone must, therefore, have been formed as other tissues grow, and must have exhibited all that vitality which marks the production and development of the varied belongings of our frames.

Let us suppose that we cut across a long bone, such as the thigh bone, or any bone of the arm itself. In the hollow interior of the bone, we find *marrow* when the bone is examined in the fresh condition. The bone itself is very dense and thick towards the outside layer, but of more open structure as we approach the inner layers. Outside the bone, and adhering very closely to it, is a tough layer known as the *periosteum*. There is no doubt that this layer has much to do with the repair of bones when they are broken or injured, and, for one thing, it supports the bloodvessels which enter the bone and which nourish it.

To properly understand what bone is, we must appeal to the microscope. A thin cross-section of bone, ground down till it becomes so transparent that we can reflect the light through it, is placed under the object-glass of the microscope. Regarding this view of bone attentively, we see the following things: firstly, a number of round spaces. These are the ends of tubes or canals cut across. They are named *Haversian canals* (after Clopton Havers, their discoverer), and in the living state contain the larger bloodvessels of the bone. Secondly, around these *Haversian canals* we note a series of irregularly-shaped spaces

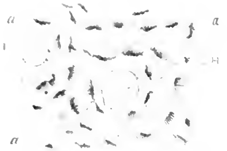


Fig. A.—A transverse section of bone in the neighbourhood of two Haversian canals, *H, H*; *a* lacunæ. Magnified about 250 diameters.

arranged in concentric circles. These spaces are called *lacunæ*. Thirdly, leading from one *lacuna* to another, and also connecting the *lacunæ* with the Haversian canals, are a number of fine lines, which are, in reality, channels.

Fig. B.—Lacunæ, *a*, and canaliculi, *b*. Magnified about 600 diameters.

These are called *canaliculi*. The *lacunæ* measure about the eighteen hundredth part of an inch in length, and the *canaliculi* a fifteen thousandth of an inch in diameter. If we imagine the *lacunæ* to be a series of lakes, the *canaliculi* will represent small rivers which connect the lake-systems. Between the lakes and their rivulets is the mineral substance of the bone, chiefly consisting of *phosphate of lime*. Now, what, it may be asked, do the *lacunæ* and *canaliculi* contain in a living bone? The Haversian canals we have seen to protect the bloodvessels which nourish the bone. The *lacunæ* contain each a small mass of living *protoplasm*—the universal matter of life—forming the *bone cell*. From each bone-cell, lodged in its *lacuna*, there passes along the *canaliculi* fine threads or processes of this jelly-like protoplasm. Thus the protoplasm of one *lacuna* is brought into connection with that of the other spaces; and the whole living substance of the bone forms a continuous meshwork of minute cells and fine fibres. Little wonder is it that, thus filled with living material, bone should demand a rich supply of nourishment in the shape of blood.

Bone, when analysed, is found to consist of an *animal* part and a *mineral* part. The animal part consists chiefly of *gelatine*. The mineral part is largely *phosphate of lime*, or bone-earth, with a little *chalk* (*carbonate of lime*) and other minerals. We learn from this fact how important for the young and growing body it must be to obtain in the food a due supply of bone-forming materials. From bread, porridge, water, and like foods we obtain the minerals necessary for bone growth. Rickety children have bones in which the process of nourishment has not been duly carried out, and hence arises the deformities to which these children are so liable. In early life the bones contain a larger proportion of animal matter than in old age, when they become brittle and easily broken from excess of the mineral constituents. If we soak a bone in a weak acid, the acid removes the mineral part, and leaves the animal part untouched, the bone retaining its shape, but becoming lithe and flexible.

"How and from what is bone developed?" is a question of much interest. The *long* bones of our bodies are "laid down," so to speak, in *gristle* or *cartilage* as their foundation. The *flat* bones, such as those of the skull, are formed from *fibrous membrane*. Cartilage, which is the *matrix* or "mother-tissue" of long bones, consists essentially of minute cells, set in a structureless layer. Where bone is to be formed, these cells arrange themselves in long, parallel rows, and multiply rapidly in numbers. Then comes the process of *calcification*, or that by which the living matter, derived from the blood, is thrown in amongst the cells, and invades the cartilage. Thus lime is provided for the formation of the bone. The further changes which take place in the growth of the bone, consist in the formation of a thin layer of spongy bone, which consists of *bone-cells* containing living protoplasm, and which has been produced by the under surface of the *periosteum*, or layer covering the bone. These bone-cells in turn develop lime around themselves, so that naturally, a ring or circle of these bone-cells will form a layer of bone, embedded in which we find the living protoplasm in spaces which will become the *lacunæ* of the full-grown bone. The spaces in the centre of the circles of bone-cells will become in like manner the *Haversian canals* of the adult bone. Meanwhile, outside the bone, the *periosteum* continues its work of bone-formation, the thickness of the bone being thus ensured and increased; whilst later on, the *lacunæ* or spaces which are set widely apart in the young bone appear more closely set, owing to the growth which fills up the interspaces, and which adds to the solidity of the structure.

Bones begin to grow usually at several points in their substances. These points are the "ossifying centres." For instance, a long bone, like the thigh bone, begins existence as a mere rod of gristle, and ends it as a dense solid bone: its growth having taken place from three "centres"—one in the shaft or column of the bone, and one for each end thereof. When it grows in length, the increase takes place at each end of the shaft; for if two pins be placed a little way apart in a growing bone, the distance between them does not increase, whilst the bone itself extends in length. Removal of the end of a growing bone destroys its further increase.

Lastly, we should note how the whole process of bone-growth is one dependent on the living protoplasm of which the *bone-cells* are composed. Later on, we shall see how the entire life of man—and necessarily that of other animals—may be truly described as the cumulative result of the growth and work of these minute living structures. And no more wonderful thought can be impressed on the mind than that which shows us that, after all, human life, as we know it, represents merely the activity of those minute units which only the higher powers of the microscope reveal to our understanding.

Telephone Wires in Birmingham.—The Telephone Company in Birmingham are negotiating with the Corporation for the laying of some of their lines underground. The work will be begun by placing underground the wires now crossing Stephenson place.

VENUS IN TRANSIT.

It has been noticed that when nearly the whole of the disc of Venus is in the sun's face, the part of her outline which is still outside the sun is surrounded by a fine thread-like arc of light—light so bright that it is manifestly not merely reflected sunlight, but sunlight itself. It is so bright that in the mere instant of time during which the photographic plate is exposed in taking solar photographs this arc of light not only had time to record itself, but even to record itself with an obvious increase of width due to over-exposure. It was then sunlight brought into view round the convexity of Venus's globe by the bending power of the planet's atmosphere. This observation is well worth repeating, and that fine arc of light is well worth studying with the spectroscope, for such a thread-like line of light would tell the story of the atmosphere through which it had passed in a most effective fashion. No slit would be required for the sifting of the solar rays, seeing that the line of light must be as fine as the finest slit would make it. Its breadth is, in fact, no other than that of the atmosphere of Venus, seen at a distance of some twenty-six millions of miles, and the part of that atmosphere effective in bending the sun's rays cannot be deeper than twenty or thirty miles, a thickness which at that enormous distance is practically evanescent. The other peculiarity, which is worthy of careful study, is the ring of light seen round Venus when she is on the disc of sun. It is commonly stated that this ring of light is brighter than the background—the solar photosphere—on which it is seen; but this, it need hardly be said, is absolutely impossible. Mr. Brett, the artist whose imagination enclosed Venus in a glass envelope, showed how, in his opinion, the brightness of sunlight, coming through the vitreous atmosphere, might be strengthened by internal reflection, and so forth, until it was brighter than its source. But although this idea is of course utterly inconsistent with optical laws, about which, unfortunately, many excellent painters know very little, the seeming brightness of this arc of light is very well worth studying. It is an optical illusion, no doubt, but an optical illusion often leads the way to the knowledge of a very real physical law. Moreover, by interpreting optical illusions, we learn how, in future, illusions of the same sort may be prevented from misleading us.

But now it may be asked how the science of astronomy is to be benefited by that which, after all, must be regarded as the most interesting matter associated with the observations of Venus in transit—the determination of the sun's distance? Newton used to say that, so far as the law of gravitation is concerned, it matters nothing whether the sun is a hundred millions of miles away, or a thousand millions, or only one million. All the movements within the solar system would take place in just the same manner whether the sun were near or far off, or rather (for that is the real question at issue) whatever the dimensions of the solar system. Precisely as a clock's hands may be shortened or lengthened, and yet show time as well as before, so our ideas as to the dimensions of the solar system may vary without the slightest change in our ideas as to the movements within the system, or as to the law on which those movements depend. All this is true so far as mere motion is concerned—the kinetics of the solar system would not be changed in the least by a change doubling or halving our estimate of the sun's distance. But it is different with the physics of the solar system. Any change in our estimate of the sun's distance involves a change in our estimate of his physical power, his might as ruler of the solar system, his capacity as the source of all the supplies of light and heat by which it is nourished, the time during which these forms of energy can be supplied, the scale on which those mighty processes take place, whose existence we infer from spots and faculæ, cyclonic storms, eruptive prominences, and even, in all probability, in the changes affecting the solar corona itself.—*Standard.*

EARTHQUAKES IN HEREFORDSHIRE.

By T. W. Webb.

May I beg permission to add a few particulars to your truly remarkable account of the earthquake felt in Herefordshire in the early morning of Oct. 6, 1863. My parish of Hardwick lies between the upper end of the Golden Valley, to which you have referred, and the town of Hay, and many of us heard the roar and felt the concussion with the greatest distinctness. One cottager compared its approach to the sound of a carriage rolling over boards, and when it came up it rattled the tiles on the roof progressively, as far as I recollect, from one end to the other, which, if his impression was correct, would bring it from the west. Feeling a great interest in such phenomena, and never having witnessed one, I thought myself very unfortunate on the occasion. During the first half of the night I had been examining nebulæ and other faint objects with my 5½-inch object-glass, and with some success. I had made out for the first time the longer of Bond's canals in the great Andromeda nebulæ, and had readily detected the nebula in the Pleiades, and had perceived Otto Struve's Pons Schroteri in the nebula of Orion. The increase, however, of moonlight and cold induced me to discontinue my employment a short time—perhaps three-quarters of an hour—before the arrival of the shock, which I should otherwise have had such an admirable opportunity of observing. As it was, I was partially roused from my first sleep by a concussion which rattled violently the doors of a locked wardrobe, and probably the pictures on the walls, but passed away leaving me too drowsy to think of anything more than a furious gust of wind, which I had forgotten on awaking next morning. The servants, however, felt their beds lifted up. The only remaining evidence in my house was the throwing on the ground of a small unframed picture that stood upright against a wall; but the chimney of an old cottage about a mile distant was believed to have been cracked at that time. But I think it was more extensive than is intimated in the account you have given. It was felt at Liverpool, and announced the previous evening, unless my memory deceives me, by the singular movements of some linen hanging on a line. At Cheltenham, where my wife was then staying, its effects were not less marked than in the distant valley of the Wye and Monnow. It awoke her roughly from sleep; the sound, as she described it, resembled that of great rocks falling one over another into a deep chasm; everything in the room was shaken: the Venetian blinds quivered; and the night-light was extinguished. Several persons were made ill. One of them, a respectable tradesman, described the sensation as that of being heaved up from beneath in bed, and having a light in the room he saw the books on a partially-filled shelf tilted from side to side. A baby was rolled out of its cot; and a policeman stated that he could see the undulation of the houses in the moonlight, and was obliged to steady himself by holding on to a lamp post.

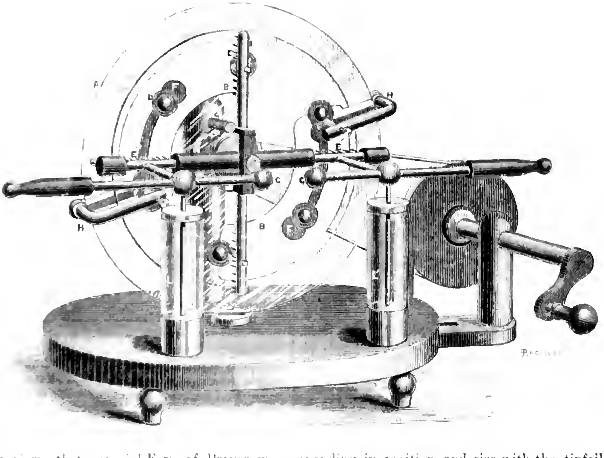
Since that time we have felt two distinct shocks at my house, though of less severity. In the former instance a little dog leaped in terror from a lady's lap, though none of the party in the room felt any shock, and the sound was ascribed to a passing vehicle: a candlestick, however, was jarred on the kitchen-table. In the other case the sound, which was like that of a train some miles away, was supposed by me to be distant thunder, till it seemed to reach the room where I was, and gave a snap to a very hard window fastening, which at once convinced me of the nature of the occurrence, though I was taken too much by surprise to notice what shock there might have been; it was felt, however, by my wife in another room; and I noticed how the pheasants in the woods immediately began to crow in terror.

I have many times felt slight tremors and jarrings, especially in bed, which I think were not illusory, and which lead me to suppose, independently of the curious experiments of M. d'Abbadie and others, that the surface of the earth is less stable than we are apt to imagine.

The earthquake in the time of Queen Elizabeth (1580) caused so much alarm that a special Form of Prayer was prepared on the occasion, and a "Report" of it seems to have been put forth by authority, both of which may be found in Clay's "Elizabethan Liturgies," a work to which I have not at present access.

THE VOSS INDUCTION MACHINE.

THE hold which telephony, electric lighting, and such like applications of electricity have made upon the public mind during the past three or four years is so much greater that progress in other branches of the science has little prospect of receiving a fair share of attention. The Voss machine is in this unfavourable position, for, while it is one of the greatest improvements of the day, it has not until recently met with that attention to which it is so justly entitled. It is represented in the accompanying illustration, from which it will be seen that the apparatus consists, like the Holtz machine, of two glass discs, unequal in diameter, of which the larger, A, is held in a fixed position, while the other is mounted upon a horizontal axis, and can, by means of multiplying gear (seen to the right of the figure) be rotated at a high velocity in front of the fixed disc and in a plane parallel to it. To the back face of the larger plate are attached two pairs of tinfoil discs, F F, F F, each pair being connected together by a strip of tinfoil, and by a second strip to one of the two bent arms H and H, by which they are connected to a light metallic brush directed towards the front face of the rotating plate. Over the tinfoil are pasted two paper coatings, which correspond to what used to be called the paper "armatures" in the Holtz machines. To the face of the rotating plate are attached, at equal angular distances apart of 60 deg., and at a short distance from the circumference, six discs of tinfoil (one of which is marked D in the figure), about an inch in diameter, corre-

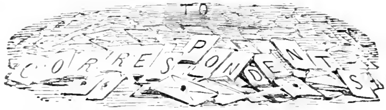


sponding in position and size with the tinfoil discs upon the fixed plate—that is to say, if the discs (D) were numbered in rotation, 1, 2, 3, 4, 5, and 6, those numbered 1 and 2 would, in a certain position of the rotating plate, correspond and be opposite to one connected pair of discs on the fixed plate. Nos. 4 and 5 would similarly correspond to the other pair, and Nos. 3 and 6 would have no discs on the fixed plate opposite to them. To each of the little tinfoil discs on the rotating plate is attached a metallic button of the form of a plano-convex lens, and these buttons, in the revolution of the plate, pass under and are lightly touched by the metallic brushes (F F), which are held by the bent arms (H H), the brushes being so adjusted as only to touch the buttons, and not to come in contact with the glass of the rotating plate to which they are attached. E' and E' are two horizontal collecting combs, insulated from one another by being attached to a horizontal bar of ebonite, but connected respectively to the two discharge terminals (C and G) in the front of the instrument by the horizontal bars shown in the figure, and the distance between these terminals can be varied at pleasure by sliding them through the balls which are attached to the inner coatings of the two cylindrical Leyden jars by which the charge is accumulated and the discharge intensified. E is a vertical bar of brass, carrying at each end a comb, directed towards the rotating plate, as well as a pair of metallic brushes similar to F and F, and which also in their turn make momentary contact with the metallic buttons as they pass beneath them.

The machine is a step far in advance of anything previously produced, although it is somewhat similar in principle to Varley's electrostatic inductive multiplier.

A small initial charge is imparted to the machine in some as yet undetermined way. It may be due to the friction of the metallic brushes with the studs or buttons; or, on the other hand, it is possible that the various parts of the machine before starting are in slightly different electrical conditions. Whichever of these hypotheses is correct, a small charge of, we will say positive, electricity collects on one of the pairs of discs, on the fixed plate, and from this, as a nucleus, brilliant discharges may be obtained. To analyse the action of the machine, we will assume that we start with a stud, as being typical of the others, immediately after it has passed the bent arm, H, on the left, and that the corresponding side of the fixed plate has the small positive charge above referred to. As the stud passes before the charged disc, electricity is induced on it, the inner surface becoming negative, the outer receiving a positive charge, which is collected by the horizontal comb E', and passes thence along the brass rods to the discharge terminal, C, and the inner coating of the Leyden jar, L. The stud, in revolving, undergoes further induction, and on arriving at the vertical comb, E (really not quite vertical, but opposite the end of the paper), a further withdrawal of positive electricity takes place; a considerable negative charge, therefore, remaining. This the stud carries round till it meets the brush of the bent arm on the right side of the machine. By this means, a negative charge is communicated to the pair of discs on the right half of the fixed plate, the stud at the same time becoming neutralised. It is then re-excited in an exactly opposite manner to that previously observed, negative being imparted to the horizontal comb, E', and Leyden Jar, L', and likewise to the lower of the two vertical combs. A positive charge is collected by the bent arm, H, on the left, thereby increasing the charge already collected on the corresponding pair of discs. This action continuing, a large charge accumulates on the fixed plate. It follows that if, by means of the electricity collected through the bent arms, we increase the inducing charges on the fixed discs, we shall obtain proportionately increased charges in the horizontal collecting-combs. Assuming that the discharging terminals (C G) are in contact, there will obviously be an almost constant flow of positive electricity in one direction and of negative in the other. If, a few seconds after the working commences, we separate the discharging terminals, a stream of sparks may be obtained. The function of the vertical combs is, as may be gathered from the above, an important one, their duty being to relieve the studs of the free electricity induced in them as they pass from the horizontal combs towards the vertical.

Very little labour is required to work the machine, owing mainly to the fact that practically none of the electricity is generated by friction, the small amount of work performed in turning the plate being almost entirely converted into induced electricity. The machine works well in any atmosphere, hot or cold, wet or dry—a very important point, considering the effect usually produced by the humidity of the air. Every lecturer or student of electrical science knows how difficult it is to generate static electricity by the ordinary frictional machine when a few persons are present in the room. As the result of considerable experience with the Voss, we can confidently say that such difficulties need never be apprehended, while a flow of sparks, 4 in. or more in length, can be relied upon from a machine weighing less than 7 lb., and with a rotating plate $10\frac{1}{4}$ in. in diameter. All the ordinary experiments of static electricity can, of course, be performed, and we are rarely able to so confidently recommend a commodity as we can the Voss machine to all who desire to perform electrical experiments with a minimum amount of trouble and at a moment's notice. The machine is comparatively a cheap one, and the English agents, Messrs. F. E. Becker & Co., of Maiden-lane, Covent-garden, are now manufacturing it in large numbers.



Letters to the Editor.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to, delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

"Let Knowledge grow from more to more."—Alfred Tennyson.

SATURN'S RING.

[656]—It may not be amiss to rectify a mistaken assumption of Captain Noble, in his letter printed at p. 329 of Knowledge. The "person to whom notice was sent hereof" was not Wallis, but Sir Robert Moray—first President of the Royal Society. This appears from William Balle's letter to Oldenburg, dated April 14, 1666, in which he asks whether Sir R. Moray has communicated his observation of the previous autumn.

I notice that throughout the correspondence in Knowledge the place where Balle made his observations is printed Mainhead. This is doubtless due to the mis-spelling in "Phil. Trans." It should be Mamhead. There are two letters from Balle in the archives of the Royal Society—both (as may be seen by the published "Catalogue of the MS. letters in the possession of the Royal Society") dated from Mamhead. The only instance in which the name is written "Mainhead" is on a cutting attached by sealing-wax to the fly-leaf of the first letter, but it is doubtful whether this is in Balle's writing.

It may interest your readers to know that there is a postscript at the end of Balle's letter of April 14, 1666, containing another figure of Saturn. This figure has a dotted line across the sphere indicating the shadow of the ring, but the ring itself shows no vestige of any dividing line. This observation, however, was made only with a twelve-foot glass. Herbert Rix.

Science Club, Savile-row, W.

BRAIN TROUBLES.

[657]—May I add a quota to the singular experiences of this kind? I write a good deal by fits and starts. At intervals not very frequent I catch myself omitting the *first letter* of some words! As far as I have casually observed, the graphical objection is at [illegible]. Not thrice a year, perhaps, does this happen; but, when it does occur, I have occasionally to re-write a note in

[illegible] To have to write one note on a subject is sometimes a [illegible] the nuisance is simply torture. My [illegible] goes in for a *d* instead of a *t*. [illegible] the cause of this. For my own part [illegible] think about it. The brain can scarcely [illegible] graphic confusion. Perhaps it is general. [illegible]

T. A. R.

[illegible] myself very apt to omit the last letter of a word [illegible] as a strong letter in the next; thus, if [illegible] "he had made," to write "he ha made." [illegible] the mistake, however, before I have finished [illegible] whose last letter has been omitted. When I was at [illegible] school I often wrote, in hurried work, "g" for "d," as "and" for "and." I find myself occasionally making this mistake [illegible] surprises me, oftener with the type-writer than with the pen.

R. A. P.]

[illegible] May I add my little experience of "Brain Trouble" to [illegible] When tired or worried, I find the most [illegible] sentences, or rather strings of words without the [illegible] chasing each other through my brain with [illegible] rapidity and persistence. The combination of words [illegible] I often wish to remember some of them, [illegible] they are gone as rapidly as they come. At first it used to [illegible] but now it rather amuses me to (as it were) listen to [illegible] my own head, which I am powerless to stop. It [illegible] in a bad nervous headache, unless I can sleep it off. The words which most frequently recur, and which I begin to watch for, are "[illegible]" (?), "caterpillars," and "the old man with the wooden spoon." I cannot at all account for their frequency.

M. G.

ELECTRICITY IN DENTISTRY.

[illegible]—I observe in a recent number of Knowledge, what appears to be a reply to the inquiry of a correspondent under the [illegible] whether the shock of a galvanic coil might not be [illegible] to deaden the pain of tooth extraction. Your reply [illegible] to the idea, but as I happen to have had practical [illegible] of its utility, I will proceed, with your permission, to [illegible] I know on the subject.

[illegible] at Cork, about twenty years ago, I had occasion [illegible] a back tooth extracted which was aching, [illegible] any one in particular. I called on the first I came [illegible] I have quite forgotten, and can now only recollect [illegible] south side of the South Mall. When I was [illegible] he told me that he made use of a [illegible] to deaden the pain of extraction. To the best of [illegible] in my hand one pole of a coil machine, while [illegible] connection with the extracting forceps, and I well [illegible] passage of the current, which was very slight, ca[illegible] the tooth, which almost entirely overcame [illegible] a dabbler myself in electricity, I got [illegible] him, and examined his battery, which, I [illegible] "Smee," and he told me that he always [illegible] never had any difficulty with patients since he [illegible]

[illegible] his method of extraction, and as I [illegible] lost sight of him. I never met with [illegible] method of extraction before or since; [illegible] my experience may elicit some [illegible] subject.

Thos. C. Haines.

[illegible] 1882.

[illegible] The "shock" were evidently very feeble [illegible] be glad to hear more on the subject.—Ed.]

SUGAR AND THE TEETH.

[illegible] correspondent, letter 607, page 361, Vol. [illegible] process of refining, sugar is treated with [illegible] hurtful to the teeth. The [illegible] would have the most effect on [illegible]

H. Zocchero.

Answers to Correspondents.

This section is limited to one column as the maximum. Only a small proportion of letters received can, therefore, be answered here. Many not answered may nevertheless be noted and acted upon. Letters raising religious, political, or personal questions, asking for text-book information, proposing class-room problems for solution, and so forth, pass at once to a receptacle specially provided for them. A stern and inflexible censor has been specially appointed to stand between a too-yielding Editor and those who thus unreasonably claim his attention and space which should be otherwise occupied. No letters answered through the post.

Anna Byron Dennys. Wheels are very ancient. No one knows when they were first used. We see pictures of them on all the most ancient carvings of all nations.—E. A. Martin, Dr. R. Leigh, An Anxious Mother. Anti-corset articles in type before yours arrived, or would have inserted. You will find your arguments considered, and many others.—J. B. Young notes that Rowney & Co. supply special water-colour paints very suitable for painting on glass.—A. Z. Such spots were visible.—E. Halifax. Best exercise for reasoning powers is, I think, the study of books in which matters scientific, legal, historical, and so forth are ably reasoned. The study of logic seems to impair them.—A Constant Reader and Well-wisher. Expected rather to be sat upon for talking of those howling swells, as if (which is the case) they were just two possibly well-behaved possibly not well-behaved German persons. Certainly cannot be blamed for thinking unduly of Tel-el-Kebir: shades of Marlborough and Wellington defend us!—Hitherto Constant Reader. Your kindly letter noted. Cannot find fault with views once my own. Emotion by no means dead through science; yet reason must be satisfied. Person in question so much better than kinsfolk, that probably even future judgment will be as you say; but one cannot but remember how kinsfolk were applauded in life and utterly scorned (by same persons) when no longer "Founts of Honour."—J. Ballot. Thanks for pleasant letter. All success with your telescope.—Fellside. (1) All in motion. (2) C. G. of universe would not be centre of motion for any star, any more than for earth or moon.—T. Radmore, W. O. Prosser, F. Ebstall, J. N. Morris. Thanks; but sufficient attention given to spot for present.—F. D. Brown. Many thanks.—C. H. W. Hammick. Brave, but not affording special evidence of reasoning. Thanks. S. E. C. Howling papers sent us (marked at howling places) glanced at, W.-P.-basketed, names not noted. Science has nothing to howl at. Consider the tone of Darwin's letter in No. 57; how gentle, considerate, and modest. The last five words present his pure philosophy, "We can do our duty" (not "*Thou* shalt do what *I* consider *thy* duty"). Darwin imagined his correspondent would follow the line usual among gentlemen. Dear me! what could not some of us tell about the views of such men, if we felt free to publish private letters or utterances.—Athropa Gymreig. Seismometer is an instrument for measuring earth tremors. Many kinds exist. No space for description, which would require illustrating; and other subjects intervene.—A. Black. On return to town will ascertain the dif. cal. numbers.—H. B. (1) Not solar system gaseous as a whole, but its several parts. Why does not our air fly off, then? (2) Tresca's experiments require long and careful description. (3) Porous bodies would be soaked as a consequence of pressure. Consider case of block of wood, taken deep under water: pressure forces water in, so that wood never rises to surface unless dragged up. (4.) Apart from absorption by object-glass, you may have the same brilliancy, or less (with magnifying power 200), but never more: same brilliancy if object-glass large enough, viz., 200 times size of eye-pupil, say diameter about 3 inches. (5.) Pancratic eye-piece is one which can be so changed as to vary the power; not useful for sea-side telescopic purposes.—H. B. Shaw. So many such books. See notice at head of this column.—A. E. D. Battue sport (?) absurd, as you say; but hardly in our line.—A. Smith. Can only say the comet affords no just cause for anxiety. It does not seem now likely to return for years; but if it were even absorbed shortly by the sun, it would do no harm, I feel assured.—M. J. Harding. Maps now obtainable, 2d. each.—J. B. R. The theory "bosh." E. Skinner. Letter inserted. The numbers you mention are out of print. Cannot get them myself.—Jas. Graham. Away from my books.—Senex. Theory of tides given in *most* of the books quite wrong. Try Beckett's "Astronomy without Mathematics."—T. G. Elliott. But the earth is *not* elongated from pole to pole.—W. W. W. Know of no good books to meet your case. I only remember two English Grammar rules learned at school, and one of *those* is wrong. Read freely books by good authors.—J. A. L. R. notes that "J.'s" problem is dealt with in Burchett's "Practical Plane Geometry" (W. Collins & Son: London and Glasgow).

Our Mathematical Column.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

No. XV.

WE have next to consider the various methods available for integrating the different expressions which come before us when we apply the methods of the integral calculus.

First some expressions can be integrated at once, because they have been already obtained as the differential coefficients of known functions. For these the following table, which gives all the differential coefficients of simple functions, will be found useful, and should always be held in the student's remembrance. We write $\frac{d}{dx}$ (function of x) for the differential coefficient of the function with respect to x.

	Differential Coefficient.	Deduced Integral.
Since	$\frac{d}{dx}(x^n)=nx^{n-1}$;	$\int x^n dx=\frac{x^{n+1}}{n+1}$
	$\frac{d}{dx}(\log_e x)=\frac{1}{x}$;	$\int\frac{dx}{x}=\log_e x$
	$\frac{d}{dx}(\log_a x)=\frac{1}{x\log_e a}$;	$\int\frac{dx}{x}=\log_e a\,.\,\log_a x=\log_e x$
	$\frac{d}{dx}(e^x)=e^x$;	$\int e^x dx=e^x$
	$\frac{d}{dx}(a^x)=a^x\,.\,\log_e a$;	$\int a^x dx=\frac{a^x}{\log_e a}$
	$\frac{d}{dx}(\sin x)=\cos x$;	$\int\cos x\,dx=\sin x$
	$\frac{d}{dx}(\cos x)=-\sin x$;	$\int\sin x\,dx=-\cos x$
	$\frac{d}{dx}(\tan x)=\frac{1}{\cos^2 x}$;	$\int\frac{dx}{\cos^2 x}=\tan x$
	$\frac{d}{dx}(\cot x)=\frac{-1}{\sin^2 x}$;	$\int\frac{dx}{\sin^2 x}=-\cot x$
	$\frac{d}{dx}(\sec x)=\frac{\sin x}{\cos^2 x}$;	$\int\frac{\sin x\,dx}{\cos^2 x}=\sec x$
	$\frac{d}{dx}(\operatorname{cosec} x)=\frac{-\cos x}{\sin^2 x}$;	$\int\frac{\cos x\,dx}{\sin^2 x}=-\operatorname{cosec} x$
	$\frac{d}{dx}\left(\sin^{-1}\frac{x}{a}\right)=\frac{1}{\sqrt{a^2-x^2}}$;	$\int\frac{dx}{\sqrt{a^2-x^2}}=\sin^{-1}\frac{x}{a}$
	$\frac{d}{dx}\left(\cos^{-1}\frac{x}{a}\right)=-\frac{1}{\sqrt{a^2-x^2}}$;	$\int\frac{dx}{\sqrt{a^2-x^2}}=-\cos^{-1}\frac{x}{a}$
	$\frac{d}{dx}\left(\tan^{-1}\frac{x}{a}\right)=\frac{a}{a^2+x^2}$;	$\int\frac{dx}{a^2+x^2}=\frac{1}{a}\tan^{-1}\frac{x}{a}$
	$\frac{d}{dx}\left(\cot^{-1}\frac{x}{a}\right)=\frac{-a}{a^2+x^2}$;	$\int\frac{dx}{a^2+x^2}=-\frac{1}{a}\cot^{-1}\frac{x}{a}$
	$\frac{d}{dx}\left(\sec^{-1}\frac{x}{a}\right)=\frac{a}{x\sqrt{x^2-a^2}}$;	$\int\frac{dx}{x\sqrt{x^2-a^2}}=\frac{1}{a}\sec^{-1}\frac{x}{a}$
	$\frac{d}{dx}\left(\operatorname{cosec}^{-1}\right)=\frac{-a}{x\sqrt{x^2-a^2}}$;	$\int\frac{dx}{x\sqrt{x^2-a^2}}=-\frac{1}{a}\operatorname{cosec}^{-1}\frac{x}{a}$

The last six relations are, of course, reducible to three only, so far as integration is concerned. Since

$$\sin^{-1}\frac{x}{a}+\cos^{-1}\frac{x}{a}=\tan^{-1}\frac{x}{a}+\cot^{-1}\frac{x}{a}=\sec^{-1}\frac{x}{a}+\operatorname{cosec}^{-1}\frac{x}{a}=\frac{\pi}{2},$$

it is manifest that the second values given respectively to

$$\int\frac{dx}{\sqrt{a^2-x^2}},\quad\int\frac{dx}{a^2+x^2}\quad\text{and}\quad\int\frac{dx}{x\sqrt{x^2-a^2}},$$

differ from the first only by a constant,—to wit, $\frac{\pi}{2}$ in the first of the three cases, and $\frac{\pi}{2a}$ in the other three cases.

Our Chess Column.

By Mephisto.

REPRINTS.

THE following position, sent us by Mr. Pearson, is (probably) the original of Eichstadt's problem. The position is as follows:—
White.—King on QR7, Rook on QKt8, Knights on Q5 and K7.
Black.—King on QR4, Knight on QR7.
White to play and mate in three moves.

The following problem by the late Rev. H. Bolton was sent to us by Mr. Miles:—
White.—King on QB8, Rook on KR5, Bishop on KKt3, Pawns on KKt2, QB4, QR3.
Black.—King on QB3, Pawns on QR5, KKt5.
White to play and mate in four moves.

THE following game was played by Mr. Steinitz, who is now on a visit to Philadelphia:—

STEINITZ GAMBIT.

White. Steinitz.	Black. Capt. Michaelis.	White. Steinitz.	Black. Capt. Michaelis.
1. P to K4	P to K4	13. Q to Q2 (*d*)	Castles (*e*)
2. QKt to B3	QKt to B3 (*a*)	14. B to R6 (ch)	K to Kt sq.
3. P to B4	P takes P	15. KR to K sq.	Q to Q4
4. P to Q4 (*b*)	Q to R5 (ch)	16. QR to B sq.	Kt to B3
5. K to K2	P to QKt3 (*c*)	17. Q to B2 (*f*)	B to Q3
6. Kt to Kt5	B to R3	18. B to QB4	Kt takes P (*g*)
7. P to B4	B takes Kt	19. Q to Q3	Q to KB4 (*h*)
8. P takes B	Q to R4 (ch)	20. B takes B	Q takes Q
9. Kt to B3	Q takes P (ch)	21. B takes Q	Kt takes Kt
0. K to B2	Q to Kt5	22. B tks P(ch(*i*)	K to Kt2
1. P to QR3	Q to K2	23. P takes Kt	R to QB sq.
2. B takes P	Q takes P	24. B to K5 and wins.	

NOTES.

(*a*) We prefer KKt to B3. Also B to B4 leads to an even game.

(*b*) This constitutes the Steinitz gambit. We do not consider it sound play. White thinks to be able to develop by Kt to B3, and then bringing his King to B2.

(*c*) Black must play carefully, as otherwise White will speedily bring his pieces into play, besides having two strong centre Pawns. White also threatens to win the weak KBP. Black's best move at this juncture is 5. P to Q4, which White might follow up by either 6. Kt takes P or 6. P takes P. If 5. $\frac{\quad}{\text{P to Q4}}$ 6. $\frac{\text{Kt takes P}}{\text{B to Kt5 (ch)}}$ 7. $\frac{\text{Kt to B3}}{\text{Castles}}$ 8. $\frac{\text{B takes P}}{\text{Kt to B3}}$, and Black has the advantage, for he will win one of the centre Pawns. 9. Kt takes Kt would be no good, on account of Kt takes P (ch); if P to B3 or B4, then KKt takes P, or if B to Kt3, then Q to R3. Also B takes BP is of no avail, *i.e.*, 9. $\frac{\text{B takes P}}{\text{R takes Kt}}$ 10. $\frac{\text{P takes R}}{\text{KKt takes P}}$ 11. $\frac{\text{B to K5}}{\quad}$ to prevent Kt takes P (ch) or B takes Kt (ch) 11. $\frac{\quad}{\text{Kt takes B}}$ 12. $\frac{\text{P takes Kt}}{\text{B to QB5}}$ (as the White Queen cannot take the Knight, on account of Q to B7 (ch), followed by R to Q sq. winning the Queen) 13. $\frac{\text{Q to K sq.}}{\text{Kt to B5 (ch)}}$ 14. $\frac{\text{K to Q sq.}}{\text{R to Q sq. (ch)}}$ 15. $\frac{\text{B to Q3}}{\text{Kt takes KtP}}$ 16. $\frac{\text{Q takes Q}}{\text{Kt takes Q}}$ 17. $\frac{\text{R to B sq.}}{\text{Kt takes Kt and wins.}}$ If again, in reply to the proposed move of 5. P to Q4, White should play 6. P takes P, the game would proceed thus:—5. $\frac{\quad}{\text{P to Q4}}$ 6. $\frac{\text{P takes P}}{\text{B to Kt5 (ch)}}$ 7. $\frac{\text{Kt to B3}}{\text{Kt to K2}}$ 8. $\frac{\text{P to Q6}}{\text{P takes P}}$ 9. $\frac{\text{B takes P}}{\text{Kt to B4}}$ 10. $\frac{\text{K to Q3}}{\text{Q to R5}}$, and we think Black has no disadvantage.

(*d*) Threatening R to K sq., B takes P would not be good, on account of P to Q3.

(*e*) White has a great facility for deploying his pieces; for that reason Steinitz believes in this risky gambit. Castles has the disadvantage of exposing the King to the attack of the two Bishops, but, as in most of Steinitz's games, although apparently he threatens nothing in particular, yet it is difficult to see what to do. If Q to Q4, then White would obtain a good game by R to B sq., threatening by B to B4, R to K sq., or P to Q5, to bring all his pieces into fine play, and make things in general uncomfortable for Black. Our choice would have been 13. Kt to B3, if now 14. R to K sq., then B to K2. White, of course, will not take the Queen; probably he would play B to KKt5, to which Black's reply would be Q to Q4, but his game would be very difficult.

(*f*) To guard against Kt to K5 (ch) and also with the option of playing P to Kt4 and Kt5.

(*g*) A miscalculation; he ought to have played Q to KR4.

(*h*) Black thought this move saves his piece. White cannot capture the Knight on account of B to B4, or if 20. Q takes Q, then Kt takes Q, but as will be seen White wins.

(*i*) This is the flaw. By being able to take this Pawn with a check he wins the Knight.

Sir,—Herewith en[illegible] please find detailed solution of that [illegible] Problem No. 60, by John Simpson, which [illegible] of Knowledge for November 24. I have spent many [illegible] trying to solve this problem, and have at last [illegible] at the correct result. The more I [illegible] beautiful it seems, and one cannot help [illegible] game chess is, and how [illegible] mastery. G. H. Bonner.

SOLUTION OF PROBLEM No. 60.

By John Simpson, p. 424.

1. Kt [illegible] Q8.

[illegible] apparently does not influence the position in [illegible] option of four different moves with his King [illegible] B3, B5, K5, and Q4. Besides this remarkable [illegible] of Black's King, [illegible] has three additional moves [illegible].

We shall now consider the various defences.

(a) 1. K to B3
2. Kt takes P — 2. K to B2 or K4
3. Q [illegible] Kt7 or Q4 mate.

(b) if 1. K to B5
2. KKt [illegible] B3 and Q mates on Q4

(c) if 1. K to K5
2. KKt [illegible] B3 and mates as before.

(d) if 1. K to Q4
2. Q [illegible] K3 — 2. Anything.
3. QKt [illegible] Kt6 mate.

(e) if 1. P to B5
2. KKt [illegible] B5 and mates with Q as in (a)

(f) if 1. P to K4
2. Q [illegible] K3 [illegible] — 2. K to Q3 or B3
3. Q [illegible] K7 mate.

(g) if 1. P to Kt6
2. Q [illegible] K3 [illegible] — 2. K to Q4
3. QKt to Kt6 mate, or
2. K to B3
3. Q to K7 mate.

ANSWERS TO CORRESPONDENTS.

•.• *Please address Chess Editor.*

[illegible] not suitable.

A. W. [illegible] to find no solution of Problem No. 60 in our No. 57. He will be further "shocked" by seeing that his own [illegible] No. 61.

[illegible] solution is wrong.

[illegible] might have sent the first move.

Correct solutions of Problem No. 59 received from J. J. A. [illegible] G. H. Bonner, Henry Planck, R. T. Berrow. No. 61 [illegible] Reynolds, C. Hammick. No. 62, Henry Planck, A. [illegible] Drake, W. H. B. H. No. 64, John Watson, H. Seward. [illegible] Seward.

[illegible] from John Watson (63 and 65), [illegible] Meldrum, W. Kinsey Dover, Schmucke, [illegible]

[illegible] A. M., 63, 4, 5. John O'Keeffe, 63, [illegible] 65. John Simpson, 63, 4, 5. Berrow, 63, 4. [illegible] 61, 2, [illegible] 5. [illegible] 64. T. T. Derrington, T. S. L., 62, Geo. H. [illegible] G. Woodcock, 61, 2, 4, 5.

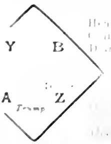
[illegible] B to K6 [illegible] certainly better; but better still is to play [illegible] Q3.

Our Whist Column.

By "Five of Clubs."

PLAYING OUT THE WINNING TRUMP.

The Hands.



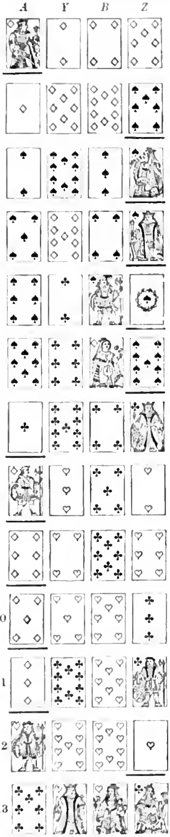
B. Spades—Kn, 4, 3. Hearts—Q, 10, 8, 7. Clubs—8, 5, 4. Diamonds—Q, 10, 4.

Z. [illegible] A, K, Q, 9, 7. [illegible] A, 6, 2. [illegible] K, Q, Kn, 3. Diamonds—7.

[illegible]

THE PLAY.

Note.—The card underlined wins the trick, and card below leads next round.



MR. LEWIS'S NOTES.

1. *A* has no other lead.

2. In this position *Z* should not trump with the penultimate. The latter is the turn-up card, and as *Z* is about to play out his tierce major, it is better if the trumps fall that *Y* should be left in no doubt. As, however, the Eight and the turn-up remain in after the play of the three rounds, *A* may be credited with the Eight, for if *Z* had had the Eight, he ought to have trumped with it. The fall of the Diamonds at trick 2 leaves *Z* in doubt as to whether *Y* or *B* has the Queen, but when at trick four *Y* discards Diamond Nine, he cannot have the Queen, as by discarding the Nine he would be giving up the tenace.

5. *Z* continues the trump to draw two for one.

6. At this point *Z* should have cleared the Club suit. He must make two by cards, even if *B* has Knave and Queen of Diamonds, by refusing to trump, and discarding the two small Hearts. By drawing the last trump before clearing the Clubs, he enables *B* to take advantage of the information *Y* gave him when he discarded the Nine of Diamonds. *B*, therefore, properly discards Diamond Queen, thus leaving *A*, if he has a *rentrée* card, in full possession of the suit.

7. Behold the result! *A* is left with four good Diamonds, and making six tricks, saves the game. If at trick six, instead of drawing the trump, *Z* had played Club King, *A* and *B* could have made but three tricks, Club King, Diamond King, and Diamond Queen; of course *Z* would not have trumped the Diamond Queen. The drawing of the last trump was the more blamable because *Y*, at the fourth trick, had practically told *Z* he could not depend upon him for a trick in the Diamond suit.

Note.—The above is the second of the three interesting games kindly sent to us and annotated by Mr. F. H. Lewis. Apart from the lesson specially conveyed by it, it is specially instructive in showing the advantage of carefully playing bad hands. Both *Y* and *B* have poor hands, and as the game proceeds, it becomes clear to both players that all they can do is to play with careful reference to the indications as to their partner's hands. This they do. *Y* does all in his power to save his partner from the mistake into which nevertheless *Z* falls. As it happens, the enemy gains more than *YZ*, but that is not *Y*'s fault. *B* carefully clears his partner's suit by throwing away the winning Diamond left alone in his hand.

Vacnor.—Whether with weak trumps (not more than three), you should or should not force partner after he has had the lead and refrained from leading trumps, would depend on circumstances. In most cases, *not*. For he is likely enough to have just such strength in trumps as would guard both your hands if he is not forced, but leave you powerless if he is. Yet there are many cases in which it may be better to make a certain trick by forcing, than trust to maintaining trumps against the enemy. The rule, If weak, refrain from forcing partner, is one to which there are many exceptions.—Five of Clubs.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, DECEMBER 22, 1882.

CONTENTS OF No. 60.

Science and Art Gossip.

A CONTEMPORARY takes us to task, though not unkindly, for saying that the death of a novelist is a more serious calamity than many about which more is said. But is it not true? We said in reality the death of such a man, not meaning a novelist specially, because the death of a great historian, dramatist, poet, man of science, actor, singer, and so forth, belongs to the same category—unless death comes in the fulness of a man's years, when all his work has been done. Are there not men much higher in position, whose death causes much more talk, who yet pass away and are not missed at all by the world at large? A great statesman's death may, like Cavour's, be seriously felt by a nation, yet not often. A king dies and another succeeds, the only change generally being that the boot-lickers transfer the virtues of the dead to the living, and suddenly find the dead king was not so very good or great after all. The "first gentleman in Europe" is recognised (first by the dust-swallowers, *always*) as rather low-lived, to say the least of it, while one who had been thought less than little of becomes "our gallant sailor king;" he dies in turn, and a Greville publishes three volumes describing a half-crazed person, father of a large family, yet "no son of his succeeding." But when a Thackeray dies who can replace him, who can even complete his last unfinished work? When even a Garrick dies, it can be truly said that "the gaiety of nations" is eclipsed.

MR. RUSKIN has said that our English middle and lower classes—we are not sure he has not extended the remark to the upper classes—behave like boors, while the peasantry of some continental countries have the bearing of noblemen. It may be true, though possibly he should not have said it. Anyway, mere bearing is not a matter of so much importance as kindliness of heart. We wonder, though, what he would have thought of the bearing (not so much boorish as brutal) of a number of persons, disguised as gentlemen, who proposed to attend his lecture on "Cistercian Architecture" at the London Institution. The lecture-room was full nearly an hour before the lecture began, and many ladies, a few gentlemen, and the persons we refer to, were unable to gain admittance. Three ladies fainted, and an appeal was made to those who stood in the passages to make way while they were carried out. But while the few gentlemen present did all they could to assist these ladies, the more numerous brutes wilfully blocked up the way, which it was easily within their power to have cleared. They also talked and laughed and disturbed the audience so disgracefully, that at last the doorkeepers had to do what (with a knowledge of the ways of this set, they should have done earlier) to close the doors, and deprive the ladies and gentlemen outside of such small satisfaction as they might have had in hearing the lecturer's voice.

DOCTOR HENRY DRAPER'S death has caused much sorrow among his fellow-workers in science in America. That he was not appreciated at his full worth here is shown by the fact that when his name (among the very worthiest) was recommended for an Associateship of the Astronomical Society, it was rejected in favour of some certainly not worthier. It should be known, however, that the opposition came from a *clique* who seem to think that the recognition of skill or success in solar research in any but the high-priest of the sun-spot religion, and still more the admission of a discovery inconsistent with his views, would be most blameworthy.

As with poor Buckle, so with Henry Draper. He sorrowed most in death for the work he had to leave unfinished. "I have fought hard," he said, "but it is of no use: I must go." For many a long day science will feel the premature loss of this zealous worker.

MR. R. H. MUSHENS, Secretary of the Sunderland Provident Dispensary, writes to us that he has submitted to the principal railway companies an Ambulance Emergency Case, "specially designed to meet the requirements of railway accidents," but, as yet, the result has been *nil*. It would be well if a law were passed ruling that in every train three cases containing splints, lint, plaster, sponge, tourniquet, bandages, &c., should be carried (under certain penalties in case any accident occurred, and injured passengers suffered for want of these things). The cost of such cases would be little, their value great.

"THE interviewer," writes Mr. Freeman, in *Longman's Magazine*, "who questions you simply in order to print your answers in a newspaper, is, as far as my experience goes, purely American. The process is not always pleasant; for the questioning consists largely in asking for one's impressions on various American matters, and especially on points of likeness and unlikeness between America and England. It is certainly odd that, when so many American papers are always assuring the world that they do not care for British opinion, they should still be so untiringly anxious to find out what British opinion is. And the questioning on these points sometimes puts one in an unfair dilemma. If one blames anything, one, of course, runs an obvious chance of giving offence. And if one praises anything, one runs the chance of giving offence on the subtler ground of being thought 'condescending' and 'patronising.'"

"ON the whole, I got used to the interviewers," Mr. Freeman proceeds: "and I was specially charmed with the moral portrait of me which was given by one of them at

St. Louis. From him I learned that, when I don't know a thing, I say that I don't know it; and that, when I do know a thing, I speak as if I were quite certain about it. To the interviewer, as I gathered from his report, this way of acting seemed a little strange, though he clearly approved of the eccentricity. To my own mind, the puzzle would be why any man should either pretend to know a thing which he does not know, or pretend not to know a thing which he does know."

In the *Zeitschrift für Analytische Chemie*, Tjaden Modderman remarks that he has for some time been accustomed to prepare pure sulphuric acid by recrystallisation of the hydrate ($H_2SO_4H_2O$), and finds this seldom-adopted method of purification to be really an excellent one. The author has experimented in this way upon acids containing considerable quantities of lead and arsenious and nitric acids, and by protracted recrystallisation has in all cases obtained a pure acid from them. The method is very simple. The acid is mixed with sufficient water, and, in bottles two-thirds full, exposed to the cold in the open air on a frosty night. If the mixture has been properly made, it is generally frozen throughout the next morning. The chief thing then is to carefully separate the crystals from the mother liquor, and for this purpose the author employs a centrifugal apparatus, so constructed that the acid only comes in contact with glass. The separation is very easily effected, and except in cases where an acid is strongly contaminated with the different oxides of nitrogen, one recrystallisation is generally sufficient.

According to statistics compiled by the Agricultural Bureau, at Washington, the annual meat product of the United States is in round numbers :—

	Number.	Pounds.
Dressed Hogs	29,000,000	5,120,000,000
[illegible]	6,250,000	3,124,000,000
[illegible]	3,000,000	275,000,000
[illegible]	7,000,000	350,000,000
[illegible]	5,000,000	100,000,000

About one-fourth of the pork and one-twelfth of the beef are exported, leaving for home consumption about seven thousand six hundred and fifty million pounds of the above meats, mostly beef and pork; or an average of almost half a pound a day for every man, woman, and child in the country.

At a meeting of the Manchester Geological Society, Mr. C. E. De Rance, of the Geological Survey, read an interesting communication with reference to an important discovery of manganese ore near Abergele, in Denbighshire, occurring in the old red sandstone. The deposit, he [illegible], occurred in a bed, and not in a vein, as in the ordinary way, and reached a thickness of 17 ft. of solid [illegible]. The deposit had been opened out by the Abergele [illegible] Company, and its existence had previously been [illegible], that the ore had actually been used for [illegible] purposes. He was of opinion that close investigation [illegible] similar localities throughout North Wales would lead to the discovery of other deposits of like nature, [illegible] be of great value, considering the present [illegible] for manganese for the manufacture of Bessemer [illegible] the Spiegeleisen process. The source of this ore, [illegible] the basement beds themselves, the [illegible] concentrated by the percolation of water downwards [illegible] arrested by the impermeable floor beneath.

The Captain-General of the Philippine Islands telegraphs from Manilla that on the first day after the recent hurricane, which almost entirely destroyed the town, not a single case of cholera occurred in Manilla or the island. The tornado not only swept over the entire archipelago, but was felt many hundred miles out at sea, especially to the south and west. It is believed that more lives have been lost by shipwreck than on land.

They have a curious way of clearing away wrecks in Ireland. Recently an attempt was made to blow up the steamship *Silkstone*, which had sunk in the Suir, opposite Waterford Quay. The force of the explosion was so great that the windows in every house on the quay, the principal street in the city, were smashed to pieces, and goods and articles of furniture dashed about the shops and houses in every direction. So great was the amount of damage done, that the shutters were put up in every shop. Nor did the windows in the upper stories escape. Several shop assistants were knocked off their legs. A *Times* correspondent says the principal business concerns of the city have been completely wrecked, but leaves it to be inferred that the "*Silkstone*" remained monolithic.

M. Dumas recommends water saturated with alum for extinguishing fires, its value being supposed to be due to the coating it gives to objects wet with it, which prevents contact with the oxygen of the air, and thus diminishes the rapidity of the combustion. The Minister of the Interior has recommended that the firemen of the French towns be supplied with facilities to use such solutions of alum.

An automatic electrical appliance for giving notice of the approach of trains, invented by M. Mors, has, says the *Engineer*, been successfully tried on the Paris-Lyon-Méditerranée line. It consists of a box filled with mercury placed under the rail at the required distance from a bell; the trepidation caused by a train passing over it agitates the mercury, and forms contact with the wire communicating with the bell, thus causing it to ring.

A Broker's office in Wall-street, New York, having a leased wire, sent up a message to 195 on the morning of the big electrical storm to know what was the matter with their wire. Chief Operator Bogart replied that the "aurora" was on it. The firm thereupon telegraphed back to have it cleared off immediately, as they wanted to use the wire.—*Operator.*

During the discussion at a recent special meeting of the Town Council of Newcastle-on-Tyne, one of the speakers said that Liverpool had spent £15,000 on electric lighting experiments, and then rejected a proposal to apply to the Board of Trade for a provisional order.

At a meeting in New York, on Nov. 21, of the shareholders of the Edison Company for Isolated Lighting, a report was read of the business done by the Company during the year ending Nov. 19. In this period, 137 installations had been fixed, the total number of lamps in use being 25,751. A dividend at the rate of 14 per cent. per annum was declared.

There is a charming article about cricket in *Longman's Magazine* for January. It is from the pen of Mr. Murdoch, the captain of the Australian eleven.

A NATURALIST'S YEAR.

By Grant Allen.

III.—THE MISLETOE BOUGH.

Of course, everybody has a bit of misletoe in his house just at the present moment; and therefore I feel sure I could have no better text in the world on which to preach my Christmas sermon than its forked branches and its semi-transparent white berries. So I stick a spray of the uncanny green thing in the little red Japanese vase before my eyes as I write, and I strongly advise you to do the same, as a sort of check or reference, while you follow my didactic exposition. Misletoe, we all know, is a parasite; and yet there are many worse parasites in the world than that pretty green-leaved plant, with its strange angular forks and its graceful bunch of pale white fruitlets; for you observe at once that it has foliage of its own. Now, regular thorough-going parasites, such as broomrapes and dodder, have either no leaves at all, or else have them reduced to mere functionless scales upon the tall, naked flower-stem. Naturally, as soon as a plant has begun to live entirely upon organised material stolen from other and more industrious accumulators, it has no further need for leaves of its own. Misletoe, however, though a very old parasite (as shown by the fact that it belongs to a numerous parasitic family, rich in species, especially in the tropics) has never acquired such habits of complete sponging as these very degraded leafless plants. It has a little honesty left in it still. Yet if you read any of the old-fashioned books about botany, you will be told that misletoe is a complete parasite, while dodder is an incomplete one. The phrase and the distinction which it implies have descended to us from times when vegetal physiology was less understood than at the present day; but people go on using them still in a somewhat unthinking fashion, though the progress of knowledge has exactly reversed our ideas as to the true state of the case. Let us look a little at the origin and functions of the misletoe, and we shall then see how far it has really become degraded to parasitical habits.

I don't know whether you will be able to find a single belated flower upon your misletoe bough, though I am afraid there isn't much chance so late in the season as this; for the plant generally blossoms early in the year. But whenever you do come across one in flower, you will find that it points back to an ancestor not unlike the common dogwood. The little blossoms are stuck close in the angles of the branches, where they fork, and they are of two kinds, male and female, each growing on a separate plant. The male flowers consist of a very small calyx, enclosing four minute petals, with a stamen fastened on to the middle of each in a very close fashion; and they grow in little groups of four or five together, surrounded by a cup-shaped bract. The female flowers, again, consist of a calyx which has grown into one piece with the berry, and of four extremely tiny petals. Like the males, they are surrounded by a bract, but they generally grow solitary within it, or at most, by twos and threes. All these peculiarities show that the misletoes are a very ancient, though much degraded, type—that they have long been started on a special course of development apart from their nearest relatives; and this is still better seen in some of their tropical congeners, which have the stamens reduced to two or one, and the petals entirely wanting. But the indications they give us are clearly these—that the misletoe group are immediately descended from ancestors with a four-lobed calyx, four petals united into a single corolla, four stamens, and an ovary combined with the calyx. All the other special marks of the genus—its separate sexes, its stalkless stamens, its inconspicuous calyx, its peculiar mode of fertilisation—have been acquired at a later date than the beginning of its parasitic habit.

The hypothetical ancestor of the misletoe tribe, then, must have been a free bush or shrub, growing in the soil on its own account, and very much like cornel or dogwood. At the same time it must have closely resembled the sandalwood family, of which we have one rare English example, the small white bastard toadflax which grows among the chalky pastures of our southern counties. Only, the sandalwoods have entirely lost their petals, while many of the misletoe group still retain them. In other respects, however, the sandalwoods have varied less from the primitive type than the misletoes. At the same time, it is an interesting fact that several of them have also acquired semi-parasitic habits, as is the case with our own little bastard toadflax, which fastens itself by little suckers on to the roots of other plants, and derives nourishment from the sap in their tissues. This would seem to show that a parasitic tendency existed in the common ancestor of sandalwoods and misletoes even before they began to split up into two groups in different directions.

The misletoes, however, struck out a new line for themselves; instead of merely fastening themselves on to the roots of other plants, they took to an aerial existence upon their trunks and branches. For this rôle, their peculiar fruit specially adapted them. The bastard toadflaxes bear small one-seeded nuts, adapted only for falling out upon the ground, and, therefore, ill fitted for such a life as that to which the true misletoes have accommodated themselves. A plant so circumstanced, with a parasitical tendency already ingrained in it, can only fix upon its destined host by means of root-suckers. But the misletoe tribe bears one-seeded coloured berries, instead of green nuts; and this habit, which is probably of great antiquity in the family, since it is common to all its members, has made an aerial existence peculiarly easy for them to follow. Birds naturally eat the berries, and thus carry them from tree to tree, dispersing the seeds with their droppings on the branches, where the future plant is to gain its dishonest livelihood. In our own English misletoe, and in most others, the pulp of the berry is very glutinous indeed, being in fact the stuff employed in making bird-lime; and from its Latin name *viscum* we even get our English adjective "viscid." Now, this viscidity clearly helps the plant in accomplishing its felonious purpose, for it ensures the seed sticking wherever it may be dropped; and, in all probability, the berries are often carried clinging to the legs or wings of birds, and then rubbed off at the exact place where the young plants grow best, in the angles of the branches. It is significant, too, that our own kind at least is found most frequently on trees which bear fruits or berries, and especially on the apple, which are just the ones frequented by frugivorous birds; while conversely, it is extremely seldom found on nut trees, such as the oak, its rarity in these situations being the very thing which gave an oak misletoe special sanctity in the eyes of the Druids (if, indeed, we know anything at all about them). Yet so little does the world at large discover about nature at first hand that I don't doubt ninety-nine people out of a hundred in England still firmly believe that misletoe grows exclusively on oak trees.

When the little hard seed, surrounded by its glutinous pulp, has thus gummed itself firmly on to the bark of the apple bough, it begins to sprout vigorously on its own account, and to fasten its blunt root on to the tissues of its host. However it may happen to be stuck on, the radicle or sprouting rootlet bends downward or outward towards the supporting tree, exactly as though it knew where it must fix itself. Then the root-end flattens out into a sucker, and soon, piercing the bark, buries itself in the young tissues of its host. As it grows, its veins become almost continuous with the apple's, and its base becomes a broad flap, drinking in the proper elements of the sap from the vessels of the bough beneath. At the same time it is no mere lazy parasite of the worst type; for, after it has sprung up a little, it begins to put forth its yellowish green opposite leaves—thick, leathery, oblong things, with hardly any look of life about them, but still containing lots of chlorophyl inside them, which enables them to assimilate material on their own account from the outer air, and thus leaves them partially independent of the hospitable apple. The leaves are evergreen, too, so that the plant can ripen its fruits in winter, while its deciduous-leaved host is bare and leafless. Such habits are very different from those of dodder, which never possesses any foliage of its own at all, but simply fastens its suckers on to the stems of gorse or heath, and steals from them every atom of the material from which it manufactures its twining red stems, its pretty pink flowers, and its numerous seeds: indeed, some few exotic members of the misletoe family are not parasitical in any way, though in these cases it seems more probable that they have gradually lost their sponging habits than that they never acquired them at all.

BICYCLES AND TRICYCLES;

WHAT ENERGY IS REQUIRED TO DRIVE THEM.

By John Browning.

The conclusions arrived at on this subject by Dr. Johnstone Stoney, as quoted in a recent number of Knowledge, seem to me to require so many qualifications and corrections that I trust the Editor will allow me to state the results of my own experience in the matter, as I think they will at least throw some additional light on the question, if they do not furnish a complete answer to it.

Bicyclists in fair practice think but little of riding 100 miles in twelve hours. The number of those who have accomplished this is now so great that the cycling journals have ceased to publish the names of the riders as they used to do. The distance of 100 miles has been ridden by a bicyclist on an ordinary road in a trifle over seven hours.

The distance of 100 miles in a day has now been accomplished by many tricycle riders; several riders in my own club have done it without any severe exertion, while 180 miles has been ridden over a mountainous road in twenty-three hours forty five minutes. One member of my club, over 70 years of age, has ridden forty miles in a day, though he has only recently taken to riding. A gentleman residing at Brighton, who has ridden ever since the introduction of the tricycle, though nearly 70, easily rides sixty miles in a day.

I do not consider myself at all a strong rider. I am above fifty, and I have never had any continuous practice, yet this year I have ridden fifty-six miles in eleven hours, over roads rotten with rain, without ever tiring myself, and on one occasion I left off after riding forty six miles, feeling fresher than I did when I began. I have since tried how far I could ride in a day, but feel sure, with a little preliminary practice, that I could accomplish eighty miles without unduly exerting myself. No one who knows me would speak of me as an athlete.

What can be done by athletes was shown by Lowndes, who rode fifty miles, over an exceedingly hilly road, winning the Tricycle Championship in 1882, in three hours, forty-seven minutes, and Marriott, who won the second prize, who was only three hours, forty-nine minutes in covering the same distance.

I am quite unable to understand the distinction Dr. Stoney draws between the bicycle and tricycle, when he says that the exertion required to drive a bicycle is just below, while that required to drive a tricycle is just above, the amount which produces perspiration. Though I seldom rode a bicycle faster than eight miles an hour, I never rode without perspiration, and this is the experience of every bicycle rider known to me.

A little consideration will show that no hard and fast line can be drawn as to the perspiration point, as it will vary with the weight and friction of the particular machine, and with the inclination and roughness of the road, as well as with the habit of body of the rider.

CORSET PHILOSOPHY.

I waited till this week for your promised pictures of ancient statues which were to prove how women ought to dress now; but as they are postponed, I send you some remarks on your paper of Dec. 1; and will carry Dr. Chadwick's recommendation to you to dress up one of the statues of Venus a little further, by saying it should be modern dress; for I suppose you hardly expect to convert our ladies either to Grecian drapery, or to the usual costume of Venus. It may save you trouble to mention that you will find a copy of the result of that very experiment in the book on "Figure Training," which is said to have converted the maker of it into a believer in stays, though it probably will not you.

I almost think you must have intended to make fun of the Dress Reformers by assenting to practically all my facts, and adding some analogies of your own, which all support my conclusions, when properly understood. Thus, you serve up once more that antiquated dish of Chinese ladies' feet, which are maimed when young by doubling the toes under them, so that they can never walk again; and you add a little new sauce by telling us that they "often retain fairly-good health to an advanced age," nevertheless. You mean "fairly-good" in those respects in which it is not bad and ruined. For I suppose you do not call people in "fairly-good" health whose limbs are disabled by chronic rheumatism or temporary gout, because they may have no other ailment, and gouty men often live the longest. The "crushed heads" of some savages are also a fatal analogy for the anti-corsetites; for if they do no harm, they prove that a far more dangerous looking compression than tight-lacing may be harmless if done judiciously. If they do harm, then they are like the maimed feet, and entirely unlike tight-lacing, which is proved by long experience to do none, except in excess, as everything does. As to what is excess, I find there is a curious concurrence among the professors and confessors of both sexes in favour of contraction to seven or eight inches below the natural size for the time, though, of course, the results vary widely, and by no means all tight-lacers go as far as that.

It looks plausible enough to say that, because binding up a wrist or a knee for a long time weakens it, contracting the waist must weaken the stomach and the back. But if it must, it does, and there ought to be no difficulty in proving it by itself and not by analogical guesses; but nobody does prove it, and a multitude of people have proved just the contrary to their own satisfaction, and they must know better than you can whether they are better or worse for it. It is idle to guess that they are "weaklings," and no fair specimens of the human race. They and their friends know and say that they are not at all so, and give all manner of proofs of it. If you ask what can make the difference between stomachs and wrists or knees, you may possibly remember that one is hollow and the other solid; one has to bend continually and the other has not, except in certain work and exercises, for which tight lacing is found to be unfit, especially for men, who breathe lower down than women. Some of the most severe female tight-lacers say that they take a great deal of exercise, and every one knows how they can dance for hours, besides riding and walking as briskly as any girl of the "Bunch" order, whom Sydney Smith likened to a mile-post.

Another of your funny analogies was that we might as well argue that everybody should wear a truss because it is necessary for persons with a particular ailment, as that everybody should wear stays because they are necessary to some people. But who ever did say so? Not I. The figure-reformers denounce corsets altogether, except for some invalids. I answered that they have never proved anything against them, and that no arguments of theirs are worth anything against the experience of those who declare they have found tight-lacing in stiff stays pleasant, useful, and beneficial in a variety of ways. If it does no more than preserve aud improve their figure and carriage, and expand the chest, or even only makes their dress fit and look better, that is answer enough to those who can prove nothing against it; and would be so if it ever cured indigestion, or prevented corpulence or any other real evil.

We happen also to have had now some experience the other way. For about a dozen years before the *Lancet* began to be alarmed at the evident revival of tight-lacing, it had been very much out of fashion with both sexes, and what was the consequence? Women were losing their figures, and growing round-shouldered, and fat, and old prematurely. Somebody invented the euphemism of the "Grecian bend," to palliate it. But even that, and all your statuesque arguments and others (for they are all old enough) did not prevent women from seeing that they were wrong, and that the corset is a real necessity in our artificial way of life, though savages and hard-workers can do well enough without it. I have read several times that even Turkish ladies have taken to it at last, though they are obliged to conceal it by their dress; as a good many of the male tight-lacers said they did, until fashion set them free again to show it. Advertisements of various new corsets reappeared in all the illustrated papers, and shoulder and neck-straps were invented to help girls to be upright; from which it is clear that nothing is so good as tight-lacing over the old-fashioned perfectly stiff busk in front, besides its being better for the health, as several have written. Exercise alone will not always succeed, as any one can see by observation among his own acquaintance.

I agree with you that wide hips under a contracted waist look ill for men. Hips anything near as wide as the chest are a defect in men, and are a female characteristic. Consequently, actresses who affect male dress only look like ill-made and weak young men. Width all over may be a good form for rowing races, and perhaps for a Hercules or a coal-heaver, but not for a Jason or Apollo, as you say truly that the sculptors know full well; and it is not more the form of activity than thick ankles or large feet, nor the shape which any man desires or admires. Your own case proves that a young man with an unusually large chest may have a waist of only 28 in., just two-thirds of his chest, which I gave, and rightly, as a full size for a well-made young man of ordinary general size. Unfortunately, hips cannot be narrowed artificially, and therein women have a great advantage in figure-making over men. But they can be made to look worse by wearing trowsers loose over the hips, with large pockets, which the dandies of thirty or forty years ago never tolerated. It is true that men generally require waist contraction much less than women, though there has been ample proof that they often benefit by it in the same ways. Even if they only like it, or do it to improve their figure and dress, and consequent appearance, that gives pleasure to other people as well as to themselves, and I can see no kind of reason against it. Yet nobody can be more impartial than I am, as I never had the smallest pretence to a good figure myself, though I had more than average strength generally, and was fond of using it. But I have always admired those who have that much valued gift of a naturally good figure, male or female, and make the best of it; and so I find does every-one practically, when he sees such persons, however he may theorise about it and profess to believe that they owe nothing to artificial assistance.

Dec. 8. AN OBSERVER.

STAYED WEAKNESS.

By Richard A. Proctor.

I MUST leave to next week the continuation of my remarks on the Corset as an Aid to Philosophy, which will involve the response to most of "An Observer's" remarks; but, to avoid the inconvenience of including irrelevant matter in a set article, I may make now the following comments on some of the livelier portions of his rejoinder:—

1. I can very well believe, though I have not seen "Figure Training," that modern costume, including stays —nay, necessarily involving stays—attached to a marble figure, not yielding to receive stays, would have a grotesque effect; though this would not prove that beauty in ancient times missed stays. Nigger costume would look equally ridiculous. It is begging the question to find here an argument for the corset.

2. I think the good health claimed for corset-wearers, must equally mean "good, in those respects in which it is not bad or ruined"; for waists in such condition that contraction to 7 or 8 inches is found essential to comfort, may be very fairly compared to the disabled feet of the Chinese ladies.

3. The "multitude of people" prove just what I said, by their *consensus* in asserting that they find themselves better in stays. This shows that contracting waist does weaken the stomach; and if it does, it must. ("Bunch" is not in question; no one asserts that a mile-stone has a fine feminine figure; yet a woman may as reasonably shape herself after a milestone as after an hour-glass.)

4. A truss is necessary for persons with a particular ailment. But it seems from the arguments of the corset wearers themselves that stays are necessary for divers ailments—as the tendency to *embonpoint*, indigestion, stooping, and so forth. The truss alone can remedy the first ailment; exercise and attention to diet will remedy the others; only it is easier to strap on a corset. I shall presently, by the way, give much more evidence from experience than "An Observer's" case can bear without breaking down; and amongst this I shall note some which indicates a closer connection between the truss and the corset than he seems to think of; for overwhelming medical testimony shows that those who lace tightly are exposed to serious risk of rupture.

If the "Grecian bend" was caused as our correspondent says, and was not, as others say, a silly affectation in imitation of the enforced lame gait of a certain princess, it would only prove my case; for it is certain the persons who showed this weakness had been corset wearers. I shall give such evidence as to the strength and upright carriage women can acquire who only use corsets after full womanhood has been reached, as to prove the utter impossibility of such weakness arising in the case of young women who had not been figure trained from early girlhood by mothers either unknowing or foolish. (Exercise will not be assumed, no doubt, for all are not able-bodied; nor with corset pinched mothers is it to be wondered at.)

Of the necessity of the corset in the case of many women, and men, too, I have never had any doubt, any more than I have about the necessity of crutches in many unfortunate instances.

THE GREAT COMET.

THE following is taken from a description of the comet communicated by M. Cruls to the Paris Academy of Sciences. It relates to the comet as seen after perihileon passage.

"On September 25, at four in the morning, the sky was clear near the horizon, and enabled us to assist at a spectacle whose beauty surpassed description. A part only of the tail rose at this moment above the horizon. Its

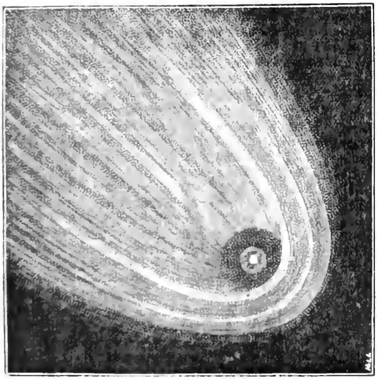


Fig. 1.

aspect was truly impressive, for it appeared rather like a column of fire than a beam of light. The tail was nearly perpendicular to the horizon, and of a well pronounced, conical form, measuring about 1° 30′ at its widest part, and 30′ at the base. It is impossible to give an idea of the grandiose effect (*effet grandiose*) produced by this column of fire, to which the lower strata of the air gave a yellowish tint, a tint strongly reflected in the waters of the mouth of the Rio. If I dwell on the impression felt at the sight of this phenomenon, it is because, to an attentive observer, there was more in the spectacle than a mere sublime but barren wonder. The telescopic examination of the tail, as the parts nearest the nucleus became visible, showed demonstrably, and without any possibility of optical illusion, the appearance of a *stream* of light, extremely bright, in which threads brighter than the adjacent parts could be distinguished, and the effect suggested strongly the idea that one would form of a jet of molten metal.

"When the nucleus was at some height above the horizon, it shone with great brilliancy, having a diameter of about 1′ of arc. A streak of light curved round the nucleus, and on either side, behind, the two branches, enlarging, lost themselves in each other, forming the beginning of the tail, which in its prolongation preserved a noteworthy intensity of light for a distance of about ten or twelve degrees. Following the axial line of the tail, one could recognise a darker track, and just behind the nucleus

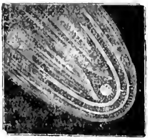


Fig. 2.

there was a space almost entirely without light and of an elongated form, growing narrower from the nucleus to a distance of about 30′ of arc.* This peculiarity, combined with the general characteristics of the comet's aspect near the nucleus, suggested involuntarily the idea of an eddy such as is formed down stream behind the buttress of a bridge in the middle of a strongly-flowing river, or more precisely recalled the vacuum left in the track of a projectile traversing the air with sufficient velocity.

"I must also note here: First, the marked curvature of the tail, the convexity of which was turned southwards; and secondly, a very marked difference between the distinctness of the edges, the convex edge being tolerably sharp and well-defined, while the concave edge was softened off and indistinct. Examined with a low magnifying power (from 8 to 10 times) it appeared rather as if it were of a vaporous nature.

"Around the nucleus a coma (*chevelure*) could be seen, which was about 20′ in width, on a line through the nucleus at right angles to the tail's length. This coma was of faint luminosity, though distinctly visible in the field of view of the great equatorial armed with a power of 60.

"As regards its length and luminosity, the tail consisted of a very luminous beam, growing obviously larger with increase of distance from the nucleus to a distance of about 12°, and ending, so to speak, abruptly. A portion of the tail extended further, but under an entirely different aspect. On the convex side, where the sharpest edge was seen, a luminous beam exceedingly faint, having a width equal to about 2/5ths the breadth of the tail at its broadest end, extended to a distance of about 15°, giving a total length to the tail of nearly 30°. In reality, then, and this was one of the most remarkable and striking features, the tail formed a very luminous and slightly-curved beam enlarging for 12°, and ended there sharply, presenting the appearance of rupture, and then extended to a distance of 15°, this prolongation having a much smaller width,

* We give the picture of the head (Fig. 1) as it appears in *Le Monde*, but it does not at all agree with M. Cruls' description. Possibly his drawing was indistinct. The appearance he describes is well known, and has been observed in many comets (Fig. 2).

and a luminosity incomparably fainter than had the other portion of the tail.

"May I here be permitted an indiscretion, pardonable, I hope, since it is committed in the interests of science, by quoting the opinion of his Imperial Majesty, Don Pedro II." (good gracious, what a daring thing to do!) "who has been able to contemplate the comet since Sept. 25, and who, comparing it with that of 1843, has condescended to express himself in the following terms?—'I observed, well, the comet of 1843. It was not so remarkable in the brightness of the nucleus and the tail, but it was very much longer. I saw it with the naked eye quite close to the sun on Feb. 28, a phenomenon which has also characterised the present comet; several days after, I examined it at sunset, during several hours; the tail nearly reached the zenith, the nucleus being but little raised above the horizon.'"

(To be continued.)

DESTRUCTION OF RARE ANIMALS AND PLANTS.

By Richmond Leigh, M.R.C.S.

THE fauna and flora of the British Islands is slowly, yet surely, diminishing in number of individual species. The increase of population, with its concomitant houses, manufactories, and other buildings, is the great cause of this diminution. But another and preventable cause is an important factor in the change. This is the destruction of the rarer animals and plants by naturalists and sportsmen. The rare bird which might revisit, and breed regularly in, our latitude, is ruthlessly shot for the poor advantage of being closely examined, and perhaps added to some private collection; and, for a similar reason, the uncommon plant is pulled up by the root, and prevented from adding beauty and variety to our native flora. It is human nature to do this without thinking of the injury done to future observers; and for the sake of obtaining the admiration of the few, which, unfortunately, is at the expense of the many.

But little consideration will be required to see that more harm than good is done to the study of natural history by this course. The loss of any species is practically irreparable, and our somewhat scanty fauna and flora should rather be carefully nursed than carelessly destroyed. The student should be taught to look for his material in the living book of Nature, not in the dry bones only of herbariums* and museums.

Travelling recently in Scandinavia, I was struck with the greater tenderness—or oblivion (?)—with which birds were treated, for even in the large cities, the sparrows were so tame that they would hardly rise from under your very feet, and magpies, in country villages, were as familiar as pigeons here. It may be unreasonable to expect the youth of this country to show the want of mischievousness implied in the preceding—though education in natural history might even do this—but the full-fledged naturalist might display an equivalent love of Nature, and seek her preservation and protection.

Then might the true naturalist and lover of Nature be gladdened by the sight of rare (at present) and beautiful forms of life much more frequently than now, and thus be able to learn more of their habits, growth, and life history.

The only justifiable cause for the killing of rare animals, or the removal of rare plants, should be that they might be added to a standard collection, as the British Museum, and to some few other similar institutions in the large centres of population; but beyond this no destruction of rare species should be encouraged, but, if possible, entirely stopped.

It is indeed desirable that no animals or plants be destroyed except for purposes of food, or when their numbers threaten injury to other food-producing plants or animals, or to men.

* In preference to herbaria.

THE DOVE FLOWER.

THE dove flower, or *Peristeria alata*, is very rare with us, as its home is Central America. The leaves of the flower are white and spotted, and give the flower the

appearance of a white bird with extended wings. The inhabitants of Central America adore this flower, believing that it represents the Holy Ghost, on account of the resemblance to a white dove the symbol of the Holy Ghost. For that reason the flower is also known in that country as "Flora di Spirito Santo." The flower represented in the cut was in bloom in the garden of Mr. L. M. Stone, 482, Franklin avenue, Brooklyn, a short time ago.—*Scientific American.*

FORESTS AND CLIMATE.

A PAPER has been prepared by Dr. Schomburgk, the Director of the Botanical Gardens at Adelaide, on the influence of forests on climate. The object of the author is to prove that the destruction of forests usually has the effect of reducing the rainfall, while, on the contrary, the planting of trees broadcast over a country is one of the best methods which can be adopted for ameliorating its climate and increasing the annual fall of rain. It cannot, indeed, be proved that the climate of South Australia is altering for the worse in this respect. In fact, a comparison of the meteorological records will show that the annual average rainfall for the colony during the past ten years has been 21·1 in., as compared with 20·1 in. for the previous ten years. The fact is that in the agricultural districts of the colony, and especially in those which were not originally timbered, the bringing of the land into cultivation has had the effect of slightly favouring the fall of rain. Ploughed land attracts moisture to a much greater degree than the unbroken soil. In considering the effect which the removal of forests has in altering the climate in South Australia, the only direct test that could be taken from the records issued by the Government astronomer is the experience of the neighbourhood of Adelaide. If the time is divided which has elapsed since 1839—the year in which observations were commenced—into two periods, there is found for the first an average rainfall of 22·8 in., and for the second one of 21·7 in. It will thus be seen that, on the whole, the rainfall at Adelaide is diminishing, though very slightly, and perhaps the diminution in the amount of timber may have something to do with the change. Dr. Schomburgk, in searching for illustrations of the effect of trees on climate, goes further afield, and brings forward some striking instances, in which it is evident that loss of forests means loss of rainfall, and *vice versâ*. He recalls how the Russians, by burning down some of the Transcaucasian forests at the time of the struggle with the Circassians, converted the country from a fertile land into a desert, simply through the cutting off of the supply of rain. Similar instances of rain having deserted a country denuded of forests have occurred in the Mauritius, in Jamaica, the Azores, and, it may also be added, to a still more remarkable extent in several of the lesser West India islands. No sooner had the forests of these places been destroyed than the springs and rivulets ceased to flow, the rainfall became irregular, and even the formation of dew was almost entirely checked. On the other hand, it is generally accepted as a fact, that Mehemet Ali increased the fertility of Egypt enormously by the planting of trees. He alone planted some 20,000,000 on the Delta. His successors followed up the work, and it is a noteworthy circumstance that the rainfall rose from 6 in. [illegible] Planting has also, it would seem, produced remarkable effects in France and Algiers. Extensive regions [illegible] planted with gum and other trees, which, for the most part, grew to about 30 ft. or 40 ft. in height, and it is stated that the quantities of rain and dew which now fall in the adjacent land are double what they formerly were.—*Architect.*

LUMINOUS PAINT.

By W. H. Hyatt.

(*Lecturer on Luminous Paint—Crystal Palace.*)

AMONGST the many valuable applications of science to the wants of mankind, few will exceed in interest the composition now known as "Balmain's Luminous Paint." The subject of luminosity has engrossed the minds of many scientific men since Casciorolo, of Bologna, in 1602, accidentally discovered that by roasting heavy spar in a furnace, a substance was obtained which had the property of giving off light, after having been previously exposed to daylight. This substance is what is now known as sulphide of barium. Since that time, it has been discovered that the sulphides of calcium and strontium, besides many other compounds, possess this remarkable property, which has been termed phosphorescence, or by many, "Fluorescence," as conveying a separate meaning, though the two are nearly, if not quite, identical.

The late Mr. Balmain studied this subject for forty years. At the end of that time, he patented, and brought out as a paint, a preparation containing rather more oxygen than a sulphide, though not sufficient to form a sulphate. When an article painted with this luminous paint is passed before the spectrum, no fluorescence appears till it reaches the green, the violet, and the ultra-violet, or actinic rays. The ultra-violet rays being too short to affect the eye, these it absorbs, and gives them off again in longer waves, which at once become visible, and continue so for many hours. On the contrary, a strong red or yellow ray will take away the light from an already luminous surface. To speak in simple language, any surface painted with luminous paint and exposed to daylight in the daytime, will shine the whole night through, even the longest winter nights. When a bell is struck, literally the whole of the bell is in motion, and gives off waves or vibrations of sound; in exactly a similar manner any wave of light, natural or artificial, falling across the surface of this luminous paint, causes the whole of the molecules of the paint to vibrate, and give off waves or vibrations of light, which continue from twelve to fifteen hours, and in exceptional cases, twenty hours. Life-buoys, mooring-buoys, channel-buoys, &c., painted with luminous paint, are distinctly visible, where a white-painted buoy is totally obscured. The paint may be used for a thousand different purposes, anywhere where white paint is generally employed, under the erroneous impression that white paint at night is visible, whereas it is perfectly invisible. Heat will increase the luminosity, and intense cold, as in the Arctic regions, will entirely destroy it, though the luminosity returns when restored to an ordinary temperature. The light given off will not affect the most sensitive photographic plates; added to this, a painted board may be carried, as a lantern, into the most dangerous places, as in powder magazines, without fear of explosion. The rapidity with which this paint will store itself with light is truly marvellous. Ten seconds exposure to diffused daylight will cause it to shine for as many hours, though the more daylight it has, the better the subsequent effect. The light for the first hour after being exposed is violet, owing to the more rapid vibrations being given off; after that it is white, till it ceases entirely. Nothing but exposure to light is again required to cause it to again emit light. This action lasts for months or years, according to the amount of exposure to weather that the paint receives. To speak roughly, it is rather more durable than ordinary paint, and continues to act till the paint is either coated with dirt or worn off, as the action is purely mechanical. The popularity of this paint is vastly on the increase, and its future will doubtless be very great. Not only is it used by Government, as during this last Egyptian war, but also by several railway companies, as an experiment for lighting their carriages through tunnels, and by many private individuals, for buoying channels at night, and a variety of similar purposes. An example of this is the painting of the end of Folkestone Pier, to act as a beacon at sea.

When we appreciate the number of lives that may annually be saved by this and other practical applications of scientific facts, the truth is most forcibly brought home to us that "knowledge is power."

THE AURORÆ.

In justice to these interesting phenomena, it is only right to remark that the one of the 17th was only a part of a series extending from the 13th to the 24th, at least, and that during this period sun-spot and magnetic disturbances were correspondingly active.

The sun-spot you have figured (p. 431), as sketched at 11 a.m., November 20, had much changed in detail by 10 a.m. the next day, and it would fill pages to notice the almost wonderful needle variations and solar storms which have accompanied the recent auroral displays. With reference to the still enigmatical spectrum of the aurora, will you permit me to record that the moving patch of light seen at 6.10 on the 17th was really an auroral cloud or beam, and not a meteor, as described in the *Times*. With the spectroscope I found only the auroral citron line, and none other. [Correspondents who are calculating orbit of supposed meteor, please note.—R. P.]

The moonlight gave no opportunity to examine the full spectrum; but I should like to ask your spectroscopic readers (as we are now at an auroral epoch) to direct their particular attention to the fainter lines towards the violet (the red and citron are already closely positioned) of this spectrum. It must not, however, be expected to measure these except in a dark field, and a companion spectrum or illuminated scale would render them invisible. A single illuminated line or point, a dark diaphragm traversing the field, or a photographed transparent micrometer illuminated by the spectrum itself, will alone give hope of success. Touching the *lumière cendrée* on the moon, described by one of your correspondents, as seen during the aurora, I also remarked this, but found it pink in tint, instead of green. T. Rand Capron.

THE TRYPOGRAPH.

Everyone who has used stencil plates must have often thought how convenient it would be to extend the system. But even in single letters the method fails; you cannot stencil an O, or a P, or an R, a D, or a B; at least, you have to complete the letter afterwards. To stencil ordinary writing, and still more, a drawing, seems hopeless. Yet this is what the "Trypograph, or Hole-Writer" does. The idea is a good one, and simple in the extreme,—when *shown*: (like Columbus's trick with that weary egg which we all wish had never been laid). You write or draw with a metal pencil on stencil-paper—that is, paper specially prepared to suit the work—placed on a metal plate the surface of which is like that of a finely cross-grained file. As the pencil presses the paper against this surface, multitudes of minute holes are made along the pencil's track. Then the stencil-paper is ready for use any number of times, precisely as a stencil-plate is used. A broad, flat scraper, dipped in a certain kind of ink, is passed over the paper, and the ink, passing through the holes, duly marks a sheet of ordinary paper underneath. Any number of copies may be taken in this way, each requiring only a single stroke of the scraper—at least, after a little practice has been obtained. A most convenient instrument this, where writing or drawing has to be many times copied; cheap, too, and easily used, success being readily attained at a first or second trial, and thereafter systematically.

The New York Edison Company state that they are now lighting from their central station in Pearl-street, 191 houses, with 4,288 lamps, of which over 2,700 burn almost continuously. It is expected that an additional 1,000 lamps will be in use before the end of the year. The fire insurance companies make no difficulty about granting licences.

The Ferranti Dynamo Machine.—This machine, which is a combination of the invention of Sir W. Thomson and M. Ferranti, has for some weeks been causing a considerable commotion in the electrical and stock-broking worlds. It is at length made public, and bids fair to far outstrip anything yet produced for incandescent lighting. All the details are not yet available, but it is our purpose to supply them when the proprietors consider their patents secure, which they tell us will be about four or five weeks hence.

The Advantage of Knowing how to Swim.—The Sydney *Morning Herald* of August 25 says: "We learn from a correspondent that, a short time ago, Mrs. G. A. D. McArthur Campbell, formerly a resident of Coonamble, distinguished herself by a deed of admirable bravery. Mrs. Campbell was a passenger in a steamer from Hong Kong to one of the northern ports of Queensland, and one day a little boy about four years of age, to whom the lady was much attached, fell overboard, the accident occurring through a sudden lurch of the vessel. With the exception of Mrs. Campbell and the man at the wheel, all the passengers and crew were at dinner. Without waiting for a life-buoy, or divesting herself of any clothing, and simply saying to the man at the wheel, "Don't tell the child's mother," Mrs. Campbell plunged into the water, swam to the boy, and held him up till both were rescued, the steamer having been promptly stopped and a boat lowered. Neither the lady nor the boy was much the worse for the immersion."

A Whale Snaps a Log-Line.—A correspondent sends the following: "On the writer's last voyage from Baltimore to Rio de Janeiro, *via* Pernambuco, his attention was called to a large whale leisurely floating on the water near the stern of the vessel. All at once he seemed possessed with a spirit of frolic, diving and coming to the surface with the most playful motions. As his huge head descended, he would slowly expose his tail, until for several seconds it remained erect on the water. I chanced to have one of Messrs. John Bliss & Co.'s logs in use, the line and rotator towing astern. Never in thirty years' of sea experience did I see or hear of a whale biting anything, but, to my surprise, he took the rotator of that log in his mouth. Immediately my mate and a passenger, in order to save the indicator, seized the line, which quickly snapped in their hands, and was drawn off by the whale, who wound it round and round his head until he appeared completely bewildered. This incident occurred in lat. 10° 5′ south, long. 38° 11′ west. I would advise all ship masters to haul in their line and rotator when whales are about, or they may lose them as did your obedient servant, John T. Holt, master of ship *David Stewart*."

Reviews.

POKER.*

A MOST interesting book on a fascinating (we are told), but most objectionable game. Our author tells us that what is wanted for success at Poker is—first, good luck; secondly, good cards; thirdly, good temper; and fourthly, [illegible]. But good cheek, above and before all things [illegible] to success. We should recommend for the four things needful: A lying face, a false tongue, the impudence of a bank thief, and the nerve of a practised pickpocket. We can understand the charm of the game; we can even imagine honest men enjoying it as a trial of skill: it makes a most enjoyable parlour game, with ivory for stakes. But how any man can play Poker as it is played (as "One of its Victims" truly describes), and yet retain a particle of respect for himself, we really are puzzled to imagine. When a Poker player assumes the aspect of an honest man, he simply "bluffs" the world; if he backed his honesty, the world might "see him" safely, "see many better, see few worse; and if the world were to "call," it would be seen what a "foul hand" he has; not a "flush" of shame for love or money! (the clergy would tell him that as a "sequence" he would have a "blaze," but that's neither here—certainly not here—nor there).

Yet the book is most amusing. It shows well, too, the ultimate fate of every ardent Pokerite. The story of the "æsthete" who won "too too" easily, and then remembered him how "he used to indulge in this little recreation at Oxford . . . come, therefore, and take a snifter with me," is as amusing as anything of Artemus Ward's or Mark Twain's. The game is fully explained, as are all its objectionable off-shoots. The chances are given, for the most part, correctly; but the reasoning quoted on pp. 81-83 from Mr. Blackbridge's "Complete Poker Player" is quite incorrect; and his inference that you may safely bet greater odds than the theoretical 5 to 1 against a "size" being cast after one or more already cast, would be very unsafe to follow in practice. If a die were tossed a great number of times, and after every time "size" had been thrown (say) six times in succession, odds of 10 to 1 were wagered against a seventh "size," there would in good time be a woeful balance against the layer of the odds.

THE PARALLEL NEW TESTAMENT.†

WHATEVER opinion may be formed as to the literary [illegible] of the Revised New Testament, there can be no doubt whatever of its value to those who wish to know in what respects the version of 1611 was incorrect, according to the opinion of the ablest biblical scholars. But every one who has looked over the revised version for this purpose must have noticed the difficulty of making the comparisons, and must have felt the wish to have the two versions in parallel columns. The Parallel New Testament meets this want. It is likely soon to be in the hands of all who have seen the Revised New Testament. It shows at once where the two versions differ, and where both differ from other readings of which some scholars approve. For our own part, we never found patience to compare the two versions closely till the Parallel New Testament made the task at once easy and pleasant.

But what an opportunity the Revisers have lost! Are we never to have the New Testament in the English of our day? Are the priesthood afraid to translate the Gospels into such English as the men of our time speak? Faith must surely be getting feeble if such a fear is well founded. It would be a useful exercise for some of our clergymen, after learning to preach as they would speak, and not as if they were half-inclined to sing (moaningly, like the distant wind), to try the effect of Bible passages in modern English. Is there anything irreligious, for instance, in this? "So Jesus said to them, I tell you truly that it was not Moses who gave you bread from heaven; the true bread from heaven is given you by my Father." Is there anything especially suggestive of devotion in the "Verily, verily," the "Unto you," the "Giveth," and so forth? If so, *such* devotion must be a plant of very shallow growth.

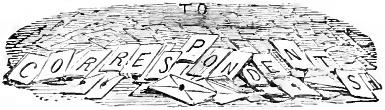
* [illegible] Poker. By One of its Victims. [illegible]

† [illegible] New Testament. The authorised and revised [illegible] Printed for the Universities of Oxford and Cambridge. (Published by Henry Frowde, Oxford, and [illegible] Cambridge.)

REPORTS from Kirkwall, dated Dec. 11, speak of a severe thunderstorm which passed over the Orkneys on the previous night, severely wounding five people and killing four cattle. The storm came on shortly before six o'clock, and continued for some time. As Mr. William Hepburn, wife, and family were sitting at the fire, a flash came down the chimney, and struck the whole five. Mrs. Hepburn was struck behind the ear, her ear being laid open on her cheek; her husband was severely struck from the abdomen down. Miss Hepburn, her brother, who was married, and his little boy, were also struck. Some of them had their clothes burnt. Grave fears are entertained for the recovery of the old people.

CONTINUOUS ELECTRIC LIGHTING.—During the recent extraordinary fog, the Edison Electric Light Company, recognising the necessity for distributing the light to their customers without intermission, maintained their dynamos at Holborn-viaduct in action for a continuous period of sixty-four hours without stopping. Starting at three o'clock on Saturday afternoon, Dec. 9, the dynamos ran without ceasing during Saturday, Sunday, Monday, and Monday night, stopping at eight o'clock on Tuesday morning, Dec. 12. We do not know of any previous continuous, nor, in fact, any similar running to this. The current was supplied from two large dynamos, which are used alternately, the change being made without any perceptible interruption in the lighting.

ITALIAN ASBESTOS.—The mining for asbestos in Italy is at present limited to the provinces of Sondrio and Turin. The asbestos in the former occurs in regular strata, varying in thickness from three to four inches, although in some cases it has been found twenty inches thick. The enclosing rocks are chloritic and telcose schists of a greenish colour, and the asbestos is found chiefly in fibrous masses of a yellowish-white colour. In some cases the fibres are long and firm, resembling a skein of thread of a yard or more in length. It has also been found that asbestos abounds in the fissures of serpentine rocks, and it is often accompanied by other minerals, among which garnites of a green colour have been found in minute crystals, to which miners have given the name of "Semenize dell' Amiento," meaning seeds of asbestos. The excavations are carried on in forty different places, and as a rule the enclosing rock is quarried by blasting. In some cases, where too much material would have to be removed, the workings are driven forward in the asbestos-yielding stratum, leaving pillars here and there to support the roofs of the workings.



Letters to the Editor.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office,* 74, *Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO, DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

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The Editor is not responsible for the opinions of correspondents.

NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

"Let Knowledge grow from more to more."—ALFRED TENNYSON.

THE TRANSIT OF VENUS—SATURN'S RING—BRAIN TROUBLES.

[661]—If I am not transgressing the "unwritten law" of KNOWLEDGE by treating of three separate subjects in one letter, I should like to say:—

1. That I observed the Transit of Venus on December 6, from 2h. 27m. 21s. p.m., Maresfield Mean Time, until about half-an-hour before sunset. I failed, of course, to see the first contacts, either external or internal, as the latter was calculated to take place at 2h. 21m. 41s. at my observatory, and it was only at the time previously specified that the sleet ceased and the clouds broke sufficiently for the sun to be glimpsed at all. What struck me most in the view of the phenomenon which I had, was the apparently large size of the planet, which resembled a jet black five-shilling piece on the solar disc—the "milling" on the edge, by-the-by, being fairly represented by the rippling due to our own atmosphere. Venus was, as far as I could see, absolutely circular, no sign of ellipticity being visible in her disc. Moreover, with the utmost attention, I could detect no trace of an atmosphere around the planet the solar photosphere appearing homogeneous up to his very limb. The interposition of a plantation compelled me, after 3 o'clock, to exchange my 4·2-inch equatorial for a 3-inch telescope, and with this my wife noted a reddish shading round the circular outline of Venus; as, in fact, I fancied I did myself. I am a little afraid, though, that want of achromatism may have had something to do with this, as the effect was invisible in the larger (and absolutely perfect) instrument. It was very odd to notice that refraction converted the circular outline of Venus into a markedly elongated ellipse as the sun approached the horizon; an instructive illustration of its action at small altitudes, inasmuch as the diameter of Venus was only 62″·8, and her lower limb must have been (apparently) considerably more raised than her upper one for her to have assumed the figure she did.

2. While thanking Mr. Herbert Rix for the really valuable information contained in letter 656 (p. 471), I must ask him to forgive me for pointing out that the "mistaken assumption" to which he refers was not really mine, but that of the late Mr. Breen ("Planetary Worlds," p. 217). I may, perhaps, note here, too, that Chambers (following Hind) calls the place of residence of the Brothers Ball, "Minehead, but curiously locates it in Somersetshire.

3. The description of an odd brain trouble which I experienced some two or three years ago may not be without interest as a supplement to letter 657. I had been hard at work taking out some hundreds of logarithms for the formation of a table of constants for the reduction of my Transit observations; and, my work over, I found myself continually making the extraordinary mistake of transposing the last two figures of any series I was writing down in a hurry. For example, for 94,623, I would write 94,632; for £8. 6s. 3d., £8. 3s. 6d.; for 1879, 1897; and so on. A short abstinence from calculations, though, set all this right again. This curious mistake is very common among bank clerks, inasmuch that when the balance for the day is wrong by such an amount as 2s. 9d., the more ingenious would set to work to ascertain by what transposition of the kind the error may have been produced, often thus getting the balance right. It is to be noted, however (though this has no bearing on Captain Noble's remark), that such a difference may be given in several ways. Thus 2s. 9d. is the difference between 4s. 1d. and 1s. 4d.; between 5s. 2d. and 2s. 5d.; 6s. 3d. and 3s. 6d.; and so forth. Note further, that in every such case, the sum of the numbers of shillings and pence is always eleven. This may be easily shown. For, let a sum of a shillings b pence be written by mistake as b shillings a pence. Suppose a greater than b, then the error is $(a-b)$ shillings + $(b-a)$ pence = $(a-b-1)$ shillings + $(12-a+b)$ pence (for $b-a$ being negative, we must, to give as usual a positive number of pence, add 12); so that the sum of the numbers of shillings and pence = $(a-b-1)+(12-a+b)=11$.—R. P.]

WILLIAM NOBLE.

BRILLIANT METEOR.

[662]—On the evening of Wednesday, the 29th ult., about 11.30, a very brilliant meteor was seen in the neighbourhood of Auchterarder, N.B. It went in a northerly direction, and came very low down before it went out; it lighted up the whole district so clearly that the minutest objects could be seen. During its flight it dropped fire something like a piece of iron when taken out of the furnace at a white welding heat; it continued to drop fire in this way until it went out, and then, in about a minute or so afterwards, a sound was heard like distant thunder, which lasted for a short time; the sky at the time was clear and the stars shining brightly. The meteor was a most brilliant one; the sight of the balls of fire constantly dropping from it was very grand.

Would the sound like thunder be the meteor exploding, or would it be a series of explosions which caused the fire to fall from it and make the sound? R. M.

[More probably, I think, the effect of the atmospheric disturbance.—R. A. P.]

A BOTTLE TRICK.

[663]—The following interesting experiment might be tried by some of your young friends when at the sea-coast. Take a clear quart bottle, and attach it at the neck, about two feet from the end of a deep-sea fishing-line, which must not be shorter than thirty fathoms. The lead sinker should be sufficient to submerge the bottle while empty. Let the bottle be well corked, the cork being of the same thickness throughout, and marked distinctly at the upper end. Sink it thus empty from a boat, in about thirty fathoms of water, and let it remain at the bottom ten minutes or more. When hauled up, the bottle will be found nearly full of water, and the cork reversed. R. MONTGOMERIE.

RAINBAND SPECTROSCOPY.

[664]—As you invited the readers of KNOWLEDGE to send you their experience of the rainband spectroscope, I am now sending you mine, in case you think it worth insertion. I may remark, in passing, that I have pleasure in confirming what Mr. Cory has written in KNOWLEDGE, Nov. 3, 1882.

1. When a band appears in the "red," small rain may be expected, the intensity and duration of which will depend on the strength and number of the bands.

2. If the sun-lines in the "green," instead of appearing clear and distinct, appear thick and muddy, heavy rain (like thunder rain) will follow, and this whether there is any rainband in the "red" or not.

3. If on moving the spectroscope slightly to the left the "blue" appears very light and the dark line down is clearly seen, then wind may be expected. I may say that this never fails.

4. One day, on looking through, I noticed, on moving the spectroscope slightly to the left as above, a peculiar appearance about the green and blue. The green, instead of giving way to the blue, seemed to fight with it and *pass over* it. Later in the day a thunderstorm followed. Twice since I have noticed this sign and predicted a thunderstorm, which occurred each time.

I have had my spectroscope since the beginning of June, and am indebted to Mr. Rand Capron's pamphlet, "A Plea for the Rainband," for learning how to use it; and I have, as a rule, adopted his plan of looking with the red colour on the left.

Liverpool, Nov. 10. J. A. BRAMLEY-MOORE

THE HAMILTONIAN SYSTEM.

[665] For the information of your readers, may we say that the Hamiltonian system has not fallen out of print. It has been published by us at the subjoined address for the last ten years, has been kept in stock for many years, and supplied by Messrs. Simpkin, Marshall, & Co., of Stationers' Hall-court, and Messrs. Hamilton & Co., of Paternoster-row, the two largest retail publishers of the trade, and can be had of any of the school-book houses in London.

C. F. HODGSON.

Gough-square, Fleet-street, E.C., Dec. 18.

A LUMINOUS SEA.

[illegible] two [illegible] articles in your columns re- [illegible] viz., during a run [illegible] the Red Sea [illegible] Socotra. I paid [illegible] in one place we ran [illegible] between long. 60½° and [illegible] 56° and 52°, latitude varying from [illegible] 17° north. [illegible] W. Symington, F.R.G.S., com- [illegible] whose command I had the pleasure to [illegible] that the phosphorescence extended [illegible] surface, which is my opinion, but to what [illegible] research was requisite. I should like some [illegible] to give an explanation in your columns of the [illegible] and depths of luminous seas. S. J. H. B.

[illegible] From my diary of what I observed in the Mediterranean:— [illegible] 29. Off Cabo de Gata. The sea very luminous; the ripple [illegible] bow of the steamer full of shining bodies apparently an inch [illegible] towards in diameter. These became visible only when the [illegible] threw up the foam. "Jellyfish" were shining brightly, [illegible] some feet below the surface. They became extremely [illegible] when approached by the vessel. Two large fish (porpoises?) [illegible] athwart the course of the ship, showing parallel furrows of [illegible], which ceased as they sank beneath the vessel, and [illegible] as they rose to the surface again on the other side. [illegible] continued to sparkle for a couple of seconds after they [illegible] passed. Another porpoise swimming at the cutwater looked [illegible] as if filled with pale opal light—without flashes, except [illegible] his fins or tail cut the surface.

Nov. 1. Alicante. As the vessel lay in harbour, the still water [illegible] looked almost black. Shoals of small fish were [illegible] on the surface, showing themselves by ripples and sparks of [illegible]. The oars dripped golden spray when lifted at each stroke, and [illegible] produced by the ripple against the boat's side and the [illegible] trailed through the water was sufficient to enable [illegible] small objects, but not to read print.

[illegible] gravel thrown into the harbour produced a pretty [illegible], and a flat stone skimmed along the surface raised a bright [illegible] at each skip. The water was dark except when disturbed, but [illegible] could be distinguished shining, apparently at some depth. [illegible] were warm and very still. Barometer about 30·1 in.

M. S.

Answers to Correspondents.

[illegible] the maximum. Only a [illegible] received can, therefore, be answered [illegible] nevertheless be noted and acted [illegible], or personal questions, [illegible] class-room problems for [illegible] receptacle specially provided [illegible] been specially appointed [illegible] this unreason- [illegible] would be otherwise occupied.
N[illegible] ANSWERED THROUGH THE POST.

[illegible]—In reply to "D. and M.," p. 422, this is of some [illegible] contains, its value as an iron ore is spoiled [illegible], the process of separation being too costly; it has [illegible] (C. G. P.)—A. R. Your query should have been [illegible] there has been some difficulty in obtaining [illegible]. Alum cake is a specially-prepared body. It [illegible] from china clay, free from iron. This substance is [illegible] of alumina, produced by the decomposition of [illegible]. The clay is calcined in a furnace, and then treated [illegible] acid to combine with the alumina present, [illegible] alumina according to the equation:— [illegible] $2H_2O + 3H_2SO_4$ [illegible] $+ 2SiO_2 + 5H_2O$. The [illegible] one, necessitating the [illegible] water. The mixture boils violently, [illegible] a solid porous mass, which [illegible] with the sulphate [illegible] the clay is still present, [illegible] form.—C[illegible] Your query with reference [illegible] "Avogadro's Law," deals with a subject of [illegible]. We [illegible] Mr. Jago to supply for our chemi- [illegible] Soft water would not be [illegible] either a [illegible] or leaden pipe. Hard- [illegible] of lime or magnesia. The car- [illegible] carbon dioxide gas, if [illegible]. The [illegible] of lime and magnesia are themselves soluble. As carbon dioxide is expelled from water by boiling, the carbonates are then deposited and the water thereby softened. This treatment does not affect sulphates. Try whether the water in question is softened by boiling; if so, the hardness is only "temporary" and can be removed by the addition of a proper quantity of slacked lime, stirring the whole up, and then allowing it to settle. It would be well to get the hardness determined by a chemist, who would also inform you as to the proper quantity of lime to add to, say, ten or a hundred gallons of water. This is an economical and simple process; it would not, however, effect the removal of hardness due to sulphates. HARROVIENSIS. Your best plan will be to go to some gentleman professionally engaged in teaching chemistry, and who has had experience of technical analysis. Mr. Jago, of the Science School, Brighton, might be able to help you.

ELECTRICAL.

F. W. HALFPENNY. See article on "Griscom Motor" in KNOWLEDGE, No. 54. How many machines do you require to work? Are they all in one room, or distributed over a building?—CRANLEIGH. 1. See answer to C. J. B., &c. 2. No.—JAMES GRUNDY. 1. Mr. B. S. can doubtless supply what you require. Write and ask him. 2. About two-thirds of a pound to each plate. 3. I wrote from my office for a price-list from which I quoted, but which apparently gives wholesale prices. 4. Glad you appreciate it; the dynamo will be described in a week or two.—FRED. W. FOSTER. I take it that by far the greater portion of the readers of KNOWLEDGE are neither dunces nor wiseacres, but people of fair intelligence, who, having a little knowledge, desire more, and that, having been once informed of the meaning of a particular term, do not wish every reference to that term to be accompanied by an elaborate definition. Granted that the article in question contained technicalities, there were none which had not been previously explained. Certain expressions are furthermore imperative, as, for instance, electro-motive force. Were I, instead of this term, to substitute "tension" or "intensity," I imagine that we should receive sufficient letters condemning the crime to fill KNOWLEDGE for a month. Let me assure you that technicalities are avoided as much as possible, their use being confined to those occasions when the adoption of any other term would lead to misapprehensions or such-like difficulties.—C. J. B., HUGH MCMASTER, F. CLAPHAM, SPLIT RING, W. H. DRUCE, and P. C. Agent, Mr. Heap, 2, Scott's-yard, Bush-lane, Cannon-street, E.C. £3. 1s.; with battery, £6. 5s.—C. S. B. Presume you have some foundation to work upon. Surely you have a public library in Leeds, and should, therefore, be able to choose for yourself. To gain a "thorough" knowledge of electricity alone, ignoring altogether the other subjects you enumerate, you would require more books than have yet been published. Our rules forbid my mentioning any particular works.—E. A. F. In all probability, yes, but I have no record of any electrical disturbance on the 6th ultimo.—THOS. F. WOODHEAD. A few advertised, but I cannot say if the one described is on sale.

JUPITER. *Vide* text-books on astronomy.—H. M. How does that prove boy not electrified by artificial means?—F. SELBY. It has been tried; but no satisfactory arrangement could ever be made.—IOTA. (1) As near as I can make out, the next total eclipse visible in England will occur in 2090, shortly before sunset, total only in the south-west counties. As the time draws near, the Editor of KNOWLEDGE will give full instructions for observing it. (2) The author of "How to Get Strong" replies that, not being medical, he cannot give advice about preventing "stitch in the side;" but it is seldom noticed except when running or walking after a meal, when it is better to let the stitch prevent exercise, than to take exercise to prevent the stitch.—G. H. S. Dimensions of Martian satellites not known. Periods, 30h. 16m. and 7h. 38m.; distances from centre, 14,530 and 5,800 miles for Deimos (the outer) and Phobos, respectively.—W. SIMMONS. Thanks; quite agree with you.—ROBT. H. MUSHENS. Thanks; see "Gossip."—R. B. G. Have you tested your theory by a little calculation. The sun illuminates one hemisphere of the moon, *plus*—how much? Answer, a zone a quarter of a degree in width. How wide would this look when near the edge of the lunar disc? Even at the *middle* it would be about a 450th part of the moon's diameter in breadth; near the edge less than the 2,000th part.—T. A. Your position cannot be assailed—by me. SIDNEY TAVICK. So much more space than can be spared.

CRANLEIGH. (1) If comets be the fuel of the sun, he needs stoking; (2) Menacing Comet (?) not same as Tewfik's; (3) "If several comets appeared at the same time," two or three would be visible at once. Know of no other consequences; (4) There is but one R. A. Proctor, and he is his own editor.—DGON PARRIE. I certainly am one of the false scientists, if what your friends say is true. We are in a bad way, you and I. But, supposing we are wrong yet (as we know) honest in our belief, and are to suffer untold pains and penalties for being wrong, then would I, for one, rather submit to such punishment than offer to the Being they describe as so powerful, so unjust, and so cruel—the hideous idol fashioned out of their own heads, and no more holy than any other wooden idol—the unclean sacrifice of a lie. I agree with them pretty nearly in thinking evolution will not be more accepted forty years hence than now; for it cannot be much more fully accepted by all who know, and the multitude of those who do not know will be always great. The ignorant, like the poor, we have always with us.—P. A. FOTHERGILL. Thanks; shall appear. How foolish are the prevalent prejudices on the subject!—E. GURNEY, writing on behalf of the Society for Psychical Research, would be obliged if Mr. Sinclair (letter 650) would give him the address of Dr. Goodall Jones, of Liverpool, or enable Mr. Gurney to get first-hand information respecting the interesting case touched on in Mr. Sinclair's letter.—A. N. S. We think with you the passage quoted from De Morgan's letters ambiguous; probably it was meant to be so. In the illustration you give of the syllogism, the inference is fairly drawn from the premisses. If there are as many non-sculptor artists as there are painters (sculptors or otherwise), and some sculptors are painters, there must be non-sculptor artists to match the sculptor painters numerically; as many artists as remain—that is, as many as there are non-sculptor painters—may be painters; but this number among the artists (that is, as many as there are sculptor painters) must certainly not be painters. Put definite numbers, and the matter is simple enough. There are 531 painters and 531 non-sculping artists, and 119 sculptors are painters; then at least 119 artists are not painters, for there are only 412 non-sculping painters, while there are 119 more non-sculping artists.—SENEX. Mr. G. F. Chambers is quite right. Kepler had supposed there could be no transit of Venus in 1639. Horrox took the time of conjunction from Kepler's tables, rejecting Lansberg's; but he inferred a transit from his own observations of Venus, the same which had shown him the worthlessness of Lansberg's tables. —G. ST. CLAIR. What is the theory?—JACOBITE. (1) It was never supposed to be Newton's comet. (2) The changes have arisen chiefly from doubts as to what part was the true nucleus; this misled us all—Hind, Pickering, Smythe, Chandler, and—yours truly. (3) The rapid working of the machine necessitates rapid combustion, therefore quick breathing. (4) Will see about *errata* idea. (5) The cheapest edition of any of my works is that begun in first three volumes of Knowledge Library.—JULES MAGNY. (1) Some of my works have been translated into French, as "Other Worlds than Ours" and "School Star Atlas," by my friend, M. l'Abbé Moigno; but I do not know who are the publishers of the French edition. (2) I do not know the Robertsonian method of learning language.—J. E. CLARK, Bootham, York, would like any information about the meteor (?) seen at 6.10 on Nov. 17; in particular the *place* where "A. G." (letter, p. 431) made his observations.—B. J. S. Difference of distance and of conditions under which seen would account for difference of size.—L. E. MAWER wishes for instructions as to setting a Fitzroy barometer right which has had a fall, air having been thus introduced into the tube.—M. B. A. Astronomy knows nothing yet of condensations from the æther of space.—P. D. I do not myself understand how Mr. W. M. Williams makes out "matter" and "motion" to be convertible terms; it seems to me that "hours" and "boots" are as readily convertible.—ANOTHER OF YOUR SUBSCRIBERS. Your letter forwarded to a telescopic friend.

Our Whist Column.

By "FIVE OF CLUBS."

KEEPING BACK THE BEST OF A PLAIN SUIT.

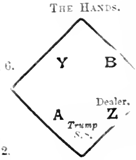
THE HANDS.

Y.

Spades—6, 5, 4.
Hearts—Kn, 10, 9.
Clubs—Q, Kn, 8.
Diamonds—Q, 8, 7, 6.

B.

Spades—Kn, 9, 3.
Hearts—6.
Clubs—10, 7, 5, 4, 2.
Diamonds—K, 9, 5, 4.



A.

Spades—A, K, 7.
Hearts—Q, 7, 5, 4.
Clubs—A, K, 3.
Diamonds—A, 10, 2.

Z.

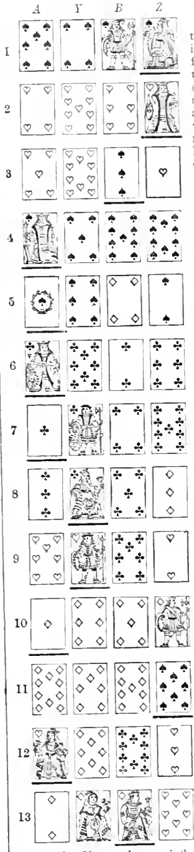
Spades—Q, 10, 8, 2.
Hearts—A, K, 8, 3, 2.
Clubs—9, 6.
Diamonds—Kn, 3.

Score:—A, B, = 1; Y, Z, = 0

THE PLAY.

NOTE.—The card underlined wins the trick, and card below leads next round.

A Y B Z



MR. LEWIS'S NOTES.

1. With such all-round strength, the trump is the proper lead. It is true that where the lead is not from numerical strength in trumps, the leader declares general strength, and gives the adversaries the opportunity of finessing against him in plain suits. But with such a hand, it is worth while running the risk. If the trump had not been led, *A* must have opened the Heart suit, in which only his partner's weakness (which might have been defeated) could have helped him.

2. *Z* opens a suit of five, headed by Ace, King. Some players, acting upon the analogy of a suit of five headed by the Ace, lead the Ace first. But I do not approve of this play. If the Ace is trumped, the position of the King is unknown. If the King on the second round is trumped, it simulates the lead of Ace, King, only.

4. Although void of Hearts, *B* properly returns the trump. *Z* leads the nine, as the eight was turned.

5. *A* continues trump, satisfied to make his Heart Queen later on. *B* is in a difficulty what to discard. As his partner led from three trumps only, he is uncertain of his suit. He keeps his numerical strength in Clubs.

9. *A* properly refuses to win the trick. With the long trump in *Z*'s hand, he would be freeing his other Hearts.

12. The success of holding back the Queen is now apparent. *A* and *B* win the game.

FORCING.—Speaking of the rule, "When weak in trumps do not force your partner," Col. Drayson makes the following sound remarks:—"It does not mean *never* force your partner if weak in trumps yourself; but it means, if you see a good chance of making more tricks by not forcing your partner than you could make by forcing him, then refrain from the force: but you should always remember it does not follow that your partner *must* take a force, even though you offer it him. He may conclude, and erroneously, that you are strong in trumps: but he would not conclude so unless he were considerably impressed with the importance of the advice, 'do not force your partner if weak in trumps.' Many players, influenced by this recommendation, will frequently throw away a game in consequence of their fertile imagination."

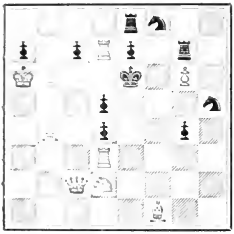
Our Chess Column.

By Mephisto.

[illegible]ROBLEM No. 66.

By L. P. Rees.

Black.



White.

White t[illegible] play and mate in three moves.

A SELECTION OF 107 CHESS PROBLEMS.

By Fran[illegible]s C. Collins (Wyman & Sons).

We [illegible] constantly being asked for good reprint problems, and for [illegible] containing the problems of eminent composers, notwithstanding that many of the good composers have published a collection of their problems, the latest of which, as our readers will be aware, is the excellent collection by J. A. Miles. Unfortunately, owing to certain unbusinesslike ways of these amateur authors, these books are not sufficiently brought before the notice of the public; hence they are not able to procure for themselves, at a low price, what to lovers of these problems must be an intellectual treat. The above is a collection of 107 very good problems, of which we select the following ingeniously-constructed puzzle:—

Black.

White.

It w[illegible] that B[illegible]k [illegible] be mated on the move. The query is: [illegible] the Black King have last moved?" The [illegible] was rendered all the more difficult by [illegible] 1. The position to admit mate on the [illegible] pieces, and at least twenty different [illegible] that the author has fulfilled [illegible].

PR[illegible]BLEM No. 62.

[illegible] A. M[illegible], p. 444.

1. [illegible]	1. K to K5 or ( )
2. [illegible]	2. K to B5, K4 or Q4
3. [illegible]	
	(1. K to B3 or ( )
2. [illegible]	
	(1. K to B5
2. [illegible] Q4	2. K to Q4
3. Q [illegible] K5 m[illegible]	

SOLUTION OF PROBLEM No. 61.

By L. P. Rees, p. 424.

1. B to Kt8	1. K to Q5
2. Kt to B3	2. K takes Kt
3. B to K5 mate, or if	
	2. K to B4
3. B to R7 mate.	

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Amateur.—"Cook's Primer" and "Cook's Synopsis."

G. H. Tillard, Francis J. Drake, J. W. Parsons.—Problem received with thanks.

Henry Freeman *v.* H. Jones.

Charles T. Gray.—Your solution of 63 and 64 properly acknowledged; we are at fault about 65, we regret to say this problem is incorrect.

Correct solutions received of C. S. Bright, J. K. Milne. Problem No. 63, of H. Seward, T. T. Dorrington, J. P. No. 64, of H. V. T., J. P. No. 62, W. F. W. Rees.

Herbert Jacobs.—Solutions correct.

C. H. Cope, T. B. S.—Solutions incorrect.

H. V. T.—Solution of Reprint No. 1 correct; in No. 2 the Bishop cannot check on Q7.

Problem No. 64 is to mate in four moves, instead of six, as stated on p. 460.

We are informed that the first reprint problem given on p. 473 is supposed to be the work of the French poet, Alfred de Musset.

A Locomotive Telegraph.—A system for enabling a railway-train in motion to send and receive telegrams was recently tried on the Atlanta to Charlotte aerial railway in America. It is the invention of Captain C. W. Williams, of the United States Army, and consists of a telegraph-wire running along the track, but insulated from it, and interrupted at intervals of 40 ft. The ends at each break are connected to copper rollers which normally are in contact, so that the electric circuit is completed through them. One car of the train is fitted up as a telegraph office, and two long metal strips or rails projecting from below the car rub against the metal rollers as the car passes. In doing so they depress the rollers, thus causing them to break contact with one another. The strips are connected together through the instruments in the car, and the electric current passes from one roller through the instruments to the other roller, and thence pursues its way along the rest of the wire. The circuit through the apparatus thus established is never absolutely interrupted; for, as the car moves from one pair of rollers to the next, the strips make contact with the latter just before contact with the former is broken. The instruments, in fact, are constantly moving along the telegraph line as the train itself moves, and hence a message can be recorded on them or dispatched. Telephones can be used as well as the ordinary Morse and Sounder instruments; and the system enables a passenger to send or receive an important telegram while travelling, or the position and state of the train to be communicated to a distant station.—*The Times.*

NOTICES.

The Star Maps for November and December, 1882, can now be had, price 2d. each, post-free, 2½d.

Just published, Part XIII. (Nov., 1882), price 10d., post-free, 1s. 1d.

The Title Page and Index to Volume I. price 2d., post-free 2½d.

Binding Cases for Volume I., price 2s. each. Subscribers' numbers bound (including Title, Index, and Case) for 3s. each.

The First Volume comprises the numbers published from the commencement to May 26, 1882 (Nos. 1 to 30).

The Second Volume will end with No. 61 (Dec. 29, 1882).

The Third Volume will commence with the first issue of 1883.

The Back Numbers of Knowledge, with the exception of Nos. 1 to 8, 10, 11, 12, 31, and 32, are in print, and can be obtained from all booksellers and newsagents, or direct from the Publishers. Should any difficulty arise in obtaining the paper, an application to the Publishers is respectfully requested.

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KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, DECEMBER 29, 1882.

Contents of No. 61.

Science and Art Gossip.

And now the end of the world is to come in 1886, *vice* 1882 departed.

But the comet, according to the latest estimate of its orbital motion, is not to return for 4,000 years,—though it *did* travel so close along the orbit of the comets of 1843 and 1882.

Between ten and eleven o'clock on Dec. 21, the attention of several persons in Broughty Ferry was directed for a time to a somewhat unusual sight in the heavens. The sun at the time was shining brightly, being about due south, when a star was seen in close proximity to it. The star was a little above the sun's path, and the peculiar phenomenon was seen by various persons, who had their attention directed to it. Being daytime, the star did not have the brilliant luminous radiance stars exhibit at night, but was of a milky white appearance, and seemed, when seen through the glass, to be of a crescent shape. Being on a light blue ground, and lying between two white clouds, it was seen to great advantage.

"De mortuis nil nisi bonum" seems to be precisely the reverse of the usual custom. For we never hear any man abused so roundly in life, as he is when, being dead, he can no longer defend himself. At least, it is so in public life. Perhaps, because a man who is in power, or may rise to power, is regarded as one whom it is best to treat respectfully—with due reference to what De Morgan called the "way up in the world." Anyhow, we never hear the worst that can be said of such men till after they are dead.

For instance, here are the words of a statesman, recorded by a bishop, who filled a greater space in public life than the innocuously neutral Tait, and had so pleasantly (to all seeming) rounded off his idiosyncratic corners that he was generally known as Saponaceous Samuel (or to that effect) respecting one who was certainly presented to the British public by omniscient newspapers as a great and chivalrous (not horsey) statesman :—

Clarendon spoke to me with the utmost bitterness of Lord Derby. He "had studied him ever since he (Clarendon) was in the House of Lords. No generosity, never, to friend or foe; never acknowledged help; a great aristocrat, proud of family wealth. He had only agreed to this (the Reform Bill of 1867) *as he would of old have backed a horse at Newmarket;* hated Disraeli, but believed in him *as he would have done in an unprincipled trainer: he wins, that is all.* He knows the garlic given, &c. He says to those without, 'All fair, gentlemen.'"

It was reported recently in certain daily and weekly papers that Colonel Keyter had done some heliographic signalling from the top of the Great Pyramid which had been read at Alexandria—a distance of 120 miles. As we pointed out in these columns, the thing was impossible, as the depression at each of a tangent line to the earth's surface, 120 miles long, and touching at its middle point, is $(60)^2 \times$ depression for 1 mile or (with due account of refraction) about 3,600 times 6 in., or 1,800 ft.—nearly four times the height of the Great Pyramid. We were invited to write to Colonel Keyter, asking under what conditions his signalling was made; but we were not very anxious to ask a question akin to, say, "Under what conditions did you see through a millstone?" But Mr. Hampden (who really *must* believe in the earth's flatness!) did so.

Colonel Keyter explains that his signalling was slightly exaggerated; it was at *Cairo*, not at *Alexandria*, that the signals were read—a distance of about 12 miles, instead of 120. The depression for the whole distance of 12 miles would be about 72 feet, or less than a sixth of the Great Pyramid's height.

A correspondent writes that Adam's Peak, in Ceylon, some 7,400 feet high, can be seen in clear weather a distance of 150 miles; but he does not say *whence*. If from the deck of a ship, I question the distance mightily, and doubt the captain's judgment of his position. If from a height of not less than 300 feet above the sea, and the barometric pressure high, so as to bring the effects of refraction to a maximum, which would make the depression for a mile rather less than $5\frac{1}{2}$ inches, the tangent line to the sea surface would touch 26 miles from the ship, and the remaining 124 miles would correspond to a depression of $(124)^2 \times 5\frac{1}{2}$ inches, or about 7,040 feet. This would leave 200 or 300 feet of the peak visible.

Messrs. Campbell, a firm of dyers at Perth, have adopted the electric light, and are well pleased with it, finding that the purity of the light enables them to distinguish colours perfectly, and to carry on at any hour operations which could be otherwise only performed by daylight.

Electric Light Companies received a somewhat severe rebuff the other day at the hands of Mr. Justice Chitty. A disappointed shareholder sued one of the subsidiary Brush Companies for the return of the money he had paid in. The claim was based on the fact that whereas the Lane-Fox incandescent lamp is the property of the British as well as the Brush Electric Light Companies, he took up his shares on the representation that the Brush Company had sole right to use it. The application was opposed on the ground that if a misstatement had been made it was not material, since the Lane-Fox lamp was the least valuable of the inventions conceded to the Company by the Anglo-American Corporation. Mr. Justice Chitty said that it was plain to an ordinary mind that there had [illegible] statement which was material, and calculated to mislead the applicant. His lordship also thought that it was not competent for persons who had issued a prospectus which had recommended as one of its leading attractions this particular invention, to afterwards say that the invention was of little or no value. The application must therefore [illegible] with costs, and the sum paid in respect of the [illegible] to the applicant by the Company.

"A [illegible] disreputable breed of flies," says the *Friend of* [illegible] appears to have its habitat in that sacred abode of learning, the Presidency College (Bengal). They are [illegible] Hindu flies nor are they Mussulman, or else they [illegible] perverted and depraved, for the dissolute little [illegible] are so shamelessly fond of intoxicants, that no [illegible] a Professor, who has been fortifying himself [illegible] arduous labours with a peg, present himself in [illegible]-room, than they swarm about his lips, revel [illegible] breath of his mouth, and drain the dews of his [illegible]. Their conduct must, we should think, be extremely troublesome to the pegging Professor: but that [illegible] the worst of it. The students know well what is [illegible] by the swarm of flies on the Professor's lips. They [illegible] that their revered instructor has been indulging in strong liquors, and it is feared that they may desire to imitate him by turning their innocent and scarce yet downy lips into taverns for the bibulous flies. This is the serious [illegible] of the humorous picture drawn by our respected contemporary, the *[illegible] Public Opinion*, who exclaims:—"Fancy the picture of a Principal and Professor coming to that class, with the perfume of wine about his person, and with [illegible] obstinately chasing his mouth: what an edifying [illegible] that!" Edifying, indeed! We join with our contemporary in advising the Principal and Professors of the Presidency College to abstain from wine and pegs till after college hours unless they can exterminate that [illegible] breed of flies that chase the bibulous mouth."

A [illegible] of the Jurgensen dynamo-machine has been [illegible] by the Danish Government. It was compared with the Gramme machine. The following table will show the [illegible] of four days' working:—

	Gramme.	Jurgensen.
[illegible] per minute	475	400
[illegible]	28,800	10,000
[illegible] after 1 [illegible]		
[illegible]	30 R	25 R
[illegible] in Ohms	0·424	0·390
[illegible]		
	3·150	3·30

[illegible] seen that the Jurgensen dynamo gave [illegible] more light than the Gramme, while, at the same time, the Gramme required about 90 times as much [illegible] competitor.

[illegible] telegraph cables are being laid in Stra[illegible] to replace the aerial wires previously employed. The [illegible] in trenches about 3 ft. deep.

THE PRESERVATION OF LEMON JUICE.—A correspondent in *M[illegible] de Med. et [illegible] Pharm. Milit.* says, [illegible] experiments and the test of eight months' [illegible] and heat of summer, he has come to [illegible] "Heating the juice or adding [illegible] would appear to be superfluous, as it is [illegible] keep it sealed in bottles; [illegible] proceeds very slowly, the best way [illegible] add 10 per cent. of alcohol to the fresh juice, and bottle. The *Pharmaceutical Journal* observes that it may be preserved without the addition of alcohol by heating it to 150° Fah., and then excluding it from the air by carefully closing the full bottles at this temperature. The operation should be carried out in winter.

A CORRESPONDENT, writing from Middlesbrough, remarks that there the Christmas Carol to which we referred in our last as almost always misquoted, "God rest you, merry gentlemen," is rendered thus:—

> God arrest you, merry gentlemen;
> Let nothing you dismire,

—a reading worthy of Dogberry himself. God rest us merry!

REFERRING at the Society of Arts the other day to the recent calamitous fire in the City, Mr. W. H. Preece called attention to the many automatic fire alarms now before the public. These cheap as well as ingenious instruments are certainly calculated to meet a great want, which must render itself more and more apparent as time goes on.

WE receive many letters showing that readers like those occasional Gossip notes in which we touch on our personal views, thoughts, plans, and so forth. But there are one or two dull souls who cannot understand why we do this. They tell us we should prefer *stare super antiquas vias*, to keep up the usual editorial dignity, and so forth. They point out that the Editor of this journal or of that magazine does not talk thus familiarly with his readers—does not (above all things) note and correct his own mistakes with those of others. We know it. We choose our own way, because we like it much better. We prefer to have no pedestal on which to assume statuesque editorial dignity.

MR. EDWARD CLODD, author of the "Childhood of the World," &c., &c., and contributor of articles on the "Antiquity of Man," &c., to the first two volumes of KNOWLEDGE (reprinted, with additions, in our forthcoming volumes, "Nature Studies" and "Leisure Readings"), will contribute to early numbers of KNOWLEDGE a series of papers on the "Origin and Growth of Myth, and its survival among civilised peoples in their folk-lore, traditions, and beliefs." These will probably be followed by papers on the place of Dreams in savage philosophy, as further contributory to the subject of human progress.

Also, for the volume which begins with No. 62, several series of articles will appear, among them the following:—

"A Naturalist's Year," by Mr. Grant Allen.
"Our Bodies," by Dr. Andrew Wilson.
"Pleasant Hours with the Microscope," by Mr. H. J. Slack.
"Nights with a Three-inch Telescope," by F.R.A.S.
"The Chemistry of Cookery," by Mr. W. Mattieu Williams.
"Sociology," by Mr. Thomas Foster.
"Sun-views of the Earth in the Seasons," illustrated;
And "The Southern Skies," by the Editor.

Besides these, there will be articles on "Electricity," "Chemistry," "Entomology," "Geology," and "Health Resorts," the series on "How to Get Strong" will be continued, and the columns of "Mathematics," "Whist," and "Chess" will be continued weekly. For the present, the "Easy Lessons in the Differential Calculus" will be replaced by simpler mathematical subjects; but they will ere long be resumed, until so much of the subject as can conveniently be dealt with in these pages has been completed.

THE STAR IN THE EAST.

By Richard A. Proctor.

It has been suggested by Ideler (1826) that the star which the magi saw in the East was in reality a conjunction of the two planets Jupiter and Saturn. In point of fact, no less than three conjunctions of these two planets occurred in the year 7 B.C., or, remembering the error of four years in the ordinary dating of the year from which the Christian era is reckoned, in the third year before the birth of Christ. On May 29, in that year, the two planets were within a distance of about one degree from each other, or about twice the apparent diameter of the moon. On Sept. 30 they were again at about the same distance from each other, and on Dec. 5 they were for yet a third time almost exactly at the same distance apart. On Sept. 30, in the year 7 B C., the two planets must have presented a very striking appearance, since they were then both nearly at their brightest.

Ideler's calculations were not quite so exact as those I have here dealt with (which are Encke's). Yet even Ideler's imperfect calculations made it clear that the two planets could not have been less than half a degree from each other—a distance equal to about the apparent diameter of the moon. Ideler, therefore, in order to explain how the two planets came to be mistaken for a single star, was obliged to introduce the subsidiary theory that the magi were very shortsighted, insomuch that the images of the two planets appeared to them to form in appearance a single star of exceptional brightness. When Encke, in 1831, announced the result of his calculations as setting the planets about one degree apart at each of their three conjunctions in the year 7 B.C., Ideler withdrew this fanciful notion. For though to a very shortsighted person the image of a star may appear a little larger than the moon, and thus two stars separated by a distance equal to the moon's apparent diameter might seem to coalesce into a single blurred image (shaped somewhat like the dumb-bell nebula, yet assuredly two stars separated by twice this distance could not possibly be mistaken by the magi for one, unless we suppose those worthies to have been miraculously shortsighted, which does not appear from the narrative. Therefore Ideler now only maintained that the unusual conjunctions of Jupiter and Saturn in the third year before the birth of Christ formed the special astronomical phenomenon which announced to the magi the approaching birth of the great King, whose "kingdom was not of this world." Singularly enough, Dr. Farrar, whom we would suppose unlikely to be led astray by astronomical fancies, adopts in his "Life of Christ" the strange theory thus advanced.

If we consider carefully the narrative given by Matthew, and especially if we consider it from the point of view of those theologians who believe in verbal inspiration, it will appear that this explanation of the Star in the East is altogether inadmissible. It will be well thus to examine the account, one of the most suggestive and poetical in the Gospels, and altogether the most poetical in the Gospel of Matthew. It is well worthy of study in whatever way we view it, whether we regard it as an inspired narrative, true in every detail, or whether we consider it as a tradition only, or whether, lastly, we take some view intermediate between these extreme opinions. Here, however, I only note those features of the narrative which might be apt to escape attention, not to run through the entire account, with which every one may be supposed to be perfectly familiar. I follow the Greek version, not that our translation is inaccurate, but because there are one or two sentences which might be wrongly understood in the English version, while their meaning in the Greek is unmistakable.

Christ was already born in Bethlehem, but how long before we do not know, when certain magi, or persons possessed of occult knowledge, came from the East to Jerusalem. Probably they were supposed to have come from Chaldea, since their wisdom is manifestly associated with the interpretation of the stars, for which the Chaldeans were in those days, and had been for ages, famous. The use of the word "magi," even if we translated it "magicians," would not of itself imply anything objectionable in their wisdom, although the same word is translated "sorcerer" when applied to Elymas, and is used in a somewhat similar sense in the case of Simon Magus. For in the East, the possession of magical power or wisdom was not necessary, or, indeed, chiefly regarded as evidence of wickedness, but frequently as the reward of special virtue. Be this as it may, it is certain that Matthew's narrative attributes a good purpose to the magi who came from the East to worship Christ—though some of the consequences of their journey were, to say the least, unfortunate. They knew from the star or celestial phenomenon which they had observed that one was born who was to be King of the Jews, and they had, therefore, come to Jerusalem, the chief city of the Jews, to ask for more precise information. Astrology, according to the teaching of its leading professors in those days (as, indeed, now), affords the means of determining what region of the earth is indicated by some special phenomenon, though not of assigning the exact part of that region which is in question.

The magi learned from Herod that Bethlehem of Judea was the place where the Messiah was to be born. He had obtained this information from the chief priests and scribes, who interpreted as a prediction to that effect certain words of the prophet Micah. So soon as the magi had been told this they set out from Jerusalem toward Bethlehem, or in a nearly southerly direction. We may suppose that, as Longfellow sings—

> They travelled by night and they slept by day,
> For their guide was a beautiful, wonderful star.

And the star which they had seen in the East went before them till it came and stood over where the young child was. This would imply, if we suppose that they reached Bethlehem near the middle of the night, that the star or orb which they regarded as signifying the coming of a great king was nearly in opposition to the sun at the time when they reached the village where the child was. We must remember, however, in reading this account, that the distance which the magi had to journey was not great—not more, certainly, than six miles. Supposing them to be very feeble old men, and to be heavily burdened with their gifts, which seems hardly probable, since they had come to Jerusalem from a distant country, they could hardly have been more than three hours at the outside upon their journey, if they set out from Jerusalem as the shades of evening closed, and the time was winter, as commonly received, then it would have been about eight in the evening at latest when they reached Bethlehem. And if at that hour the star lay due South, or rather to the west of South, then it must have been sixty or seventy degrees West of the point opposite the sun. This would correspond fairly with the case of the conjoined planets Jupiter and Saturn in the third year before the birth of Christ, if we suppose the journey to Bethlehem made nearly at the time of the third conjunction of those planets, or about December 5. It is, in fact, on this circumstance chiefly that the planetary conjunction theory of the Star in the East has [illegible]. But the whole character of the narrative is opposed to this interpretation, apart from the fact that the taxing of the Roman Empire by Augustus, when Joseph and Mary went up to Bethlehem (according to Luke's account) certainly did not take place till two years after the triple conjunction of Jupiter and Saturn. For Matthew says, "Lo, the star went before them," &c., and "when they saw the star, they rejoiced with exceeding great joy." But they would not have lost sight of the planets Jupiter and Saturn from the time when these two planets had been visible in conjunction as morning stars in May (B.C. 7) through the time of their greatest combined brilliancy in September, and onward until the time of their third conjunction on Dec. 5. We had a similar triple conjunction of Mars and Saturn in the year 1877. They were conjoined as morning stars on July 27, conjoined when nearly at their full brightness on Aug. 2[illegible], and conjoined again as evening stars on Nov. 3. But all through those months they were both visible and in tolerably close proximity. The exceeding great joy with which the magi again saw the star shows that it had been for a time lost to them, so that we must on this account reject the planetary conjunction theory which seems otherwise (and on several grounds) altogether untenable.

I do not know whether any other astronomical interpretation than the one I have just considered has been given to the account of the Star of Bethlehem—at least in a definitely scientific manner. The idea has been thrown out that a comet may have been the magi's celestial guide. Others, again, think that the phenomenon was not astronomical at all, but that some mysterious light made its appearance in the upper regions of the air and guided the magi on their way. Even if we adopted this view, though the narrative seems very distinctly to imply that the object seen was some celestial body, the observed event, apart from its [illegible] interpretation, belongs distinctly to the domain of science. I do not say it is to be explained as a simply natural phenomenon, but even if a supernatural [illegible] to be assigned to it, science, though it deals only with the investigation of natural phenomena, is interested [illegible] may say is doubly interested—in this case [illegible] this view) a phenomenon really supernatural appeared to ordinary observation to resemble [illegible] an appearance as a star or asterism (for the Greek word will bear more than one interpretation). The narrative, like the Bible account of the Creation, the description of the standing still of the [illegible] at the command of Joshua, the going back of the [illegible] on the dial of Ahaz, the account of the [illegible] the kingdoms of the earth from an exceeding [illegible] mountain, and so forth, is one which science is [illegible] to discuss in all its bearings. Even if science [illegible] supernatural interpretation, it is still its office [illegible] the observed facts, for on such scientific discus[illegible] our opinion of the quality and significance of the [illegible]

[illegible] necessary for science to pretend to explain the [illegible] religious bearing, or even to say what that [illegible] Science might fail to show why certain [illegible] presumably astrologers) were to be en[illegible] the object, whatever it may have [illegible] prophecy of Micah had, it would seem, to be f[illegible]. That the fulfilment should have [illegible] slaughter of the innocents, again, when (as [illegible] the same result might have been [illegible] without that unsatisfactory episode, is [illegible] the theologian and not the student of [illegible] to explain. But when a star is mentioned in the Bible, as anywhere else, the astronomer, following in effect the rule which forms the motto on the seal of the Astronomical Society—*quidquid nitet notandum*—is bound, or is, at any rate, free, to inquire about that star, its recorded movements, its probable brilliancy, and so forth, so far as such points can be inferred from the narrative. Students in another department of science are entitled to deal with this narrative because of the evidence which it seems to afford respecting the prevalence in long past ages of those astrological fancies which remain even in our own time, though with the gradual spread of information respecting astronomy their influence is manifestly diminishing.

THE CRYSTAL PALACE ELECTRIC AND GAS EXHIBITION.

THIS display, which was formally opened on the 13th inst., is scarcely worthy to be called an exhibition. The Electric Exhibition of last winter, it will be remembered, was several months in getting ready, and its official opening did not take place until its course was well-nigh run. Nevertheless, so far as the Palace Company was concerned, it was a great success. The public flocked in crowds unknown for years past. True, they had their reward, for never had there been so gorgeous a flood of light as then illuminated the length and breadth of the Palace, and latterly the terrace as well. Lectures were given, at first of such a character as to interest and instruct uninitiated audiences; but towards the close of the course they seemed to be stamped very plainly with an advertiser's brand. Outside the lecture-room, several of the exhibitors wisely appointed gentlemen to explain their apparatus. Vast sums of money were thus expended, although, we fear, in many cases, with little chance of return. To an outsider, all seemed to be working harmoniously towards a common end, but close beneath the brilliant surface was flowing an undercurrent which has told terribly upon the present exhibition. A gold-thirsty company could only drain its goblet once, and many were the murmurs of discontent which wafted themselves upon the ears of a watchful listener.

To crown all this, a jury of gentlemen was formed (amongst whom were many more or less intimately associated with various exhibits), who to drown the voice of jealousy, and, at the same time, to give a sprat for the whale that had been caught, appear to have bestowed medals and honours broadcast. What is the result? This year the electric exhibitors, which at one time were expected to be sufficiently numerous to fill another electric exhibition, are exceedingly few, and, nominally, cover considerably less than half the space occupied last year. We search the catalogue in vain for such names as Edison, Brush, Hammond, Siemens, Swan, Maxim-Weston, H.M. Government, the Cable Companies, and a host of others who contributed so considerably towards last year's success. In the Electrical section, therefore, we must this year be satisfied with small mercies. The Mackenzie lamp is again displayed, there being three of these arc lights exhibited by Messrs. Strode & Co., who also possess one of the most tastily-arranged displays of incandescent lamps (Swan's) it has ever been our pleasure to behold. In the Alhambra Court, which, it will be remembered, was prettily illuminated last year by Lane Fox lamps, there are some Werdermann lamps. They were not going well while we watched their performance, and the cause was not far to seek, for on adjourning to the dynamo room (the one occupied last year by the Brush Company), we saw a more brilliant "armature-fire" than we had ever seen before. The brushes or collectors were not making contact with the commutator at the proper points, and consequently, the current fused them at a great rate, the characteristic green flame of copper illuminating the dynamo and the space around it, and, frequently, pieces of red-hot copper flying off in various directions. It is surprising to us that the insulation on the field magnet underlying the commutator was not set on fire, or, at least, electrically destroyed.

The Roman Court is occupied by an "Electric Bazaar," and here our feelings received a severe shock, for on the tables were a number of Voss machines,* all of them with the fixed plate placed out of position in such a way that they could not be put right without either the vertical or horizontal combs being removed. The attendant was, of course, unable to get a spark, and to account for the failure informed inquirers that *the weather was too damp!* Along the centre of the north nave are several miscellaneous exhibits, few of them, however, being far advanced in preparation. They should be illuminated in the evening by various forms of electric light, but the three Mackenzie lamps are the only ones at present visible.

The gas exhibits are by far the more important and interesting, and are also much nearer completion than those in the electrical section. A fund of upwards of £5,000 has been subscribed by the various gas interests; and accordingly a very representative exhibition may be anticipated. The south nave is well lighted by Sugg, Bray, Siemens, Strode, Heron, and others; but of these we will speak more fully hereafter. The West Corridor is well stocked with gas-engines, cooking and heating apparatus, &c., and in other adjacent portions of the palace a crowd of very interesting exhibits are, or soon will be, open to inspection. Not the least interesting object is Pintsch's patent gas apparatus, by which a railway passenger carriage is lighted for 36 or 40 hours with one charging of gas. The charging is said to be effected in less than a minute. A cylinder underneath the carriage holds the specially-made oil gas at a pressure of 90 lb. This is being constantly reduced by the consumption at the burners, but the patent regulator always brings the gas to them at the proper burning pressure. The cost is claimed to be less than half that of the usual railway oil lamp, and several British railways are using the light. Equally interesting is Pintsch's nine-feet spherical gas-buoy, with lantern and dioptric lens. It is charged with oil gas, and will burn for three months continuously, the light being visible for six miles. By the time this notice appears, the Gas Exhibition will be nearly completed and very interesting, but the North Nave is doomed to remain in semi-darkness for some weeks.

CORSETS AND HEALTH.†

By Dr. Dio Lewis.

STRENGTH AND ACTIVITY OF WOMEN WHEN UNHAMPERED BY CORSETS.

THE Boston Normal School for Physical Education trained and graduated 121 teachers of the new School of Gymnastics. The graduates are about equally divided between the sexes. A considerable proportion of the women were school-teachers in broken health, seeking in the new profession a better means of living. The average health of the women was, in the beginning, lower than that of the men. But, with the removal of the corset and the long heavy skirts, and the use of those exercises which a short and very loose dress renders easy, a remarkable change ensued. In every one of the ten classes of graduates, the best gymnast was a woman. In each class there were from two to six women superior to all the men. In exhibiting the graduating classes from year to year on the platform of Tremont Temple, women were uniformly placed in the more conspicuous situations, not because they were women, but because they were the finer performers. Dr. Walter Channing, who was one of the professors in this normal school, often spoke with great enthusiasm of the superiority of the women.

A convincing experiment was made upon a large number of girls at Lexington, Mass. A school for young ladies was announced and large buildings prepared. During four years of personal management by the founder of the school, nearly three hundred young women were subjected to a new and peculiar regimen, to determine the possibility of improving their bodies during their school-life, as the bodies of young men are improved in some of the German universities. An exceptionally full curriculum of studies was adopted, and a large corps of teachers, including such distinguished names as Theodore D. Weld, Catherine Beecher, and Zerdahelyi, laboured with enthusiasm in the brain-work. The pupils were pressed harder, probably, than in any other school in New England. The girls averaged about seventeen years of age, and came from all parts of the country, including California, Central America, and the West Indies. They were largely from wealthy families—delicate girls, unable to bear the artificial life of fashionable seminaries, and were drawn to the Lexington school by its fame for body-training. The constant dress of the pupils, like that of the Normal school, was short and loose, leaving the girls as much liberty as boys have in their gymnasium dresses. The results of the physical training at Lexington are well known:—

On entering the school, pupils were measured about the chest, under the arms, about the waist, the arm, and the fore-arm. The average gain for eight months about the chest was 2½ inches; waist, 5 inches; arm, 1½ inches; fore-arm, about 1 inch. The work was so hard that, with all this remarkable development, the weight of the pupil was often lessened. Of course, the girls came with injunctions from their mothers not to climb stairs, and with letters from family physicians urging moderation in gymnastics, and prescribing the horizontal position a number of days each month. With the corsets and long skirts in which they came, these injunctions and cautions were not unwise; but, with the change of dress, became absurd.

And now, with a full knowledge of all the facts familiar to hundreds of grateful parents, the writer affirms that, giving little or no attention to periodicity, the girls worked through the entire month in those extreme stridings and other vigorous exercises of the legs and hips, contrived to counteract the evil effects of the long, imprisoning skirts, and that in the four years not only was no harm done by this constant and dreadful violation of Dr. Edward Clarke's counsels, but that in no instance did a pupil fail to improve in health. The results may be described as follows: Pupils came with dread of stairs, with back ache, palpitation, and other sufferings which may not be named here, and in a few months could do the full and hard gymnastic work of the school, dance three evenings a week, go upstairs without symptoms, and walk five to ten miles on Saturday without inconvenience. A common exclamation among the pupils was this: "What a slave I was! Everything was toil and suffering. I have now just begun to live!" And all this happy change came of abandonment

* See Knowledge No. 59. † From the *North American Review*.

[illegible] of a simple, physiological dress, with the [illegible] which this change in dress renders easy. [illegible] health and capacity often seemed magical. If this paper were designed for the eyes of medical men [illegible] certain facts might be given which would surprise [illegible] and leave no doubt that we have utterly failed to [illegible] the mischief done to the growing form by the [illegible] modes of dress.

[illegible] may think that camp-life in the mountains of [illegible] course of training in the Normal School for [illegible] four years drill in the school at [illegible] will account for happy changes without any [illegible] dress. We saw many ladies in the mountains [illegible] in long skirts and corsets, and their health [illegible], but the physiologist will assure us that the improvement could not be muscular and radical. As to [illegible] in the gymnasium, the observation of thirty years [illegible] seminaries leads to the conviction that girls in corsets seriously endanger their welfare when they try to exercise beyond gentle walking and dancing. All attempts at [illegible] work must prove mischievous. For many years we have cautioned corseted women against the gymnasium, and have seriously urged easy-chairs and lounges. The advice given by Dr. Edward Clarke, and repeated by thousands of doctors to their lady patients, to [illegible] as much as possible, and periodically spend a [illegible] in bed, is, if a corset be worn, not only wise and [illegible], but indispensable. To ladies who declare that they cannot abandon their corsets, the writer uniformly gives the same advice.

The errors in women's dress are:—

1. The corset, which reduces the waist from three to fifteen inches, and pushes the organs within, downward.

2. Unequal distribution. While her chest and hips are often overloaded, her arms and legs are so thinly clad that the imperfect circulation compels congestion of the trunk and head.

3. Long heavy skirts, which drag upon the body, and impede the movements of the legs.

4. Tight shoes, which arrest circulation, and make walking difficult. High heels, which increase the difficulty in walking, and so change the centre of gravity in the body as to produce dislocations in the pelvic viscera.

[illegible] of space forbids details under each of these heads, [illegible] speak briefly of the corset, by far the greatest evil. Do women practise tight lacing? Since beginning this paper we have asked this question of more than a score of [illegible]. The answer is "No." One lady, whose waist has been reduced more than eight inches, declares that she has [illegible] all her life, but has never seen it. She said [illegible] I wear a corset, though, from my immense [illegible] inches, you would hardly think it. And I [illegible] ladies generally manage about as I do; they [illegible] corset to keep their clothes in shape, but it hardly [illegible]. In forty years' professional experience [illegible] the wearer of [illegible], we cannot now recall a single [illegible] of those who had reduced their waists [illegible] inches. One can write freely on this [illegible] of hurting the feelings of lacing [illegible], for no one of them will imagine herself guilty; [illegible] disparagingly as he please of [illegible] the smallest woman regards herself as [illegible] immense.

We have [illegible] with several corset-makers, and sum up [illegible] as follows. Fashionable ladies, and [illegible] them, purchase corsets which are from three to [illegible] inches smaller than their waists, and then use them so as to reduce their waists from two to eight inches. More than one corset-maker has placed the averages higher than these figures.

Many inquiries have been made of those artists who make a special study of the female figure. Their testimony is stronger than that of the corset makers. One artist, who is a recognised authority in this department, has assured us that in painting portraits of women, no good artist will paint the laced figure. The subject must hide with drapery what the artist regards as a hideous deformity. An eminent artist, with a good eye and thorough knowledge of proportion in the female figure, permitted the writer to sit by his side on a thoroughfare when ladies were out in force, and expressed his opinion about their waists.

"That one is reduced six inches; that one ten inches; that young lady five; that one twelve; that large woman has reduced her waist fully fifteen inches." "What proportion of these ladies would you paint in their corsets?" he was asked. "I have not seen one that I would paint without asking her to cover her deformity."

If any one will devote an hour to a study of the female figure as seen in classic art, and will then give another hour to street observations during the fashionable promenade, with an aching heart he will go over to the ranks of the discouraged. He cannot forget that these are to be the mothers of our next generation.

A STRANGE CATERPILLAR,

AND ITS REMARKABLE METHOD OF CAPTURING PREY.

By C. F. Holder.

Among the many interesting creatures that have been unearthed by scientific investigation during the past few years, the Peripatus deservedly stands foremost in the rank, not alone for its peculiar individuality, but for certain habits shown when obtaining food and defending itself from attack. According to late classification, it forms the single insect of the sub-class Malacopoda, and is only represented by a single genus—Peripatus. It is considered an extremely ancient form, from its wide and peculiar distribution, being found at Cape of Good Hope, St. Thomas, Australia, New Zealand, Chili, and Isthmus of Panama, and thought the nearest extant representative of the ancestors of our air-breathing anthropoda, spiders, &c.

In appearance the *Peripatus capensis* is exceedingly disagreeable, resembling a large black caterpillar, three inches or more in length. From the head protrude a pair of curious jointed horns like antennæ that incline forward, seemingly used as feelers, though the head bears a small pair of simple eyes. Beneath is the mouth, with its singular turned lips and double pair of horny jaws, well adapted for crunching the larger game it affects. The seventeen pairs of feet are short, fleshy, and provided with two short claws adapted for clinging upon rocks or trees. The body is cylindrical and soft, the integument not chitinised, and head not separate from the body, its great difference from other anthropods being in its "two widely separated minutely ganglionated nervous cords sent backward from the brain; also in the minute numerous tracheal twigs arising from the many minute oval openings situated irregularly along the median line of the ventral surface of the body." It calls to mind features of Lingualulina and Tardigrada by its curious soft clawed feet, and, according to Packard, is not a worm, but an intermediate between them and the sucking myriopods. Its method of breathing is peculiar in the extreme. Instead of the tracheal tubes opening to the exterior by small stigmata arranged along the body in regular order, as in other animals that have tracheæ, their tracheæ are scattered here and there over the entire body. It appears, says Moseley, that we have existing in Peripatus almost the earliest stage in the evolution of tracheæ, and that these air tubes were developed in the first tracheate animal out of skin glands scattered all over the body. In the higher tracheate animals the tracheal openings have become restricted to certain definite positions by the action of natural selection.

The sexes are distinct, and the males much smaller and rarer than the females. Out of fifty specimens found only two were males. The females are viviparous; and, according to the above-mentioned distinguished author, a standard-bearer of the lamented Darwin, a process of development of the young shows that the horny jaws of the animal are the slightly modified claws of a pair of limbs turned inward over the mouth as development proceeds; in fact, "foot jaws," as in other anthropods.

To Moseley is due all the present knowledge concerning this curious insect, and previous to his elaborate examinations at the Cape of Good Hope nothing was known as to its method of breathing air by means of tracheæ, scientists believing it to be an annelid.

In the accompanying cut the great peculiarity of the animal is shown. Being slow, cumbersome, and utterly unable to pursue game, it seems to have been provided by nature with ample compensation. We see it lying upon the ground almost invisible, so similar is it in colour to its surroundings; a fly or some larger insect approaches; the two horns dilate, move to and fro, as if in excitement, and the approaching fly, when within several inches, suddenly stops, as if paralysed and unable to move, but remains suspended in the air. We draw nearer and see the cause of this phenomenon. At the approach of the victim the Peripatus has ejected from its mouth curious thread-like jets of some glutinous irritating fluid that forms instantaneously, as if by magic, a complete network of gleaming, glistening web, that resembles the maze of the spider with its quivering drops of dew. Myriads of these glistening darts or threads encompass the victim, holding it in a close embrace until the unwieldy Peripatus approaches, breaking through the sheeny prison, and releasing the victim to a worse fate.

This remarkable web is found to proceed from large glands that secrete a clear viscid fluid that seems to crystallize when ejected from the papilla, one of which is found at each side of the mouth. If the Peripatus is attacked suddenly the web appears in front of it instantly, the jets forming a perfect protection from many enemies, as it is almost as tenacious as birdlime. It is not an irritant when tasted, but when taken from the glands and placed upon a glass slide, forms a trap for the largest insects, holding them securely.

The food of the Peripatus is, however, to a great extent, vegetable, and in the stomachs of nearly all the specimens examined by Professor Moseley at Good Hope, vegetable matter was found. In their habits they are similar to the common centipedes, living under logs, stones, and dead wood. They are nocturnal insects, moving about in a slow, hesitating manner in the daytime. When at rest the body is perhaps two inches long, but in motion they stretch out in a surprising manner to nearly twice that length. Most of the specimens found by Professor Moseley were in old willows that were highly luminous, and in the weird light the insects were seen coiled up ready for transportation to the collecting case. Professor Moseley thus describes the search for this *rara insecta*:—

"My colleague, the late Von Willemoes Suhm, and I both searched hard for *Peripatus*. He was unsuccessful, but I was lucky enough to find a fine specimen first under an old cart-wheel at Wynberg. Immediately that I opened this one I saw its tracheæ, and the fully-formed young within it. Had my colleague lighted on the specimen, he would, no doubt, have made the discovery instead."

In New Zealand, the species known as *P. Novæ Zealandæ*, is found among the dead wood near Wellington. Here, also, the females predominate. It much resembles the *Capensis*, having, however, thirty feet instead of thirty-four.

Equally remarkable as a web-constructor are the larvæ of a lepidopterous insect, the *Hyphantidium sericarium*, found in Australia. Myriads of the creatures join forces and produce a silken web, in some cases measuring nearly 300 square feet. Mrs. Thos. Wiseman, of Australia, has successfully raised numbers of them, and sent specimens to Europe. Mr. Helenus Scott, of the Wollombi, thus refers to her work in a communication sent to an English naturalist with some specimens:—

"Mrs. Wiseman had placed a quantity of shelled maize in a veranda room, 8 ft. 6 in. long, 6 ft. wide, and 9 ft. 3 in. high, the stone walls being plastered. At a subsequent period, this room being required for a bedroom, the walls were found to be entirely and uniformly covered by a beautiful white-coloured web, fastened at the ceiling, floor, and corners by a stouter and coarser fabric, and occasionally to portions of the wall itself: so that in this instance an unbroken sheet of cloth, containing some 72 square feet, might with care have been obtained; while the web measured at least some 252 square feet. The specimens of this cloth sent to me, rudely torn from the walls, were of the size of a large handkerchief. The remaining portions of the original construction had been ruthlessly destroyed by the servants. The larva, when full grown, is about five-twelfths of an inch in length, with the head and first annulation depressed, somewhat horny, and of a blackish-brown. It possesses sixteen feet.

"It is of a pale yellowish-white colour, with whorls of six small black spots on each annulation, each emitting a tiny hair. The caudal segment is spotted with brown.

"In confinement these caterpillars were found to be active, with a dislike to the light; so that when exposed, they immediately commenced spinning their web, connecting together several grains of the maize, upon which they subsisted. They likewise lined the top and sides of the box with their silken tissue.

"At the latter end of August they assumed the pupa state, each larva assuming a separate cocoon for itself [illegible] the [illegible] consisting of a flimsy web somewhat tightly [illegible] the chrysalis, which was of a light [illegible] with the wing cases largely developed and [illegible] of an inch in length.

[illegible] perfect insect took wing in October, and is three- [illegible] of an inch in expanse, and active in its movements. [illegible] wings were elongated, the costal margin [illegible] the apex rounded. General colour greyish-brown, [illegible] with stigmata and strigæ of a darker [illegible] wings of a light semi-transparent silvery [illegible] with a deep marginal fringe. Thorax similar in [illegible] the anterior wings, and not crested. Abdomen [illegible], the whole of the under side light silvery grey. [illegible] wings are slightly convoluted in repose."—*Scientific* [illegible]

"OUR BODIES:"

SHORT PAPERS ON PHYSIOLOGY.

No. II.—JOINTS.

By Dr. Andrew Wilson, F.R.S.E.

THE name "joint" is given to the movable surfaces [illegible] two or more bones; and, as a matter of fact, [illegible] movements (to be discussed in another paper) [illegible] towards the movements of the bones concerned [illegible] forming the joint. The scientific name of a joint is an [illegible] and the reason for the application of this [illegible] at once to the connected series of syllables and words [illegible] form "speech," and to bodily mechanics, can be [illegible] appreciated. There are some five structures which enter into the formation of an ordinary "joint." Firstly [illegible] the [illegible]. Then, secondly, bones are tied together [illegible] fibrous cords, known as *ligaments*. The beautiful [illegible] of the knee, uniting the thigh to the top of [illegible] shin-bone, or those of the elbow joint, illustrate the [illegible] in question. Ligaments are related to the sinews [illegible] of muscles in their composition; both being [illegible]. Thirdly comes the layer of gristle or [illegible] which coats the ends of the bones which rub on [illegible] other in the movements of the joint. This cartilage [illegible] *cartilage*. It is of a beautifully smooth, [illegible] structure (as may be seen in a butcher's shop, [illegible] the end of a bone which has just been turned [illegible], and is of a bluish white colour. This [illegible] the part of a "buffer," and serves to limit [illegible] in joints, besides rendering the [illegible] of the bones smooth. The fourth structure [illegible] a peculiar membrane or layer, which [illegible] *membrane*, and which, prac- [illegible] the cavity of the joint. The office of this [illegible] a glairy fluid named *synovia*, [illegible] oil," and which, being poured out [illegible] surfaces, lubricates the bones in [illegible]. When, through inflammation of the [illegible] fluid increases in extent, we suffer [illegible] called "dropsy" of the joint. [illegible] which may be found [illegible] *bursæ*. These are little [illegible] with synovial membrane, [illegible] there is liability to friction. [illegible] in fact, what the grooved wheel [illegible] to the tackle of a ship: they [illegible] them in situations where, [illegible] great play of muscle or sinew over [illegible] between the skin and the knee-cap, for [illegible] much friction must exist, a [illegible]. Another exists between the great projection near the head of the thigh-bone and the hip-muscles which rub over the projection at every step we take.

Such being the general conformation of "joints," we may now survey the various forms of articulations met with in our frames. There are three classes of joints to be found in the bodies of man and his neighbour animals. Firstly come what seem to imply a contradiction in terms, namely, *immovable joints*. These are well represented in the dove-tailing which is seen between the bones of the skull, a process securing immense firmness of union. The next variety of joints includes those which are named *mixed* articulations. Here we find only a limited range of movement, which may, as in the spine, confer general flexibility, rather than exact movement, upon the parts concerned. In the spine, for example, we have a series of bones, firmly united together (for the protection of the *spinal cord*) by intervening plates of gristle or cartilage. The alternating series of bone and gristle-pads thus seen confers a high degree of flexibility on the spine, without permitting any definite range of motion between the separate bones.

But the most typical joints are those in which free movement in one direction or another is permitted. Under this head that of *movable joints*—come the ordinary joints of the body: elbow, shoulder, ankle, knee, fingers, toes, &c. It is very obvious to any one who swings his arm round and round at the shoulder, that the movement there is of a different nature from that seen in the knee or elbow; whilst the familiar "turn of the wrist" again represents a movement of a third kind. Thus it becomes clear that we find in the mechanics of our bodies—firstly, *ball-and-socket*, or "universal" joints, capable of free movement in all directions. The deeper the cup, or socket, the more limited is the movement. Witness, in proof of this fact, the more limited movement of the hip joint (where the cup is deep) compared with that at the shoulder, where the cup is a mere shallow "saucer" of the shoulder-blade. At the elbow, knee, ankle, and in the fingers and toes, *hinge-joints* are represented. The motion is backwards and forwards in these joints; but such a joint as the knee performs more complex movements than are included under this description. Lastly come the *rotatory joints* in which the movement takes place round a fixed point or *pivot*. When, after keeping the fore-arm fixed with the palm of the hand turned forwards, we suddenly reverse the palm and turn it backwards, one of the bones (*radius*) of the forearm runs (or rotates) round the other bone (*ulna*) of the forearm, and so reverses the position of the hand. The radius thus comes to cross the ulna, as when a speaker, addressing an audience, places both palms downwards on a table in front of him, in the familiar style. Here there is seen the round head of the radius rotating round the ulna, its neighbour bone; and it may be added that there are certain animals (*e.g.*, elephants and dogs, cats, and carnivora generally) in which the radius is permanently fixed in the crossed position, known scientifically as *pronation*. The position in which the two bones lie side by side (as when the palm is directed forwards) is called *supination*. When we turn our head on our neck we receive a second illustration of a "pivot-joint." Then the head, together with the first vertebra of the spine, or "atlas," move a little around a little bony peg borne on the second vertebra or *axis*.

It may be added that in the use of the various "joints," highly instructive examples of "animal mechanics" may be occasionally found. Thus the bones really constitute a series of levers of various kinds. When we pull the head backwards on the neck, we are using a lever of the first order. Here the *weight* (the face) is on one side of the *fulcrum* (the neck), and the *power* (the muscles of the back of the neck) is situated on the opposite side of the fulcrum from the weight. Again, if we stand on tip-toe, we use a lever of the second order. Here, the *weight* (*i.e.*, the body or leg) is situated between the *power* (the calf-muscles) and the *fulcrum* (the toes). Or when we raise our hand to our mouth in the act of eating, or of feeding ourselves, when the shoulder is fixed, we use a lever of the third order. For in the latter case, the *weight* (the hand and its contents) is placed at one extremity, the *fulcrum* (the *elbow*) at the other, whilst the *power* (the biceps muscle) acts between the weight and the fulcrum.

LEARNING LANGUAGES.

(*Continued from page 465.*)

HAMILTON'S METHOD.

WE have been asked by several correspondents to quote what Sydney Smith has said on the Hamiltonian method, before giving our own experience with it. His essay (written fifty-six years ago) is too long to be given in full; but the following passages will meet our readers' wishes:—

"One of the first principles of Mr. Hamilton is to introduce very strict literal, interlinear translations, as aids to lexicons and dictionaries, and to make so much use of them that the dictionary or lexicon will be for a long time little required. We will suppose the language to be the Italian, and the book selected to be the Gospel of St. John. Of this Gospel Mr. Hamilton has published a key, of which the following is an extract:—

'1. Nel principio era il Verbo, e il Verbo era
In the beginning was the Word, and the Word was
appresso Dio, e il Verbo era Dio.
near to God, and the Word was God.

'2. Questo era nel principio appresso Dio.
This was in the beginning near to God.

'3. Per mezzo di lui tutte le cose furon fatte: e
By means of him all the things were made: and
senza di lui nulla fu fatto di ciò, che è stata
without of him nothing was made of that, of which is been
fatto.
made.

'4. In lui era la vita, e la vita era la luce degli
In him was the life, and the life was the light of the
uomini:
men:

'5. E la luce splende tra le tenebre, e le
And the light shines among the darkness, and the
tenebre hanno non ammessa la.
darknesses have not admitted her.

'6. Vi fu un uomo mandato da Dio che nomava
There was a man sent by God who did name
si Giovanni.
himself John.

'7. Questi venne qual testimone, affin di rendere
This came like as witness, in order of to render
testimonianza alla luce, onde per mezza di lui tutti
testimony to the light, whence by mean of him all
credessero.'
might believe.'

"In this way Mr. Hamilton contends (and appears to us to contend justly), that the language may be acquired with much greater ease and despatch than by the ancient method of beginning with grammar and proceeding with the dictionary. We will presume at present, that the only object is to read, not to write or speak Italian, and that the pupil instructs himself from the Key without a master, and is not taught in a class. We wish to compare the plan of finding the English word in such a literal translation, to that of finding it in dictionaries—and the method of ending with grammar, or of taking the grammar at an advanced period of knowledge in the language, rather than at the beginning. Every one will admit, that of all the disgusting labours of life, the labour of lexicon and dictionary is the most intolerable. Nor is there a greater object of compassion than a fine boy, full of animal spirits, set down in a bright sunny day, with a heap of unknown words before him to be turned into English, before supper, by the help of a ponderous dictionary alone. The object in looking into a dictionary can only be to exchange an unknown sound for one that is known. Now, it seems indisputable, that the sooner this exchange is made the better. The greater the number of such exchanges which can be made in a given time, the greater is the progress, the more abundant the *copia verborum* obtained by the scholar. Would it not be of advantage if the dictionary at once opened at the required page, and if a self-moving index at once pointed to the requisite word? Is any advantage gained to the world by the time employed first in finding the letter P, and then in finding the three guiding letters P R I? This appears to us to be pure loss of time, justifiable only if it be inevitable: and even after this is done, what an infinite multitude of difficulties are heaped at once upon the wretched beginner! Instead of being reserved for his greater skill and maturity in the language, he must employ himself in discovering in which of many senses which his dictionary presents, the word is to be used; in considering the case of the substantive, and the syntaxical arrangement in which it is to be placed, and the relation it bears to other words. The loss of time in the merely mechanical part of the old plan is immense. We doubt very much if an average boy, between ten and fourteen, will look out or find more than sixty words in an hour: we say nothing at present of the time employed in thinking of the meaning of each word when he has found it, but of the mere naked discovery of the word in the lexicon or dictionary. It must be rembered, we say an *average* boy—not what Master Evans, the show boy, can do, nor what Master Macarthy, the boy who is whipt every day, can do, but some boy between Macarthy and Evans; and not what this medium boy can do, while his mastigophorous superior is frowning over him, but what he actually does, when left in the midst of noisy boys, and with a recollection that, by sending to the neighbouring shop, he can obtain any quantity of unripe gooseberries upon credit. Now, if this statement be true, and if there are 10,000 words in the Gospel of St. John, here are 160 hours employed in the mere digital process of turning over leaves! But, in much less time than this, any boy of average quickness might learn, by the Hamiltonian method, to construe the whole four Gospels, with the greatest accuracy, and the most scrupulous correctness. The interlineal translation of course spares the trouble and time of this mechanical labour. Immediately under the Italian word is placed the English word. The unknown sound therefore is *instantly* exchanged for one that is known. The labour here spared is of the most irksome nature: and it is spared at a time of life the most averse to such labour: and so painful is this labour to many boys, that it forms an insuperable [illegible] to their progress. They prefer to be flogged, or to [illegible]. It is useless to say of any medicine that it [illegible] it is so nauseous that the patient flings it away. You must give me, not the best medicine you have in your shop, but the best you can get me to take.

Our author then illustrates the dictionary method; but he wrote at a time when as yet even the idiocy of supplying boys with only Greek-Latin lexicons had not been [illegible]. We quote the passage, though instructively [illegible] to what lengths educational absurdities may go, and [illegible] that they are not quite hopelessly long-lived. Sydney Smith speaks of this particular case as an "afflicting piece of absurdity."

"The reference to a translation is treated in our schools as a species of infirmity and meanness; just as if there was any other dignity here than utility, any other object in learning languages than to turn something you do not understand into something you do understand, and as if that was not the best method which effected this object in the shortest and simplest manner.

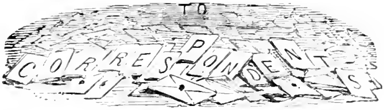
If a boy were in Paris, would he learn the language better by shutting himself up to read French books with a dictionary, or by conversing freely with all whom he met? And what is conversation but an Hamiltonian school? Every man you meet is a living lexicon and grammar—who is perpetually changing your English into French, and perpetually instructing you, in spite of yourself, in the terminations of French substantives and verbs. The analogy is still closer, if you converse with persons of whom you can ask questions, and who will be at the trouble of correcting you. What madness would it be to run away from these pleasing facilities, as too dangerously easy—to stop your ears, to double-lock the door, and to look out [illegible], *take a walk*, and *fine weather*, in Boyer's Dictionary; and then, by the help of Chambaud's Grammar, to construct a sentence which should signify, *[illegible] to my house and eat some chickens, if it is [illegible]*

But what is to become of a boy who has no difficulties to grapple with? How enervated will that understanding be to which everything is made so clear, plain, and easy! No hills to walk up, no chasms to step over; everything graduated, soft, and smooth. All this, however, is an objection to the multiplication table, to Napier's bones, and to every invention for the abridgment of human labour. There is no record of any lack of difficulties. Abridge and [illegible] by any process you please—multiply [illegible] power to any extent—there will be sufficient [illegible], more than sufficient, of laborious [illegible] for the mind and body of man. Why [illegible] the boy to [illegible]? By and by comes the book [illegible] a key; by and by comes the lexicon. They [illegible] at last, though at a better period. But [illegible] if they were useless, if language [illegible] attained without them, would any human being [illegible] difficulties for their own sake, which led to [illegible] the annihilation of which our faculties [illegible] exercised by difficulties which *do* lead [illegible] mathematics, natural philosophy, and [illegible] knowledge? Can any be so [illegible] suppose that the faculties of young men [illegible] and their industry and activity called [illegible] Mr. Hamilton teaches, in three [illegible] years what has on a more vicious system de[illegible] or eight? Besides, even in the Hamiltonian [illegible] it is very easy for one boy to outstrip another. Why may not a clever and ambitious boy employ three hours upon his key by himself, while another boy has only employed one? There is plenty of corn to thrash, and of chaff to be winnowed away, in Mr. Hamilton's system: the difference is, that every blow tells, because it is properly directed. In the old way half their force was lost in air. There is a mighty foolish apophthegm of Dr. Bell's, that it is not what is done for a boy that is of importance, but what a boy does for himself. This is just as wise as to say that it is not the breeches which are made for a boy that can cover his nakedness, but the breeches he makes for himself. All this entirely depends upon a comparison of the time saved, by showing the boy how to do a thing, rather than by leaving him to do it for himself. Let the object be, for example, to make a pair of shoes. The boy will effect this object much better if you show him how to make the shoes, than if you merely give him wax, thread, and leather, and leave him to find out all the ingenious abridgments of labour which have been discovered by experience. The object is to turn Latin into English. The scholar will do it much better and sooner if the word is found for him, than if he finds it—much better and sooner if you point out the effect of the terminations, and the nature of the Syntax, than if you leave him to detect them for himself. The thing *is* at last done *by the pupil himself*—for he reads the language—which was the thing to be done. All the help he has received has only enabled him to make a more economical use of his time, and to gain his end sooner. Never be afraid of wanting difficulties for your pupils; if means are rendered more easy, more will be expected. The animal will be compelled or induced to do all that he can do. Macadam has made the roads better. Dr. Bell would have predicted that the horses would get too fat; but the actual result is, that they are compelled to go ten miles an hour instead of eight."

The Edison electric light has been exhibited in Australia, under the auspices of Major Flood Page, late manager of the Sydenham Crystal Palace. The light is exceedingly well spoken of.

Professor Marsh has unearthed some extraordinary fossil remains in America, but his discoveries only whet the appetite for more. Here is one reported from Paris, Kentucky, which gives an account of the discovery of the bones of a mastodon which must have been a veritable monster. The backbone, measuring from the head to the bones of the tail, was 40 ft. in length, and the hind quarters stood over 25 ft. in height. The head must have been 5 ft. in width, and the jaw is 12 in. thick, with teeth in good preservation, weighing between 2 lb. and 3 lb. each. The remains are said to be all in good condition, and they are rightly described as the most astounding discovery in the way of fossil remains with which America has yet presented us.

Consumption of Watch Glasses.—According to the *Revue Chronométrique*, there are annually manufactured 2,500,000 watches, and during the last fifty years more than 70,000,000 have been put on the market; there remains yet for us to add a stock of not less than 50,000,000 of old watches, which makes a total of 86,000,000 to 87,000,000 watches requiring glasses. The new watches consume nearly 1,000,000, which makes an annual consumption of not less than 17,000,000 of glasses. But we must add that every watchmaker away from a town sees the necessity of always having on hand an assortment responding to the wants of his customers. "Then, if we take into account children's watches, lockets, compasses, &c., one finds one's self with astonishment in the face of an annual consumption which cannot be less than 100,000,000 of glasses."



"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Letters to the Editor.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office, 74, Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO, DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

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BRITISH SNAKES.

[668]—The three British snakes are the Viper, Ringed Snake, and the Smooth Snake, (*coronella lævis*). The Smooth Snake is as local in England as on the Continent—indeed, I do not recollect any records of its occurrence hitherto, except in Hants and Dorset.

It becomes tame in confinement, and though it may sometimes try to use its teeth, it belongs to a perfectly harmless genus. The plate in Cook's "Reptiles" conveys a fair idea of the Smooth Snake, but living examples can often be examined at the Reptile House of the Zoological Society, on application to the keeper. The Smooth Snake subsists mainly on lizards. H. A. M.

COLD BATH AT NIGHT.

[669]—In reference to A. E. Oram's query (605, page 364) as to the healthfulness of a cold bath at night, I should be inclined to say that—as a practice—it is not healthy. After a hard day's work, when the muscles are wearied or the nerves strained, a *warm bath* is undoubtedly very comforting, and is also in a sense beneficial, as it produces a relaxation of the stiffened muscles. A *cold bath*, on the other hand, has an astringent effect, and must necessarily cause further contraction of the muscles. (In plethoric persons there would also be a risk of congestion of the lungs or brain.) For my own part, I decidedly object to the idea of a cold bath at night after a hard day's work.

This opinion is, of course, one on the general question merely.

ROBERT MACPHERSON, M.D.

SINGULAR RAINBOW.

[670]—In letter 637, KNOWLEDGE, Nov. 24, the writer evidently does not grasp the whole problem. In a communication sent to the Physical Society, London, Nov. 10, and read Nov. 25 (a copy of which I have forwarded to you), I have shown (1) that for the observer to see a complete non-concentric bow he must be surrounded by water, and also what parts of the bow he sees if the reflecting sheet of water be only behind, before, or to one side of him; (2) that the non-concentric bow is inclined to the reflecting plane at an angle equal to the angle of incidence of the light falling on this same plane; (3) that the non-concentric bow has been seen only when the sun has been at a low altitude, on account of there being at such times a maximum of light reflected and a minimum of loss from polarisation; and (4) that at such an angle as that given in the second figure (letter 637), KNOWLEDGE, p. 422, it would be impossible to see a complete non-concentric bow on account of polarisation. WILLIAM ACKROYD.

HOVERING INSECT HOUSE-FLIES.

[671]—No one has answered Mr. Wynne's note, No. 616, so the following information may be useful:—I never heard of such an insect as an ichneumon wasp; they (the ichneumons and the wasps) are two distinct families of the order Hymenoptera, and do not hover as he describes. The insect he has observed is without doubt a dipterous fly of the family "Syrphidæ," either "Eristalis" or "Syrphus," probably the common "Eristalis tenax." They are often called "hoverers" from their peculiar flight. As regards the number of vibrations of the wings, I can give him no information, but Latour has calculated those of a common gnat at 3,000 a minute (Kirby & Spence, p. 59).

In answer to M. D. (No. 633), I am afraid he is very much mistaken in stating that bluebottles are developed within the body of the female fly in a maggot state. All flies are produced from eggs laid in or on the substance upon which the maggots afterwards feed and they breed so rapidly that a very few specimens of hybernated impregnated females who lay their eggs in the spring will produce the numbers he sees every year. The same holds good with a number of other insects, notably wasps and bumble-bees, who may be seen on the move, and looking out for a suitable place for their nests on a fine spring morning. Destroying them at that time means destroying a whole nest; and if then hunted and killed, will make a distinct diminution in the number of nests in the immediate neighbourhood.

Réaumur has proved that in five generations an aphis can be the progenitor of 5,904,900,000 descendants, and that there can be twenty generations in one year (Kirby, p. 96). The flies don't go on quite at this rate, but they are what the Yankees call "pretty smart." As to their disappearance in the autumn, I think the spiders and the frosts quite account for that.

AN OLD M. E. S.

ISLANDS IN PACIFIC OCEAN AND RATS.

[672]—My experience has been quite opposed to the statement made in KNOWLEDGE of 17th ult. on the above subject.

I lived for about a year on the largest island of a small group called Labos de Afuera (important chiefly on account of the deposits of guano on them), situated in about 7° south latitude, and fifty or sixty miles from the Peruvian coast.

I occupied a portion of a large modern house, which, I might say, was infested with rats. I have been repeatedly wakened at night by the rasping noise they made in their endeavours to force their way into my bedroom. Sometimes two would be simultaneously at work—one near the bottom of the wall, or partition, the other near the ceiling. Where an entrance was effected, I used to get up, and arming myself with a stick, give the intruders chase.

They were a great nuisance, and I would have been heartily glad if they had all been carried off by a *rapid* consumption. Two cats which we had (first-rate ratters) used to reduce their numbers considerably, but they still continued to increase. On one occasion I found a nest under a water-butt, containing, if I remember rightly, ten little rats.

Nothing in the shape of eatables was safe from these vermin; they even attacked our live-stock, such as pigeons and chickens.

J. H. M. FALLON.

ALTERATION IN COAST LINE.

[673]—I thought it very interesting to observe how the sea has receded along the coast of Lancashire from the Mersey almost to Preston. The whole country for miles is as flat as the proverbial pancake, and it can at once be seen that all this land, which is entirely made up of sand, must have been gradually formed by the retrocession of the sea.

At Southport, at low tide, the water goes out for at least two miles, the head of the pier, which is nearly a mile long, being just kept free of sand by a channel which runs by it. [illegible] ebb almost at once for a considerable distance out, and the time cannot be very remote when Southport will be an inland town.

Are there any data showing the rate the water is receding along the Lancashire coast? H. S.

Oct. 17, 1882.

Answers to Correspondents.

READERS. Glad to find you among readers, whether you hail from Giggleswick, Cambridge, Rugby, or [illegible]. I fear you have given some time to logic. No offence [illegible], and I wish the time had been better bestowed. But the four you name were teachers, not students only. Besides, their reasoning powers would have stood a good deal of impairing. Yet can you name any useful product of their logic? Note, further, that it was one of these very four who said that certain false reasoning would mislead students of logic, though its falsity is obvious to persons of ordinary reasoning powers. You write rather snappishly. Perhaps it misled you. Well, well! But you should not be angry with [illegible].

ingenious; but the crescent is in the first place too narrow, and in the second, it is black compared with solar disc having, if of lightness of full moon only about 1-620,000th of the brightness of the sun.—A. F. Osborne. Next total eclipse visible in England in 2090, last on May 22, 1724; band of total phase just outside London on the north-west.—T. A. B. Glad my experience corroborates yours. But I could quote multitudinous evidence. On the other point, I have very little doubt you are right, though how many are so unwise it would be difficult to say. Possibly many. As Herbert Spencer well says, the average man cannot at all shake off those absurd notions, even the exceptional man only imperfectly. I suppose I must be extra-exceptional; for, since I was a lad at college, most of them have been simply non-existent with me, and the rest have gone the same way, making room for worthier thoughts. Still, such nonsense is not even worth ridiculing, unless unwisely obtruded on notice.—W. Marshall. Queries noted; in electrical and chemical column may be replied to.—A. P. Holden. Frankly, I dread the flood of sun-spot and anti-sun spot letters, articles, cuttings, &c., which the publication of your letter would bring upon us. If I note that the case for auroras seems to me fully made out (long since), and variation of temperature also, as Sir W. Herschel anticipated, I have admitted all that has been proved. I think I have read very nearly all that has been said for and against; and I must say it seems to me marvellous how little evidence will suffice with some to establish a cycle of rain, storm, famines, &c. Perhaps a hundred years hence there will be evidence ranging over a long enough period to exclude such chance coincidences as cannot but be observed in these matters.—W. Adams. The secretary who "does" my autographs is from home just now.—Dr. E. H. R. Many thanks; but literally no available space.—Corsetiéé. (1) Unquestionably excessive. It would be nearer the mark to say that by constant lacing the abdominal and lumbar envelopes become so relaxed and flaccid that when the pressure is removed they yield seven or eight inches. (2) On the authority of all medical men, save perhaps one or two, sleeping in tight corsets is very bad indeed for the health. (3) There are doctors who have stated that at least one-third of the ailments of married women are caused by tight lacing—not by wearing corsets, for whatever some caustic writers may assert, a great number of those women who say they do not lace tightly, tell the truth; as is shown (according to medical testimony) by the shapeliness of the figure when the corset is removed. The tight lacers are known (I speak always of medical testimony) by having no shapeliness at all.—W. R. The temperature of space, if space is practically void of matter, would be near the absolute zero of temperature, or 458° Fahr. below zero, or 490° Fahr. below the freezing point of water, if Clerk Maxwell and Clausius are right in their views about the absolute zero.—H. S. Do not know what clergyman you refer to as having invented an instrument for testing the magnifying power of a telescopic eye-piece.—W. M. Gahan. Many thanks for cutting and pamphlet respecting hurricane.

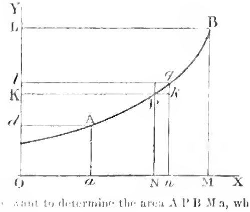
Our Mathematical Column.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

Note.—These papers were commenced in No. 35, p. 83, vol. II., and continued in Nos. 36–42, 44, 46, 49, 50, 52, 54, and 57–59.]

No. XVI. Integration by Substitution.

It is sometimes found that an expression which cannot be integrated as it stands, may be integrated by changing the variable. The best way of making clear the rules for doing this will be by considering a simple geometrical example.



Suppose we want to determine the area A P B M a, which, as we have seen, is represented by $\int_a^b y\,dx$

(Suppositions the same as before.) Then drawing A d, B L, perpendicular to O Y, we might find it convenient to regard y as the dependent variable, passing from O d to O L, instead of taking x from O a to O M. As before, we should get for our element of area P n; where N n is Δx, a small increment of x. We can, however, as readily use l K, or Δy, the corresponding increment of y. For we have

$$\text{N n} = \text{P k} = \frac{\text{P k}}{\text{q k}} \cdot \text{qk} = \frac{\Delta x}{\Delta y} \cdot \Delta y.$$

That is $\quad$ rect P n = P N . P k $= y\frac{\Delta x}{\Delta y} \cdot \Delta y$;

or ultimately when Δx, Δy are made indefinitely small,

$$\text{P n} = y\frac{dx}{dy} \cdot dy$$

and taking y from O d ($=a_1$ suppose) to O L ($=b_1$ suppose) we have

$$\text{area A B M a} = \int_{a_1}^{b_1} y\frac{dx}{dy} \cdot dy.$$

In any such case where we have to integrate between $x=a$ and $x=b$, the expression $\int u\,dx$, where u is some fraction of x, we may regard x as a function of some new variable y, if only by changing y between certain limits a_1 and b_1 we get all the values of u which it would receive when we changed x between a and b. We have then

$$u\,dx = u\frac{dx}{dy} \cdot dy \text{ and } \int_a^b u\,dx = \int_{a_1}^{b_1} u\frac{dx}{dy} \cdot dy$$

and the work of integration is reduced to that of integrating the indefinite integral $\quad \int u\frac{dx}{dy} \cdot dy.$

Suppose, for example, we had to integrate

$$\int \frac{dx}{x\sqrt{x^2-a^2}}$$

Let us try the experiment of putting $x = \frac{1}{y}$.

$$\text{Then } \frac{dx}{dy} = -\frac{1}{y^2} \text{ and} \int \frac{dx}{x\sqrt{x^2-a^2}} = \int \frac{y^2}{\sqrt{1-a^2y^2}}\left(-\frac{1}{y^2}\right)dy$$

$$= -\int \frac{dy}{\sqrt{1-a^2y^2}} = -\frac{1}{a}\int \frac{dy}{\sqrt{\frac{1}{a^2}-y^2}} = -\frac{1}{a}\sin^{-1}ay = -\frac{1}{a}\sin^{-1}\frac{a}{x}$$

Again, take $\quad \int \frac{dx}{x\sqrt{2ax-a^2}}$. Here noting that the denominator may be written $x\sqrt{x^2-(x-a)^2}$, we are led to try putting $\frac{x-a}{x}=z$, which will obviously simplify the radical.

This gives $\quad 1-\frac{a}{x}=z$, or $x=\frac{a}{1-z}$; $\frac{dx}{dz}=\frac{a}{(1-z)^2}=\frac{x^2}{a}$;

and $\quad \frac{x^2-(x-a)^2}{a^2}=1-z^2$, *i.e.*, $\sqrt{2ax-x^2}=x\sqrt{1-z^2}$;

$$\therefore \int \frac{dx}{x\sqrt{2ax-x^2}} = \int \frac{1}{x^2\sqrt{1-z^2}}\frac{dx}{dz} \cdot dz = \frac{1}{a}\int \frac{dz}{\sqrt{1-z^2}}$$

$$= \frac{1}{a}\sin^{-1}z = \frac{1}{a}\sin^{-1}\frac{x-a}{x}$$

This method of integration by parts is usually tentative, several substitutions may be tried before one is hit upon which gives an integrable expression.

Integration by Parts.

Another method (also tentative) is available, when we are endeavouring to integrate an expression.

Supposing we had to obtain the area A B M a. We might in some cases find it more convenient to determine instead the area A B L d, which gives us what we are seeking, because

area A B M a = rect L M − rect d a − area A B L d.

If we regard O N, P N (or P K, P N), the ordinates of P, as functions x and y of some third variable t, then we have

rect K N $= xy = u$, say,

and if we increase t by Δt so that x becomes O n or $x+\Delta x$, and y becomes O l or $y+\Delta y$. We have

increase of rect K N = rect P n + rect l P (ultimately);

that is, $\quad \Delta(xy) = y\Delta x + x\Delta y$

$$= y\frac{\Delta x}{\Delta t}\Delta t + x\frac{\Delta y}{\Delta t}\Delta t$$

whence, making Δt indefinitely small

$$\frac{d(xy)}{dt} = y\frac{dx}{dt} + x\frac{dy}{dt}$$

or $\quad xy = \int y\frac{dx}{dt}dt + \int x\frac{dy}{dt}dt$

wherefore $\quad \int x\frac{dy}{dt}dt = xy - \int y\frac{dx}{dt}dt$

(This really corresponds only to saying that in passing from P to B, the increment of rect K N, namely the gnomon L P M, is equal to the sum of the increments of the areas A P N a and A P K d). Thus if an integral can be written in the form $\int x\frac{dy}{dt}dt$, where x and y are both functions of t, we may substitute for the integral so written

$$xy - \int y\frac{dx}{dt}dt$$

This is equivalent to finding the area A B L d, instead of the area A B M a.

As an example consider the integral

$$\int \log x\,dx$$

This may be written $\quad \int \frac{dx}{dx} \cdot \log x\,dx$

Hence by the formula just obtained we have

$$\int \log x\,dx = x\log x - \int x \cdot \frac{1}{x}dx$$

$$= x\log x - x$$

Our Chess Column.

By MEPHISTO.

THE following lively game was played by Mephisto against an amateur:—

EVANS GAMBIT.

White. Mephisto.	Black. Amateur.	White. Mephisto.	Black. Amateur.
1. P to K4	P to K4	13. Kt tks P (ch)	K to K sq. (*g*)
2. Kt to KB3	Kt to QB3	14. R to K sq. (*h*)	B to K3
3. B to B4	B to B4	15. P to Q5	Kt takes P (*i*)
4. P to QKt4	B takes P	16. Q to R5 (ch) (*j*)	P to Kt3
5. P to B3	B to B4 (*a*)	17. Kt takes P	Kt to B3 (*k*)
6. P to Q4	P takes P	18. R tks B (ch)	K to B2
7. Castles	P to Q3 (*b*)	19. Kt to K5 (ch) (*l*)	K takes R
8. P takes P	B to Kt3	20. Q to R3 (ch)	K takes Kt
9. Kt to B3 (*c*)	Kt to B3 (*d*)	21. R to K sq. (ch)	K to B4
10. P to K5	P takes P	22. Q to Kt3 (ch)	K to B5
11. B to R3	Kt to R4 (*e*)	23. R to K5 mate.	
12. B tk P (ch) (*f*)	K takes B		

NOTES.

(*a*) B to B4 is considered a more reliable defence than B to R4.

(*b*) His best.

(*c*) Other good continuations are either 9. B to Kt2 or 9. P to Q5. The game would proceed as follows:—If 9. B to Kt2, KKt to K2. 10. Kt to Kt5, P to Q4. 11. P takes P, Kt to R4. 12. P to Q6, Kt takes B. 13. P takes Kt, Q to Q4. 14. Kt to QB3, Kt takes B. 15. Kt takes Q, Kt takes Q. 16. R takes Kt, &c. If 9. P to Q5, Kt to R4. 10. B to Kt2, Kt to KB3, &c.

(*d*) Black may also reply with 9. Kt to R4, or 9. B to Kt5

(*e*) Now Black lays himself open to a strong attack. Had he played either 11. B to Kt5 or B takes P, White would have played 12. Q to Kt3.

(*f*) A sacrifice promising a strong attack.

(*g*) This move practically decided the game. Amateur ought to have played K to Kt sq., which would have given him a safe game.

(*h*) Threatening to win the Queen by discovered check with the Knight.

(*i*) Black might have played 15. P to B3 with the intention of exchanging Queens if White took the Bishop at once, which, however, he would not do, but play Q to R4 first, to be followed by QR to Q sq. Also 15. P to B4 commended itself, but White would likewise play Q to R4 (ch), forcing the Black King to play [illegible] White with a [illegible]

[illegible] takes Q. B takes Q. [illegible] Kt. White's [illegible] a diagram of [illegible]

[illegible] 15th move.

[illegible] somewhat better, although [illegible] Kt takes R (ch).

SOLUTIONS.

[illegible] p. 460.

[illegible] 1. K to Kt [illegible]
2. [illegible] 2. K takes KKt, or QKt, or K to Q5
[illegible] accordingly.

[illegible] B. P[illegible].

[illegible] 1. R takes B (ch) best
2. [illegible] 2. B to B2 or Q2 (ch)
[illegible] 3. B takes BP or KtP (acc.)

[illegible] G. H. T.

[illegible] several solutions, such [illegible] 1. Q to K7.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

[illegible] We [illegible] act upon your excellent [illegible]

[illegible] received with thanks. [illegible] correct.

[illegible] with thanks. Solution correct. [illegible]

[illegible] received with thanks. [illegible]

[illegible] Solutions correct. [illegible] 2. R to QB5, K takes R?

Our Whist Column.

By "Five of Clubs."

[illegible] OF THE GAME.

W[illegible] both from strength and [illegible] play of the [illegible] towards being [illegible] of the play in each [illegible] strength or from weak- [illegible] partner seek to [illegible] generally [illegible] We [illegible] the various plans [illegible] proceed, [illegible] other side.

We assume for the moment that the hands are so distributed that trumps are not led out very early on either side.

A suit is established when the holder of the strength in the suit has the best card or cards, with the certainty of drawing those intervening between it or them and lower ones. For instance, if in the first two rounds eight Hearts have fallen, including the Ace, Queen, Knave, and Nine, and I hold King, Eight, and Three, I know that two cards remain with the enemy; and if I know nothing more, my Hearts are not established, because, if I lead King, I am not sure that the Ten will fall; for one of the adversaries may hold both Ten and a small one, and playing the latter to my King will retain the command. But if the first two rounds have shown that the Ten is held single by one of the adversaries, I know it must fall to my King. I know this even if, besides the Ten, two other cards, one of them the Three, remain with the adversaries. My suit is therefore established, though I have but two cards left in it. The King will draw the Ten and the Three; the Eight will win the last trick in the suit.

The contest in plain suits manifestly turns on the acquisition of the command, in this way. So long as the enemy retains the command of my suit, in such sort that the next trick in the suit will go to them, any attempt to bring in the suit is of little avail. Suppose I get out all the trumps, and having then the lead, play a small card of my own suit. The enemy take the trick and bring in their suit. Nay, even if my partner has the commanding card of my suit, alone, my purpose is foiled; for he takes the trick, and cannot lead me my suit.

Thus we see that, in general, no attempt must be made to bring in a suit, even if strong, until the adversaries have been deprived of the command, or partner, if he has the command, has given it up. And viewing the matter from all sides—as holder of a strong suit, as adversary of such holder, and as his partner—we deduce the rules:

1. Unless you have good cards of re-entry, as king-cards in the adversaries' suits, or good prospect of holding long trumps, do not try to bring in a suit of which you have not perfect command.
2. Keep the command of an adversary's suit.
3. Get rid of the command of a partner's suit.

(*To be continued.*)

The chief Editor has sent to us a letter from Benares, in which the writer asks that the Whist Column be discontinued, because—though he admits Whist is a fine game—"he got into the way of passing a quiet evening at Whist, when at Cambridge, not for money, but found far more wanted him to play at Loo and Vingt-Un." Our correspondent's logic is not very clear; but we suppose he considered those evenings wasted. Very likely. A little *good* Whist goes a great way; and two, or at most three, rubbers, closely and rather quickly played, are worth ten or a dozen rubbers of the bumble-puppy called Whist in many college rooms. There is no more risk of the readers of this column learning to waste time over Whist, than there is of the thousands who follow "Mephisto" going irretrievably to the dogs by playing Chess from noon to the small hours daily.

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